

**INTER-HEALTHCARE FACILITY TRANSFER OF CRITICALLY ILL
NEONATES: THE DEVELOPMENT OF A PROGRAMME FOR EMERGENCY
MEDICAL CARE IN THE SOUTH AFRICAN CONTEXT**

A thesis submitted in fulfilment of the requirements for the Degree of Doctor of
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DECLARATION OF ORIGINALITY

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is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources).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

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ETHICAL CLEARANCE

This is to certify that this study received ethical approval from the Institutional Research Ethics Committee (IREC) of the Durban University of Technology (DUT) in KwaZulu-Natal.

The Ethics Clearance number is **IREC 101/15**

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ABSTRACT

Neonates are considered a vulnerable age group due to a variety of clinical problems that can occur. Critically ill neonates are a high risk population with single or multiple organ system failure that places their lives at risk. They require urgent medical lifesaving intervention and where appropriate care is unavailable, are transferred to a higher level of care to improve their chance of survival. Inter-healthcare facility transfers are the responsibility of Emergency Medical Service, and an integral part of the South African medical system. The Emergency Medical Service serves as an extension of the intensive care unit, but is associated with a very high level of risk due to the stressors of the pre-hospital environment which impacts on the clinical outcomes of the neonate.

The aim of this study was to develop a programme for inter-healthcare facility transfer of critically ill neonates in the South African context.

Developmental Research and Utilization (DRU) model was the overarching framework, guided by critical realism paradigm that enabled a deeper level of understanding of the context. Developmental research methodology provided a guide to collect data and through predetermined steps, each designed to achieve a specific purpose towards achieving the study aim, using a qualitative approach.

The study found that the Advanced Life Support paramedics were inadequately prepared to deal with the neonates and the accompanying family members during the transfer process. Organisational structures and transfer processes were found to be inadequate. Emergency Medical Care lecturers were ill prepared to provide appropriate experimental instruction and the accompanying mothers were neglected during the transfer.

A holistic and multi-dimensional inter-healthcare facility transfer programme that was relevant for the local context, with appropriate organisational structures and transfer processes was developed and thereafter appraised by a group of experts. It included the knowledge and skills required by paramedics and support for accompanying family members during the transfer process.

DEDICATION

This thesis is dedicated to:

My family, (my parents Mr and Mrs Dukhi, my wife Maureen, my daughter Shinese, my brother Ryan, my sister-in-law Desree, my sister Hema, my brother-in-law Calvin, and my niece Teyra and nephew Rylan), who have honored me by courageously sharing the sorrows and triumphs of my life. From you I derive my inspiration for this work and my success is attributed to your unconditional love, patience, and encouragement. It meant alot to me during the pursuit of my Doctoral Degree and I am grateful for all that you have done for me. To each of you, I offer my sincere thanks and deepest gratitude.

My daughter Shinese, for filling my life with love and riotous joy. This study is dedicated especially to you.

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- I would also like to extend my sincere appreciation to my colleagues in EMS nationally who serve humanity unselfishly and continuously in order to help those in need for the greatest good of mankind.

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ABBREVIATIONS

ALS	Advanced Life Support
BLS	Basic Life Support
CCA	Critical Care Assistant
DoH	Department of Health
DR	Developmental Research
DR & U model	Developmental Research and Utilization Model
ECP	Emergency Care Practitioner
EMC	Emergency Medical Care
EMS	Emergency Medical Service
ECT	Emergency Care Technician
ETA	Estimated Time of Arrival
HPCSA	Health Professions Council of South Africa
HMD	Hyaline Membrane Disease
ILS	Intermediate Life Support
IALCH	Inkosi Albert Luthuli Central Hospital
LBW	Low Birth Weight
KZN	KwaZulu-Natal
MAS	Meconium Aspiration Syndrome
MDG	Millennium Development Goal
MDG4	Millennium Development Goal 4
ND	National Diploma
NHI	National Health Insurance
NICU	Neonatal Intensive Care Unit
PRF	Patient Return Form
PPT	Planned Patient Transport
PHC	Primary Health Clinic
RDS	Respiratory Distress Syndrome
SA	South Africa
SDG	Sustainable Development Goal

CHAPTER 1

INTRODUCTION

This chapter introduces the research study, giving the background, motivation, problem statement and research question, as well as the aim and objectives, and the researcher's interest in this area. It also defines the key operational concepts applied and provides an overview of the thesis structure.

1.1 Context of the study

Over the past few decades, reducing child mortality has become the focus of attention globally. This is in response to the global commitment to meet the Millennium Development Goal (MDG) set out by the United Nations to reduce the under-five mortality rate (U5MR) by two-thirds between 1990 and 2015 (United Nations 2015). In Sub-Saharan Africa, the incidence of under-five mortality in 2016 was one in 13 children. This may be compared to the incidence in high income countries, which is one in 189 children. Additionally, in Sub-Saharan Africa little or no progress has been made in reducing the neonatal mortality rates (NMR). Consequently, the United Nations Inter-agency Group for Child Mortality Estimates (UN IGME) (2017) has suggested that neonatal mortality contributes to a large percentage of U5MR, with a noted increase in this percentage being seen in every region of the world. In 2015, the NMR in South Africa contributed 44% of the infant mortality rate and 32% of the U5MR (Dorrington *et al.* 2016).

A systematic analysis of the overall global patterns in neonatal mortality by Liu *et al.* (2015) identified pre-term birth complications and infections as being the two major causes of neonatal death. In keeping with global findings, Rhoda *et al.* (2018) refer to the Perinatal Problem Identification Programme (PPIP) 2014–2015, which showed that in South Africa, the main causes of neonatal death are complications of prematurity, intrapartum-related events primarily due to intrauterine hypoxia, and infections. These three factors have remained the highest cause of neonatal mortality since 2012. Hoque, Haaq and Islam (2011) stated that in South Africa, other causes of neonatal mortality include birth asphyxia, hyaline membrane disease, sepsis and meconium aspiration syndrome, these being the most common

among multiple co-morbidities. With reference to the PPIP 2014–2015, Rhoda *et al.* (2015) also reported health-system-related factors, including administrator-related factors and issues regarding medical personnel, as being among the top ten avoidable causes that contribute to neonatal mortality.

Of a total of 12 192 neonatal deaths, 3105 could probably have been avoided as inadequate facilities and equipment contributed to the largest number of avoidable neonatal deaths. The need for specialist equipment and facilities were also documented. Specifically, a lack of beds with ventilators contributed to 306 deaths and delays in referral of patients for secondary or tertiary treatment contributed to 337 deaths. Inadequate management of the neonate and monitoring resulted in 288 and 254 deaths, respectively. The lack of transportation by emergency medical services (EMS) also contributed to neonatal mortality, with 148 deaths occurring. This is also noted in a study by Ashokcoomar and Naidoo (2016), which found that the unavailability of emergency ambulance services, resulted in life-threatening adverse events in neonates, including death.

In instances where the neonate is critically ill, the availability of transport plays an even more important role in overall survival owing to the need for specialist intervention and care (Stroud, Trautman and Meyer 2013). In addition, specialised equipment, adequately skilled personnel, and a safe and timely transfer system also have an impact on the neonate's survival. Caring and monitoring for the critically ill neonate during transport is very different, from doing so in a neonatal intensive care unit (NICU). In a moving ambulance (air or land) the transfer teams have to deal with adverse weather conditions, noise, mechanical vibration, unstable equipment, restricted lighting, limited work space and limited support services. This places additional stress on critically ill neonates who can easily deteriorate during the transfer. This has a direct impact on their morbidity and mortality. In spite of these difficulties, Carreras-Gonzalez and Brió-Sanagustin (2014) argued that the transfer of a critically ill neonate can be safely and timeously accomplished if the correct resources, organisational structures and transfer processes are in place. The transfer of critically ill neonates demands a rigorous level of care and is specialised in nature owing to the exacerbated vulnerability of this population.

In order to reduce the number of neonatal deaths in developing countries, all neonatal mortalities must be scrutinised in terms of the clinical and health systemic causes (Velaphi and Rhoda 2012; Liu *et al.* 2016). It is also important to explore innovative interventions to reduce these deaths. Such an approach is required in order to improve health systems, including effecting changes to the intervention processes in hospitals, primary health care and emergency medical services (EMS) systems. Hence, a multidimensional programme that takes cognisance of all factors and issues is required to ensure the survival of those being transferred.

1.2 Background

The United Nations MDGs were articulated to motivate and accelerate global progress in economic and social development; and environmental sustainability. Eight critical goals were developed, focusing on ending poverty and hunger; achieving universal primary education; promoting gender equality and women empowerment; reducing child mortality; improving maternal health; reducing HIV/AIDS, tuberculosis and malaria; ensuring environmental sustainability; and promoting a global environment for development with respect to international economic, financial and commercial relations (United Nations 2015).

The 2017 UN IGME reported estimates of the fourth MDG (reduction of U5MR by two-thirds between 1990 and 2015), with the global U5MR declining from 90 (12.7 million) to 41 (5.6 million) deaths per 1000 live births between 1990 and 2016. However, post 2015, the implementation of the Sustainable Development Goals (SDGs), which succeeded the MDGs, refocused global goals by setting targets of the U5MR at below 25 per 1000 and the NMR at 12 per 1000 live births by 2030. The intention of quantifying the fourth MDG in the third SDG goal was to ensure that countries with already low child and neonatal mortality would be seen as achieving targets rather than being classified as “not met” due to the inability to reduce the low mortality rate any further (Byass *et al.* 2015).

Globally, it is reported that approximately 1 million neonatal deaths occurred on the first day of life, a further 1 million occurred within the first week of life and a total of approximately 2.6 million occurred within the neonatal period. However, even though there was a global decline in the NMR from 37 to 19 deaths per 1000 live births

between 1990 and 2016, the proportion of neonatal deaths contributing to the U5MR increased from 40 to 46% from 1990 to 2016.

In Sub-Saharan Africa, 1 in 36 children will die within the neonatal period. This is in comparison to high-income countries where the ratio is 1 in 333, hence the need to reduce NMR in Sub-Saharan Africa has to be re-addressed. This drastic difference is also noted in the U5MR, with the ratio being 1 in 13 in Sub-Saharan Africa against 1 in 189, in high-income countries. According to the prescribed SDG3 target for neonatal mortality, more than 60 countries will not meet the 2030 target of 12 deaths per 1000 live births. If current trends continue, an estimated 30 million neonates will die between 2017 and 2030, with 80% of these deaths occurring in Sub-Saharan African and Southern Asia.

In South Africa, this dramatically slow decline in NMR has also been noted (United Nations 2015). Statistics South Africa (2016) reports on early neonatal deaths, noted a decline in the annual mortality rate from 8516 deaths in 2012 to 7495 deaths in 2014. In order to ensure that the NMR is further reduced in South Africa, it is essential to consider the disparities that exist in the current healthcare system. According to Bill of Rights in the Constitution, the right to healthcare is fundamental to the physical and mental well-being of all individuals, including children. However, notable disparities in the South African healthcare system continue to widen between both the public and the private sector (Mayosi and Benatar 2014). These vast differences have also been noted in the public sector between and within provinces despite the legislative direction provided by the Constitution and the National Health Act 61 of 2003 (NHA), which provides a framework for a structured and uniform health system (South Africa, Department of Health 2003).

Section 27(3) of the Bill of Rights clearly states that no one may be refused emergency medical treatment (South Africa 1996). In section 5 of Chapter 2, the NHA also stipulates that “no one should be refused emergency medical treatment”. Emergency medical treatment for intensive care transfers requires skilled and experienced personnel and therefore it is the responsibility of EMS to provide these personnel. Section 15 in Chapter 4 and section 40 in Chapter 11 of the NHA make provision for “specialised hospital services” and “emergency medical services and emergency medical treatment, both within and outside of health establishments”

respectively. Critically ill neonates require specialised hospital services and, as neonatal intensive care exists at only a few facilities, they are generally transferred to higher level healthcare facilities. EMS is the link between these healthcare facilities and an extension of the intensive care unit.

A priority of the Negotiated Service Delivery Agreement (NSDA) for the health sector is improving the health status of the entire population and to contribute to government's vision of "A Long and Healthy Life for All South Africans". To contribute tangibly to the realisation of this vision, all healthcare facilities and health districts should strengthen their emergency referral and treatment capacity through training in the triage, assessment and resuscitation of critically ill children, as well as the development of suitable transport systems for the movement of critically ill children into and within the health system (South Africa, Department of Health 2011a: 3). This places the responsibility on the health system, that transferring a critically ill neonate is a joint responsibility of the referring hospital, the transfer team and the receiving hospital; therefore it is essential that all role players have a thorough understanding of the emergency transfers in order to provide the best possible service.

In order to assure best possible services, trained health professionals in maternal and infant health care are essential. The National Development Plan (NDP) launched in August 2012 focuses on improving quality healthcare for all by reforming public health systems by providing better trained health professionals and focusing on maternal and infant health. In addition, an important objective of the NDP is the development of a national health insurance (NHI) system with a focus on upgrading public health facilities, producing more health professionals and reducing the relative cost of private health care (South Africa, Department of Health 2012b). In June 2017, the White Paper on NHI was signed off by the Minister of Health Dr Aaron Motsoaledi (South Africa, Department of Health 2017b). The essence of the policy document is a massive reorganisation of the current health system, both private and public, to ensure access to quality, affordable personal healthcare services for all.

The NHI categorises health care service delivery into three areas, Primary Health Care (PHC) Services, Hospital and Specialised Services, and Emergency Medical Services (EMS). The NHI also recommends that standardised EMS practice should

exist, determined by national norms and standards in relation to the level of care, staffing requirements, prescribed equipment, suitability of response vehicles and ambulances and other relevant components based on the level of care. The clinical teams need to have the competencies to assess, stabilise and provide essential acute emergency care and clinical interventions for categories of patients. The new EMS Regulations (December 2017) were promulgated to put in place dedicated, staffed and equipped emergency medical care, inter-healthcare facility medical treatment and transport of the ill or injured (South Africa, Department of Health 2017a).

As EMS is a component of the health system, inter-healthcare facility transport of patients is a major sub-component of the EMS, including the transfer of a critically ill neonate. Therefore, it is imperative that EMS abides by these stipulations, especially when transferring a critically ill neonate, owing to the vulnerability of this population and the life-threatening risk associated with the transfer process.

1.2.1 Referral system of the level of care in South Africa

Neonatal care is provided by various levels of healthcare facilities. Primary healthcare clinics (PHC), community healthcare centres (CHC) and district hospitals form the first level of care or level 1 (South Africa, Department of Health 2011b). Regional hospitals form level 2, tertiary hospitals level 3, and central and specialised hospitals serve as level 4 facilities (South Africa, Department of Health 2012a). Intensive care for neonates is only provided at the higher levels, hence the need for transfers from lower-level to higher-level facilities or across levels of facilities, especially when life-threatening situations arise. In the case of such an event, ensuring the safe and effective transportation of the critically ill neonate between these healthcare facilities becomes the responsibility of EMS. The levels of care in the public sector health system in South Africa are described below:

Level 1

- *Primary health care clinic.* This is the first step in the provision of health care and offers services such as family planning, immunisation, antenatal care, treatment of common diseases, treatment and management of tuberculosis,

HIV/AIDS counselling, among other services. If the PHC cannot assist, then the patient is referred to a CHC (South Africa, Department of Health 2011b).

- *Community health care centre.* The CHC provides similar services to a PHC and can also be used for first contact care. Services offered over and above the PHC include a 24-hour maternity service, emergency care and casualty and a short-stay ward. The CHC will refer a patient to a district hospital if necessary (South Africa, Department of Health 2011b).
- *District hospital.* The third step in the provision of health care is the district hospital. These hospitals are categorised into small (minimum 50 beds and maximum 150 beds), medium (minimum 150 beds and maximum 300 beds) and large (minimum 300 beds and maximum 600 beds) facilities, and provide generalised support to PHCs and CHCs. They provide 24-hour primary health care generally delivered by doctors and specialist nurses. The services provided include diagnosis, treatment and care, and counselling and rehabilitation services. Obstetrics and gynaecology, paediatrics, surgery, pharmacological services, mental health care, geriatrics, forensic medical services and a casualty and out-patient department add to the specialised services offered at the district level (South Africa, Department of Health 2011b).

Level 2

- *Regional hospitals.* Regional hospitals provide 24-hour care for patients normally referred from districts facilities when they require additional health services in the fields of internal medicine, paediatrics, obstetrics and gynaecology, and general surgery. These hospitals also offer trauma and emergency services and short-term ventilation in a critical care unit. The services are provided to a specified regional population and are limited to provincial boundaries. If the regional hospital is unable to deal with a patient, they will transfer them to a tertiary hospital (South Africa, Department of Health 2012a).

Level 3

- *Provincial tertiary hospitals.* Tertiary hospitals provide sub-specialist support to patients who cannot be cared for at the regional level. These hospitals have the supervision of a specialist or a specialist intensivist and equipment that enables them to provide neonatal intensive care services. These hospitals are often the endpoint in the transfer of a critically ill neonate. If a tertiary hospital cannot help, the neonate will be referred to a central hospital (South Africa, Department of Health 2012a).

Level 4

- *Central hospitals.* Central hospitals are the fourth and highest level of health care offered. These hospitals provide highly specialised care which includes multi-speciality clinical services, innovation and research. Central hospitals are attached to a medical school, as a teaching platform, and receive patients from various provinces (South Africa, Department of Health 2012a).
- *Specialised hospitals.* Specialised hospitals provide care only for certain specialised groups of patients including psychiatric patients, those suffering from tuberculosis and infectious diseases and the also offer rehabilitation services (South Africa, Department of Health 2012a).

1.2.2 The role of Emergency Medical Services in inter-healthcare facility transfers

In South Africa, EMS regulations guide the service provided by both private and public sector ambulances. The transportation of ill and/or injured patients is integral to pre-hospital and inter-facility treatment and care (South Africa, Department of Health 2017a). The modes of transport used are ground and air ambulances, the former including response units and the latter consisting of rotor wing aircraft (helicopter) and fixed wing aircraft. Although EMS in South Africa has developed rapidly over the past 20 years compared to those elsewhere in Africa and other developing countries, there is an unequal distribution of ambulance services, with many rural areas being poorly resourced. Naidoo (2011) stated that the standard of Emergency Medical Care (EMC) offered by EMS varies widely between and within

provinces, from well-developed sophisticated first-world systems to more rudimentary systems.

It is in this context, and bearing in mind that South Africa is a developing country with resource limitations, that neonates are transferred from one facility to another under conditions that lack resources (human and material), especially when specialist clinical interventions are needed. Hence, the need for appropriately staffed and equipped ambulances is essential in critical care. While the transfer of critically ill neonates has been standard practice for approximately three decades and is an integral component in the neonatal care process, it nevertheless occurs outside the NICU, is potentially hazardous and is associated with a very high level of risk. This places significant physiological and equipment-related stress on the neonate, who can easily deteriorate clinically during the transfer, which adversely affects its clinical outcomes (Ashokcoomar and Naidoo 2016).

Critical care and monitoring of a critically ill neonate during the transfer process is provided by an Advanced Life Support (ALS) paramedic. These paramedics are registered as either Critical Care Assistants (CCA), National Diploma in Emergency Medical Care (NDEMC) or Emergency Care Practitioners (ECP). These ALS paramedics play a vital role in the EMC environment as they are the pre-hospital specialists and currently responsible for intensive care during the neonatal transfer (Health Professions Council of South Africa 2014). Their scope of practice enables them to provide a vast range of intensive care techniques, including but not limited to advanced airway management and ventilation, cannulation (intravenous, intraosseous and umbilical), pharmacological administration, emergency cardiovascular care and advanced cardiac arrest management.

The development of clinical skills in ALS paramedics is based on a range of factors. For the new ALS paramedic, formal registration with the HPCSA allows for immediate interaction with critically ill neonates. There is no apprenticeship programme in terms of which these graduates gain experience, as they are expected to practise as independent practitioners. Experience is gained through trial and error by treating real patients, which can have disadvantages, especially for critically ill neonates requiring inter-healthcare facility transfers. Furthermore, the education and training modules in undergraduate programmes are broad, with no dedicated

specialised programmes for the inter-healthcare facility transfers of neonates. Apart from the competencies required for the clinical management of the neonate, expert knowledge and skills to manage and utilise specialised monitoring and lifesaving equipment appropriately and safely is crucial.

Owing to the range of equipment and the measures required to transport critically ill neonates successfully, the ALS paramedic is usually accompanied by an Emergency Care Provider qualified as a Basic Life Support (BLS) and/or Intermediate Life Support (ILS) and/or Emergency Care Technician (ECT). The nature of the teamwork in the transfer process may also influence the outcome of the transfer. Moreover, in addition to the urgent clinical attention and continuous monitoring the life-threatening neonate requires, the equipment that has to be managed and the stresses of the pre-hospital environment that have to be dealt with, the baby is usually accompanied by a family member who is also the responsibility of the transfer team.

1.3 Motivation for the study

In South Africa, problems associated with neonatal transfers have been documented in a previous study and have been brought to the attention of the researcher in his position as an ALS paramedic and the current Principal of the College of Emergency Care within the Department of Health (DoH) in the Province of KwaZulu-Natal. Neonatal mortality and morbidity that occurs due to negligence has resulted in legal action being instituted against the DoH. However, even more important is the ensuing emotional trauma that is experienced by the accompanying family member of the neonate. Reports relating to adverse effects, including death, indicate that many problems could have been prevented had an organised system to guide the transfer been in place.

Very little research has been done on the transfer systems of critically ill neonates, in particular, who is involved and for what reasons. Moreover, there is a paucity of literature related to neonatal inter-healthcare facility transfers in South Africa. Hadley and Mars (2001) noted that neonatal transfers in South Africa remain hazardous owing to a shortage of human and material resources, and a lack of adequate knowledge and skills on the part of paramedics, to perform clinical interventions.

However, little has been changed since their study. In another study Mgcini (2011) found that many neonates deteriorated during a transfer, which resulted in a relatively high mortality rate 48 hours after the transfer. In 2006, De Vries et al. (2011) found that a dedicated maternal and neonatal Flying Squad service programme which significantly improved the transit times. Of significance, however, was the work of Ashokcoomar and Naidoo (2016), which drew attention to the severe shortfalls in inter-healthcare facility transfer of neonates, which suggested the need for a comprehensive, multi faceted programme to guide neonatal transfers. This is what the study seeks to achieve through its developmental innovation.

1.4 Problem statement

The fourth MDG aimed to reduce child mortality rate globally, yet developing countries such as South Africa showed no appreciable net change between 1990 and 2015. The relevant newly developed third SDG expanded on MDG4, calling for the under-five mortality to fall below 25 per 1000 live births by 2030. Therefore, all neonatal mortalities, including those occurring during the transfer process, which is often neglected, must be scrutinised by focusing on both the clinical and the healthcare system causes. In addition, the need for interventions that reduce these deaths, improve healthcare and reduce inequalities should be explored. Despite the fact that EMS have been in operation in South Africa since the late 1970s, no national programme has been developed for critically ill neonatal transfers, despite the mortality rate in that age group remaining high. Consequently, there was little evidence-based, empirical data on which to base such a programme, no indication of the most suitable state-of-the-art practices that could accommodate the South African context, and no exploration of relevant stakeholder opinions regarding what such practices should include.

Current EMS practices relating to the inter-healthcare facility transfer of critically ill neonates are challenged by a number of factors, including the differences among services nationally and within the provinces, which depend on the availability of resources. Furthermore, the researcher's experience has shown that there is a disjuncture between theory and practice. In the absence of a locally relevant transfer programme for critically ill neonates, the ability to survive a transfer may be severely compromised.

Furthermore, as there are no standards that staff need to adhere to, current practices cannot be effectively appraised. Thus far, there has been no research in South Africa related to the multidimensional issues facing the transfer of critically ill neonates and the challenges experienced by ALS paramedics and accompanying family members during a transfer. Hence the need to develop a programme to deal with these multiple issues in order to effect a transfer that does not compromise or jeopardise the neonate and thereby improve the health outcomes. The development of such a programme therefore forms a starting point in enhancing the profession and enabling it to meet the multiple issues facing the inter-healthcare facility transfer of critically ill neonates in South Africa and other developing countries.

1.5 The research question

How can developmental research be applied to investigate the multidimensional issues involved in the inter-healthcare facility transfer of critically ill neonates in the EMC context and how can it guide the development of a programme to address all these issues holistically?

Sub-questions:

1. What are the multidimensional issues that challenge the safe inter-healthcare facility transfer of critically ill neonates?
2. What are the state-of-the-art practices that guide the inter-healthcare facility transfer of critically ill neonates?
3. What are the views of ALS paramedics, family members, neonatologists and EMC lecturers on what needs to be operationalised in a programme for the inter-healthcare facility transfer of critically ill neonates in South Africa?
4. What are the components of a multidimensional programme that will enable a successful transfer?
5. What are the views of expert ALS paramedics, neonatologists and EMC lecturers on the newly developed programme?

1.6 Aim and objectives

The study aims to develop a programme for the inter-healthcare facility transfer of critically ill neonates in the South African context.

The objectives for the research were formulated as follows:

1. To analyse the current inter-healthcare facility transfer of critically ill neonates in KwaZulu-Natal.
2. To investigate the state-of-the-art practice that guides the transfer of critically ill neonates.
3. To explore the views of ALS paramedics, family members, neonatologists and EMC lecturers on all aspects that need to be operationalised in a programme that will guide the inter-healthcare facility transfer of critically ill neonates in South Africa.
4. To develop a programme that will enhance the EMC profession to deal with the multidimensional issues facing the inter-healthcare facility transfer of critically ill neonates in South Africa.
5. To evaluate the newly developed programme for the inter-healthcare facility transfer of critically ill neonates.

1.7 The researcher's interest in the study

The researcher is a South African educated and registered paramedic who has been employed by the EMS in the KwaZulu-Natal provincial Department of Health since 1989. His career to date spans twenty-seven years of pre-hospital care and he is currently the Principal of the KwaZulu-Natal College of Emergency Care. During his employment, he has been involved in many inter-healthcare facility transfers of critically ill neonates using both ground and air, in rural and urban areas, and has developed an interest in this area of service. More importantly, his practical experience has led him to conclude that there is a disjuncture between theory and practice. Moreover, there is a lack of empirical research in this field. His knowledge and expertise in this field, has been guided through research undertaken as part of a Master's degree, which confirmed that a large number of neonates are being transferred from one healthcare facility to another, by non-specialised neonatal transport teams using ambulances with inadequate or malfunctioning equipment. These issues have compelled him to explore the development of a programme to guide the inter-healthcare facility transfer of critically ill neonates in South Africa, so as to improve the overall transfer process and ensure that mortality rates are reduced.

1.8 Definitions of key operational concepts

The following definitions guide this study:

Advanced Life Support (ALS) paramedics

ALS paramedics are pre-hospital specialists in EMC registered with the Health Professions Council of South Africa. Importantly, these are the paramedics who are responsible for the inter-healthcare facility transfer of critically ill neonates. (Health Professions Council of South Africa 2014).

Critically ill neonate

A neonate who has life-threatening illnesses associated with single or multiple organ system failure (Whyte and Jefferies 2015).

Emergency Medical Care (EMC)

The rescue, evaluation, treatment and care of an ill or injured person in an emergency and the continuation of treatment and care during the transportation of such person to or between health facilities (Health Professions Council of South Africa 2014).

Emergency Management Communication Centre

Any established central communications system that coordinates the personnel and resources of an EMS (South Africa, Department of Health 2017a). It has a publicised emergency telephone number and has direct communications with its personnel and resources.

Emergency Care Provider

A person registered under section 17 of the Health Professions Act, 1974 (Act No. 56 of 1974) as paramedics, ambulance emergency assistants, basic ambulance assistants, operational emergency care orderlies, emergency care assistants, technicians and practitioners by the Professional Board of Emergency Care of the Health Professions Council of South Africa (Health Professions Council of South Africa 2014).

Emergency Medical Service

Any private or public sector ambulance service that is dedicated, staffed and equipped to offer the following services (South Africa, Department of Health 2017a): emergency medical care, inter-health facility medical treatment, or transport of the ill or injured.

Inter-healthcare facility transfer

A transfer of a patient from one health-care facility to another (South Africa, Department of Health 2017a).

Neonate

Neonate is a term used in the international literature to refer to infants, specifically from birth to the first 28 days of life. Neonates can be further categorised into newborns (at the time of birth), early neonates (from birth to 7 days of life) and late neonates (from 7 to 28 days of life) (Smith *et al.* 2009).

Programme

A holistic multidimensional set of actions that has been developed to guide the inter-healthcare transfer of critically ill neonates in South Africa.

1.9 Structure of the thesis

The layout of the thesis is as follows:

Chapter Two: The literature review engages and synthesises a wide range of literature related to the inter-healthcare facility transfer of critically ill neonates. This chapter presents an in-depth literature review which aims to contextualise the study objectives and provide the reader with a theoretical grounding, a survey of published work relating to the study, and an analysis of this work.

Chapter Three: The conceptual framework, presents the Developmental Research and Utilization model and the critical realism paradigm. The chapter also explains the operationalisation of the steps in the model.

Chapter Four: The methodology, describes the study design, the phases of the study, the study population and sampling strategy, followed by a discussion on the data collection tools, the data collection process and the analytical methods applied.

The chapter concludes with a review of the reliability and validity issues that were addressed, as well as the ethical considerations taken into account.

Chapter 5: Discussion of findings : analysis phase. This presents the findings made within phase 1. This was the analysis phase of the study, which was undertaken in the province of KwaZulu-Natal. It began with a one-month preliminary analysis to provide baseline information about the context, structures and processes relating to the inter-healthcare facility transfer of critically ill neonates. This was followed by conducting individual semi-structured interviews with ALS paramedics who had undertaken the transfer and the mothers who had accompanied their babies. The data was analysed using thematic analysis.

Chapter 6: Discussion of findings : developmental phase. This presents the research findings obtained in phase 2. The developmental phase of the research, which involved the development of the new programme, was undertaken nationally. Three sample groups were used viz. operational ALS paramedics, EMC lecturers and neonatologists. Data were collected from operational ALS paramedics in strategic provinces during four focus group discussions and three focus group discussions for the EMC lecturers. Qualitative data analysis involved inductive reasoning which was applied to analyse the empirical data emerging from the thematic analysis.

Chapter 7: Developing the programme. This chapter discusses the series of operational steps during which the data was applied to inform and shape the programme.

Chapter 8: Findings and discussion of the evaluation phase. This chapter discusses the appraisal of the newly developed programme by a group of experts involved in the emergency transfer of critically ill neonates.

Chapter 9: Conclusions and recommendations. This chapter concludes the thesis by presenting a summary of the findings made along with conclusions deduced from the evidence. This is followed by a number of recommendations being made for the implementation of the programme.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter literature produced between 2007 and 2018 was reviewed. This generated a comprehensive summary of current research, related to the transportation of the critically ill neonate between healthcare facilities, specifically in relation to the adverse events that may occur during inter-healthcare facility transfers; the impact of training programmes both internationally and locally to determine whether these programmes are linked to improving neonatal outcomes; as well as the state-of-the-art practice that guides the transfer of critically ill neonates. This was ultimately to identify what components should guide a programme on neonatal transfers in South Africa.

Over the period of this research, the databases explored for related literature included MEDLINE, ProQuest, EbscoHost, Sabinet Reference, ScienceDirect, PubMed and the Cochrane Library. Global search engines included Google, Google Scholar and DUT Summons. The search covered relevant literature in English, including books and published journals articles, case reports, dissertations and edited sources from the World Wide Web. The literature covered both qualitative and quantitative methodologies containing systematic reviews and literature reviews, observational studies (case-series, case-control, cross-sectional, and cohort), experimental studies (controlled and uncontrolled trials) and meta-analyses. This also included the review of policies, procedures, frameworks, systems, and guidelines, and the appraisal of existing technology for state-of-the-art practices.

The search strategy focused on key concepts to retrieve relevant literature using thesaurus, free-text and broad-based terms. These included “transportation” or “transfer” or “retrievals”, “inter-hospital” or “inter-healthcare facility”, “patients”, “children”, “neonates”, newborn”, “pre-mature”, “adverse events”, “complication”, “mortality”, “critical” or “critically ill”, “intensive care”, “ambulance”, “best practice”, “paramedics”, “mother”, “psycho-social support”, “structures”, “processes”, “skill”,

knowledge” and “programmes”. Once the literature was sourced they were scanned for relevance. Since then, ongoing literature searches were performed to ensure that current information is included. In addition, the researcher attended the 2016 Pre-Hospital Emergency Care Conference in Cape Town, as well as quarterly national education and training workshops to balance theory and practice, and monthly ALS forums which focused on the development of the EMC profession in South Africa..

2.2 Factors associated with adverse events during inter-healthcare facility transfer of critically ill neonates

The transportation of critically ill neonates is essential when life threatening circumstances arise, however such transportation does not come without risk. Without intervention at specialist or higher-level care facilities, mortality is almost a certainty with the critically ill neonate (Lim and Ratnavel 2008). During the transportation of neonates, the likelihood of an adverse event occurring is at least 75% (Pan 2017; Sabzehei *et al.* 2016). Apart from transportation, the change of environment from a specialised neonatal intensive care unit (NICU) to an ambulance adds additional stress to the neonate, commonly resulting in either minor or life-threatening events. This entails a risk in addition to that of the neonate’s actual illness. These adverse events may be categorised into physiological, equipment and human related events.

2.2.1 Physiological related adverse events

Physiological related adverse events are directly linked to the clinical deterioration of the neonate, with physiological changes being a real possibility during both ground and air transportation (Sethi and Subramanian 2014). The frequency of physiological related adverse events has been described in both international and local studies (Henry and Trotman 2017; Sabzehei *et al.* 2016; Ashokcoomar and Naidoo 2016; Sethi and Subramanian 2014; Alvarado-Socarras *et al.* 2014; Dalal, Vishal and Solanki 2013; Porwal *et al.* 2013; Dalal 2013; Narang *et al.* 2013; Borimnejad 2013; Goldsmit *et al.* 2012; Senthilkumar *et al.* 2011; Mgcini 2011).

In a study conducted in Argentina, Goldsmit *et al.* (2012) reported physiological changes in 91 (57%) of the 160 newborns transferred. In London, Senthilkumar *et al.* (2011) and Lim and Ratnavel (2008) also reported adverse events for 43.4% and

36.1% of transfers, respectively. The proportion of adverse events linked to physiological changes in these two studies accounted for 39% and > 1% of all clinically related adverse events, respectively.

The common physiological changes that result in the clinical deterioration of neonates include hypothermia, hypotension, hypoglycaemia, cardiac dysrhythmia, respiratory deterioration and decreased levels of consciousness. Goldsmit *et al.* (2012) documented that 49 (31%) of the 91 neonates who experienced physiological changes, required immediate cardiorespiratory support. Thermal instability was the most common adverse reaction, with 73 (46%) of the neonates deteriorating as a result of hypothermia (Goldsmit *et al.* 2012). Hypothermia was also found to be a significant physiological related adverse event in studies by Senthilkumar *et al.* (2011) and Henry and Trotman (2017), at 19% and 54% respectively. The frequency of hypotension as the most common physiological change is evident in studies by Sabzehei *et al.* (2016), Dalal *et al.* (2013) and Porwal *et al.* (2013) at 18%, 23.4% and 28.8% of all neonatal transfers, respectively.

In developing countries such as India (Sethi and Subramanian 2014; Dalal 2013; Narang *et al.* 2013), Iran (Sabzehei *et al.* 2016; Borimnejad 2013), Jamaica (Henry and Trotman 2017) and Colombia (Alvarado-Socarras 2014), where the burden of disease and neonatal mortality is particularly high, the chances of physiological related adverse events occurring are higher. In addition, contributing factors to an increased incidence of physiological related adverse events during transportation include delays in recognising the severity of the illness and delays in delivering the appropriate healthcare, thereby influencing the critical level of the neonate.

In South India, Deepak, Adhisivam and Vishnu (2015) found that sepsis and birth asphyxia were the primary reasons for transporting a neonate to a tertiary hospital. Of the 303 neonates transported, one-fifth died, indicating a high level of neonatal mortality during and following transportation. The abovementioned common physiological changes were also key findings in this study, where 76% of all neonates were hypothermic and 10% hypoglycaemic on admission. Likewise, a study by Henry and Trotman (2017) in Jamaica analysed 50 neonatal transfers undertaken over a period of 15 months, with 42 (84%) being undertaken by ground ambulances, of which 17 (34%) experienced at least one adverse event during

transportation. On arrival at the hospital, 27 (54%) were hypothermic, 42 (84%) hypotensive and 14 (28%) clinically unstable. The mortality rate was 18 (36%) neonates post-admission, with 80% of these neonates experiencing cardiorespiratory deterioration and requiring CPR during transportation. All neonates that required CPR prior to transportation died, as did 61% of neonates requiring CPR on arrival (Henry and Trotman 2017).

In South Africa, although there is limited literature on inter-healthcare facility transfers of critically ill neonates, the evidence shows cause for much concern. Mgcini (2011) conducted a cross-sectional, descriptive study of 104 transfers by both private and public ambulances in Gauteng province from October to December 2007. The study found that many neonates arrived in a poor clinical condition following transfer to a referral hospital, resulting in a relatively high mortality rate (7%) occurring within 48 hours after transfer, with significant predictors of mortality being bradycardia, hypoxia, hypotension and hypothermia. These findings are similar to those in other developing countries, such as Argentina, where Goldsmit *et al.* (2012) reported that 28 (17.5%) of the 160 transported neonates died, 12 within the first seven days of admission, and Jamaica, where Henry and Trotman (2017) reported that the death of all 18 neonates in their study, occurred during an average period of 5.5 days. The mortality rate in the Goldsmit *et al.* (2012) study was significantly higher (24%) in neonates who experienced adverse physiological changes compared to those who did not clinically deteriorate (9%) during the transport process. This is also a finding in the study performed in Jamaica by Henry and Trotman (2017), who reported that those neonates who deteriorated clinically during transportation and required CPR on arrival were twice as likely to die.

Mgcini (2011) listed the common adverse clinical events noted on arrival at the receiving hospital as hypotonia (32%), hypoxia (22%), hypothermia (21%) and acidosis (40%). Similar findings were identified in KwaZulu-Natal province by Ashokcoomar and Naidoo (2016), who showed that of the 29 (24.2%) critically ill neonates transferred, 10 (8.3%) physiological related adverse events occurred during transfer, including one (0.8) death. The remaining nine incidents were all potentially life threatening, with conditions such as respiratory and cardiac deterioration, desaturation, the development of hypothermia, and cardiorespiratory

arrest. The causes of neonatal death (Ashokcoomar and Naidoo 2016) were multifaceted, with reasons including inappropriate pre-transport preparation, as well as the lack of pre-transfer stabilisation and available ALS paramedics. This too is in keeping with international studies based in developing countries, such as India (Deepak *et al.* 2015) and Jamaica (Henry and Trotman 2017), where physiological changes, such as hypothermia and hypoglycaemia that were reported during transport could have been prevented, if those neonates were stabilised prior to departure.

Physiological related adverse events are also linked to both equipment and human related adverse events (Gonzalez 2014; Parmentier-Decrucq *et al.* 2013; Messner 2011; Fried *et al.* 2010; Lim and Ratnavel 2008). Equipment and human related adverse events will be reviewed in the next two subsections.

2.2.2 Equipment related adverse events

In a mobile intensive care unit, the role of specialised optimally functioning equipment is crucial to the outcome of the neonate, especially when dealing with the critically ill (Whyte and Jefferies 2015). Noise levels, limitations in space and low levels of light increase the need for optimally functioning equipment for patient monitoring and care during transport. According to Blakeman and Branson (2013) and Kue *et al.* (2011), equipment related adverse events during inter-hospital transfers occur more commonly than physiological and human related adverse events. This has also been highlighted in the study by Fried *et al.* (2010), who performed a retrospective review of 2396 inter-hospital transfers. Of these, 29 transfers reported adverse events with the most common events being equipment related.

Equipment related adverse events occurring during inter-healthcare facility transportations have been identified by Gonzalez (2014), Parmentier-Decrucq *et al.* (2013), Messner (2011) and Lim and Ratnavel (2008) as being as a result of equipment malfunction or technical errors. Gilpin and Hancock (2016) emphasised that neonatal deterioration from equipment failures should not occur and should be related to progression of the neonatal illness rather than the physical transfer. McEvoy *et al.* (2017) agreed and suggested that critical care neonates should be

supported during the transfer with reliable equipment to monitor the neonate, thus minimising adverse events.

Equipment malfunctions and technical errors are not confined to neonatal transportation as they also occur in the transfers of paediatric and adult critical care patients, as seen by Droogh *et al.* (2015), Baird and Ravindranath (2012) and Lee *et al.* (2010). Nevertheless, in critically ill neonatal transfers, such equipment related adverse events are often a result of equipment malfunction resulting in a loss of monitoring or functionality as seen with the ventilator, oximeter, infusion pumps and the incubator. Vehicle breakdown and exhaustion of supplies, including oxygen and battery life for portable equipment, also contribute to equipment related adverse events. Technical errors include tracheal tube blockages, accidental tracheal extubations and loss of intravascular access or catheters (Goldsmith *et al.* 2012; Meberg and Hansen 2011; Senthilkumar *et al.* 2011; Viera *et al.* (2011); Lim and Ratnavel 2008). Messner and Staffler (2015) stated that the main reason for equipment malfunction during a neonatal transfer is that routine NICU equipment is commonly used during the transfer rather than equipment designed specifically for use during transportation.

According to Blakeman and Branson (2013), the most common equipment malfunction reported was a loss of battery power to the incubator. As a result, temperature could not be maintained, resulting in warmth being compromised. This is directly linked to a commonly reported physiological related adverse event, hypothermia. Lim and Ratnavel (2008) also found that 21% of all transfers in their study exhibited an adverse event related to equipment, of which 9% were linked to problems with the transport incubator. Stroud, Trautman and Meyer (2013) and Whyte and Jefferies (2015) are of the opinion that critical incidents associated with equipment failure are also associated with the changeover of oxygen supplies and equipment when moving the neonate either around the hospital, between trollies or neonatal beds, or in and out of ambulances. The resultant adverse event will either be hypoxia or hyperoxaemia. This has also been noted by Wiegersma *et al.* (2011), where 12.5% of all adverse events, found in their study were related to technical failure, of which leakage of compressed air was the most common at 4.1%. Findings from Viera *et al.*'s (2011) also supported this. Out of a total of 1197 intra-hospital

transfers, 58 (4.8%) of the transports noted a lack of oxygen or compressed air supply, the highest of all equipment or technical related errors (Viera *et al.* 2011).

According to Schmölder, O'Reilly and Cheung (2013), optimally functioning pulse oximeters and respiratory function monitors are crucial to limiting adverse events in neonatal transfers. Both these instruments measure vital signs and are clinical indicators of adequate breathing and respiratory support. Although the international guidelines suggested by the American Heart Association for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care recommended the use of a stethoscope as the standard of care for assessing oxygenation and heart rates, this is challenging during transportation owing to the movement and vibrations of the ambulance (Kattwinkel *et al.* 2010). Therefore, during transportation the pulse oximeter is the primary tool for assessing vital signs and thus the optimal functioning of this tool is essential. The failure of the pulse oximeter was also identified in a study by Viera *et al.* (2011), who found such failure in 1.6% of all transfers with equipment related adverse events.

Technical errors were reported in studies by Goldsmit *et al.* (2012), Senthilkumar *et al.* (2011), Viera *et al.* (2011), Meberg and Hansen (2011) and Lim and Ratnavel (2008). In an observational study performed by Meberg and Hansen (2011) over a period of 29 years, 500 consecutive transfers were analysed in order to assess the need for and the current quality of neonatal transports in Norway. Technical failure relating to clinical complications was found to have occurred in 16 (3%) of all transfers. Viera *et al.* (2011) and Wieggersma *et al.* (2011) identified infusion pumps as an occurrence in 1.2% and 1.4% of their samples respectively, related to equipment related adverse events. Fried *et al.*'s (2010) study documented that the most commonly occurring equipment related adverse events, were due to monitor failure, infusion pump failure and unspecified ventilator failure.

Loss of intravascular access occurred in 12% and 3.1% of all neonates transported in the studies by Goldsmit *et al.* (2012) and Viera *et al.* (2011), respectively. Accidental extubation occurred in 0.6% and 2% of the studies by Viera *et al.* (2011) and Senthilkumar *et al.* (2011), respectively, whereas Meberg and Hansen (2011) reported eight accidental extubations and Fried *et al.* (2010) reported one in their study. Viera *et al.* (2011) found the occurrence of tracheal tube obstructions in 0.1%

of their study population, while catheter-related issues were seen in studies by Senthilkumar *et al.* (2011), where 9% of neonates were affected, and Viera *et al.* (2011), where loss of bladder catheters occurred with 0.3% of neonates.

Vehicular-related problems were noted in studies performed in the Netherlands (Wiegersma *et al.* 2011), London (Senthilkumar *et al.* 2011) and India (Kumar *et al.* (2010). Wiegersma *et al.* (2011) reported ambulance breakdown and mechanical problems, with the starting of the ambulance and dysfunctional lights and loading bridges making up 4.2% of these problems. Senthilkumar *et al.* (2011) reported 34 (19%) vehicle-related issues, whereas Kumar *et al.* (2010) noted a significant increase in vehicle breakdown in transfers covering longer distances. The findings of Kumar *et al.*'s (2010) study are noteworthy, as developing countries suffer financial constraints regarding the use of air ambulances even if they are available, making road transportation the only feasible alternative, thus increasing the risk of vehicle breakdown.

In developing countries such as India, Sampathkumar and Gobinathan (2018) stated that in resource-poor settings, most of the available ambulances are not sufficiently equipped to handle critically ill neonates. Kumar *et al.* (2010) further argued that in most developing countries no dedicated specialised neonatal transport equipment exists. Henry and Trotman (2017), who investigated the challenges of neonatal transport in Jamaica, another resource-limited setting, highlighted the impact of inadequate and inappropriately functioning equipment, as a common problem in developing countries. However, this is not limited to resource-poor settings, as seen in Japan (Hiroma *et al.* 2016), where 36% of all neonates transferred from perinatal medical centres across the country were transported by the fire department or ambulances that were neither designed nor equipped for neonatal care. Therefore, it can be assumed that specialised equipment within dedicated transfer units would minimise the risk of equipment related adverse events.

Although literature on critically ill neonatal transfers is limited in developing countries such as South Africa, the data available shows that equipment for high-risk neonatal transfers over the past decade remains a critical challenge (Vincent-Lambert and Wade 2018). Ashokcoomar and Naidoo (2016) found equipment related adverse events in 18 (15%) of 120 transfers, with some transfers experiencing more than one

event. These were related to problems with the oxygen supply (2; 1.7%), ventilator failure (9; 7.5%), incubator failure (9; 7.5%), loss of arterial cannulation (1; 0.8%) and ambulance breakdown (3; 2.55%). The lack of equipment was also a significant finding in this study, where equipment for 37 (30.8%) of the 120 transfers was unavailable. This equipment included incubators for 21 (17.5%) of the transfers, monitoring equipment for 13 (10.8%) transfers, ventilators for 10 (8.3%) transfers, ventilator circuits for three (2.5%) transfers, infusion pumps for three (2.5%) transfers, syringe drivers for four (3.3%) transfers, portable oxygen for two (1.7%) transfers and an administration set for one (0.8%) transfer.

Ashokcoomar and Naidoo (2016) also found correlations between physiological related adverse events and equipment related adverse events, with five (50%) of the 10 physiological related adverse events that occurred during transfers being a direct result of equipment related adverse events. Although a small number was involved (5; 50%), the χ^2 test showed a statistically significant p-value of 0.007. The results of this study can be linked to international studies where the malfunction of incubators resulted in hypothermia (Blakeman and Branson 2013; Lim and Ratnavel 2008).

The findings of both developed countries such as Argentina (Goldsmith *et al.* 2012), the Netherlands (Wiegersma *et al.* 2011) and London (Senthilkumar *et al.* 2011) and developing countries such as India (Deepak *et al.* 2015; Kumar *et al.* 2010) and Jamaica (Henry and Trotman 2017), where equipment malfunction and technical errors have been reported, are in keeping with the South African study by Ashokcoomar and Naidoo (2016). The impact of inadequate, inappropriate and malfunctioning equipment has been highlighted in the abovementioned studies; however, equipment related adverse events can be minimised. As suggested by Schmölzer, O'Reilly and Cheung (2013), personnel that have been trained to use equipment efficiently would be able to identify equipment malfunction and avoid or minimise equipment related adverse events through proficiency.

2.2.3 Human related adverse events

In the document, *To err is human*, Kohn, Corrigan and Donaldson (2000) reported that approximately 98 000 people die every year due to medical errors occurring in hospital. Hancock and Harrison (2018) stated that transport medicine is not without

medical error owing to the human factor at the centre of the process; communication, teamwork and strong leadership skills allow for safe transfers of neonates (Hancock and Harrison 2018). Dalal *et al.* (2013) supported this saying that human resources are a vital component of a safe neonatal transfer. These resources need to be highly competent to ensure the continuation of intensive care treatment and monitoring during the transfer, thereby ensuring that the neonate arrives at its destination in a stable condition with minimum or no adverse events (Gilpin and Hancock 2016).

Snijders *et al.* (2007) performed a systematic review of human error in an NICU and found that because there is the possibility of human error occurring in the healthcare sector, policies, procedures and systems have been designed to minimise these adverse events. Snijders *et al.* (2007) also stated that the extent of human error has been underestimated, despite studies confirming the relationship between human error and patient harm. While these occurrences are not confined to managing a neonate in an NICU, they are exacerbated during the transfer due to the nature of the process.

The review of adverse events performed by Lim and Ratnavel (2008) in London focused on the inter-hospital transportation of neonates. The study found that 139 (67%) of 205 adverse events, that occurred during a six-month period in a specialised team were due to avoidable human error. However, the impact of these adverse events was only significant in six cases, where the condition of the neonates deteriorated as a result (Lim and Ratnavel 2008). Another study performed in London by Senthilkumar *et al.* (2011), involving a dedicated transfer team, found that 50% of clinical adverse events were related to human error, 26% to overventilation and 24% to endotracheal malposition. In Norway, in a study of 500 transfers by Meberg and Hansen (2011), found that overventilation in the mechanical ventilation of one neonate resulted in a pneumothorax, while two neonates showed severe apnoea due to inadequate ventilation, resulting in the need for manual mask ventilation. These studies support the views of Chang, Berry and Sivasangari (2008), McEvoy *et al.* (2017) and Hancock and Harrison (2018) that adverse events related to human error are possible even when specialised teams are involved. However such events are minimised as compared to non-specialised teams.

In a study in Argentina by Goldsmit *et al.* (2012) it was found that 91 (57%) of the 160 neonates transferred, deteriorated during the process. Although the characteristics of clinical deterioration were defined as physiological changes experienced by the neonate, none of these changes could be attributed to a specific cause. Both the progression of the neonate's condition and the quality of care provided during the transfer were considered sources of physiological related adverse events. This is supported by a report developed by Kronforst (2016) which stated that when errors in neonatal transport do occur, most are believed to be secondary to avoidable human errors. Gilpin and Hancock (2016) argued that iatrogenic mortality or morbidity should be minimised and poor outcomes of transfers should be linked purely to the condition of the neonate.

In instances where non-specialised personnel have made up the transfer team, especially, in developing countries, human error is also common (Sabzehei *et al.* 2016). In countries such as India (Narang *et al.* 2013; Sethi and Subramanian 2014), Jamaica (Henry and Trotman 2017), Iran (Sabzehei *et al.* 2016; Nakhshab and Vosughi 2010) and South Africa (Vincent-Lambert and Wade 2018; Ashokcoomar and Naidoo 2016), studies analysing neonatal transportation have documented instances of human error. These errors are commonly associated with incorrect ventilator or incubator settings resulting in over- or under-ventilation or hyper- or hypothermia, respectively. Improper drug administration and endotracheal malposition or size have also been noted (Henry and Trotman 2017; Sabzehei *et al.* 2016). Inadequate pre-transfer stabilisation and failure to maintain clinical interventions by the transfer team were also found to be a notable error, as seen in the studies by Ashokcoomar and Naidoo (2016), Sabzehei *et al.* (2016), Narang *et al.* (2013), Sethi and Subramanian (2013) and Nakhshab and Vosughi (2010).

Sethi and Subramanian (2014) said that medication error was a leading human error. Sabzehei *et al.* (2016) found that 53% of neonates transferred in their study arrived with deranged blood gases, being hypoxic, while acidosis and hypercapnia ranked second and third at 50% and 43%, respectively. This Iranian study, like the Argentinian study by Goldsmit *et al.* (2012), found physiological changes to the neonate. Although Sabzehei *et al.* (2016) did not clearly define this as a human error as seen by Goldsmit *et al.* (2012), they did suggest that one of the primary causes of

hypoxia as a significant adverse event was manual ventilation. Incorrect placement of the endotracheal tube while ventilating was also considered and open incubator doors added to the risk of hypothermia, with 9% of clinical complications occurring in this study.

Nakhshab and Vosughi (2010) undertook a descriptive study on neonatal transports in Iran. They reported that a lack of pre-stabilisation prior to transport by the transfer team resulted in a 17.6% mortality rate (Nakhshab and Vosughi 2010). Likewise in Jamaica, Henry and Trotman (2017) found that poor prestabilisation techniques by the transfer team also contributed to adverse events experienced during the transport. Other human errors resulting in adverse events in this study, were due to the lack of staff training, resulting in the lack of appropriate monitoring and administration of interventions when required.

The lack of training by accompanying personnel, was highlighted by Henry and Trotman (2017), who found that 34% of staff were unable to perform resuscitative techniques and 56% were unable to intubate neonates when required. This study also found a significant correlation between mortality and the need for CPR on arrival of the neonate at the receiving facility (odds ratio: 2.3, confidence interval: 0.01–0.75, $p = 0.02$). The lack of adequate knowledge was also identified by Sola, Saldeño and Favareto (2008), who found in a survey of 4300 responders in Argentina, that approximately 70% acknowledged their lack of knowledge in terms of neonatal oxygenation and also lacked skills in terms of use and interpretation of SpO₂ (oxygen saturation) equipment.

In South Africa and other developing countries, paramedics are primarily involved in neonatal transfers. This differs from other countries. As Fenton and Leslie (2009) in the UK and McEvoy *et al.* (2017) in Switzerland reported, transfer teams consist of a neonatologist, neonatal intensive care nurses or respiratory therapists. Regardless of the composition of the teams in the aforementioned studies, competency and training with regard to reducing neonatal adverse events during the transfer process are crucial. This was further highlighted in a study by Whyte and Jefferies (2015), who indicated that there was no evidence to suggest that improved outcomes of a transfer are associated with a specific profession; however, experienced and skilled transfer teams in critical neonatal care are essential to improve the outcomes of

transfers. Stroud *et al.* (2010) added that although the golden-hour concept emphasises speed of delivery to a healthcare facility, timely lifesaving interventions and enhanced monitoring and care provided prior to the transfer are the key to improved outcomes in critically ill neonate transportation. Taking intensive care to the neonate and pre-transport stabilisation may be more beneficial than rapid delivery to a healthcare facility.

The literature shows that human errors are associated with the majority of adverse events; therefore, an attempt should be made to reduce the number of events through education, training and risk management.

2.3 Evidence of the impact of a training programme

Acknowledging the potentially hazardous environment of the pre-hospital setting, outside the ICU, reinforces the need for the transfer process to be organised and efficient. Transporting the critically ill neonate generally requires lifesaving interventions, as the degree of complications arising from not only the severity of illness but also the age group is higher compared with other populations (Fanara *et al.* 2010). For these reasons, it is imperative that the transfer team is highly skilled and competent in applying interventions timeously and correctly. The transfer thus requires an expert level of care underpinned by developed organisational structures and processes (Gilpin and Hancock 2016).

Messner (2011) stated that at least four concerns must be addressed through the organisational structures of an inter-healthcare transfer programme, namely, communication, personnel, equipment and monitoring. The development of a holistic multidimensional programme for the inter-healthcare facility transfer of critically ill neonates should address all facets of the organisational structure and transfer processes, and detail relevant knowledge, skills and attitude, as well as the ability to provide basic psychosocial support for the accompanying family member. This includes personnel with the appropriate knowledge, skills and attitude to deal with the added challenges of the transfer and the necessary specialised equipment and supplies (Fortune, Parkins and Playfor 2017). The International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations (2010) supported this, emphasising that the outcome

of a critically ill neonate during the transfer depends largely on the degree of technology, the expertise of personnel and the training programmes undergone by the transfer teams.

Training programmes aim to prepare teams to anticipate any problems during transportation but also to ensure that the patient is optimally prepared and stabilised before transportation, to avoid the occurrence of adverse events. Staff training can assist in reducing human related adverse events, as suggested by the guidelines for transport of critically ill patients compiled by the Australian College of Emergency Medicine (2015). The need for highly skilled transfer teams was also supported by, Henry and Trotman (2017), Nuria Carreras (2017), Ashokcoomar and Naidoo (2016), Carreras-Gonzalez and Brió-Sanagustin (2014) and Goldsmit *et al.* (2012) who noted that high-level interventions, were performed during the transfer. These interventions comprised advanced airway management including ventilation and intubation, cardiovascular support including CPR, fluid administration, IV and intra-osseous cannulation, the administration of pharmacological agents and knowledge of specialised neonatal equipment.

Although studies evaluating the evidence of the impact of a training programme on critically ill neonates are limited, available findings show that the risks related to transportation of critically ill patients can potentially be reduced by the implementation of a simple preventive programme (Fanara *et al.* 2010). As noted by Fanara *et al.* (2010), specific recommendations already exist for other categories of critically ill patients in developed countries, as evidenced by the recommendations of the European Society of Intensive Care Medicine and both the British and Italian Colleges of Emergency Medicine. A significant finding of the research by Fanara *et al.* (2010) reflected that inter-healthcare transport-related risks could be negated through the standardisation of procedures, which would further establish a uniform, global culture for the transfer process. In addition, Kue *et al.* (2011), Ratnavel (2013) and Gunz (2014) highlighted the need for the development of reliable procedures with continuous revision to ensure the safer mobilisation of patients. This is also in keeping with various studies undertaken in other developed countries such as the USA (Stroud *et al.* 2013; American Academy of Pediatrics 2012; Miller *et al.* 2008), Canada (Bérubé *et al.* 2013) and Australia (Shee and Gleeson 2018).

The Canadian study by Bérubé *et al.* (2013) documented the impact of a preventive programme aimed at reducing the incidence of adverse events during the transportation of critically ill patients. The study used a clinical quality improvement audit which reviewed 180 transfers, prior to implementation of the programme and 187 transfers in the post-implementation phase. It showed a 20% absolute reduction in incidents between pre- and post-implementation from 57.2% to 37.4% ($p < 0.001$), respectively. The reduction was mainly attributed to technical and clinical-related incidents. Technical problems were reduced from 25 to 7.5% ($p < 0.001$) and clinical deterioration was reduced from 24.4 to 17.1% ($p = 0.11$). Similarly in the USA, Kue *et al.* (2011) reported a 1.7% incident rate, with the introduction of a preventive programme comparative to other studies (cited by Kue *et al.* 2011) that showed an 8% incident rate. However, only significant clinical deterioration variables were considered and no analysis of the pre-implementation phase was performed.

Focusing on neonatal resuscitation, an Australian study (Shee and Gleeson 2018), reviewed the implementation of the NeoResus training programme. This study did not report on adverse events but aimed to assess the confidence levels of emergency department personnel in neonatal resuscitation. The results showed an improvement in confidence levels of 100% in participants on completion of an online and face-to-face programme that focused on improving CPR, IV cannulation and intubation of neonates. Similarly, a systematic review of the Standardised Formal Neonatal Resuscitation Training (SFNRT) programmes in low and middle-income countries found a decrease in early neonatal mortality as a result of an increase in teamwork behaviour, resulting in decreased resuscitation times (Pammi *et al.* 2016).

The impact of improved teamwork as a result of team training was highlighted by Salas *et al.* (2008), who found that overall team training had a positive effect on team functioning ($p = 0.34$; 10% CV = 0.34; 90% CV = 0.34). The study revealed that team training programmes had a positive effect on each of the four outcomes, under investigation (cognitive, affective, teamwork processes, and performance) and recommended training programmes as a viable approach for improved performance and patient outcomes.

In developing countries, the need for expertly trained healthcare professionals to conduct transfers of the critically ill neonate is higher than developed countries, as

the need for transfer is higher. Against the backdrop of the high burden of disease, skilled transfer teams, are essential to ensure a positive outcome for the transfer. However, this does not seem to be the case in developing countries, as seen by Okechukwu and Achonwa (2009) in Nigeria, who found that suboptimal conditions for neonatal resuscitation exist, with poor thermoregulation and transfer processes performed by transfer teams. These findings are consistent with findings from a study by Henry and Trotman (2017), where inadequately trained personnel used for transfers resulted in one out of every three neonates transferred, having no monitoring of vital signs and temperature. Inappropriate fluid management was also a resultant outcome due to the accompanying personnel being inadequately trained. These mismanaged or overlooked signs resulted in 54% of all neonates, requiring warming on arrival, 84% requiring fluid resuscitation and 28% requiring CPR. These researchers concluded that the pre-transport stabilisation of neonates and the availability of adequately trained staff should be addressed urgently in order to improve the outcomes of neonatal transport in resource-limited settings like Jamaica (Henry and Trotman 2017).

In South Africa, Vincent-Lambert and Wade (2018) asserted that specialised neonatal or paediatric transfer teams do not exist, with some of the personnel undertaking transfers having minimal emergency care training. Evidence from this study, as well as that of Ashokcoomar and Naidoo (2016), suggested that specialist trained neonatal transfer teams, are best suited for this task owing to the nature of the interventions required when transferring critically ill neonates.

2.4 State-of-the-art practice that guides the transfer of critically ill neonates

Gilpin and Hancock (2016) stated that by acknowledging the potentially hazardous environment of the pre-hospital setting, outside the ICU, reinforces the need for the transfer process to be organised and efficient. Messner (2011) argued that when failed or ineffective systems exist with regard to the transport of critically ill neonates, the risk of morbidity and mortality increases. In keeping with this, Stroud *et al.* (2013) expressed that the practice of inter-healthcare facility transportation of critically ill neonates continues to expand and has evolved into mobile ICUs capable of delivering state-of-the-art practices for critical care outside the NICU, thus maintaining or improving the continuum of care. In order for the transfer to follow

state-of-the-art guidelines, an expert level of care underpinned by developed organisational structures and processes is essential (Stroud *et al.* 2013). This includes personnel with the appropriate knowledge, skills and attitudes to deal with the added challenges of a neonatal transfer and the necessary specialised equipment and supplies. Communication and the coordination of the transfer process are also considered to be key elements of a successful transfer (Kronforst 2016).

Ratnavel (2013) suggested that transfers of an ill neonate should only occur when the benefits to the neonate exceed the risks of the transfer. This is supported by McEvoy *et al.* (2017), Sethi and Subramanian (2014) and Singh and MacDonald (2009), who asserted that a neonate should only be transferred when necessary. Ratnavel (2013) added that an all-inclusive systematic approach should exist when transferring critically ill patients. Barry *et al.* (1994 cited in Kronforst 2016) reported that in the UK, 75% of children transferred experienced adverse events primarily due to unreliable processes and non-specialised teams undertaking the transfer. These adverse events can be avoided or minimised, as suggested by Lee *et al.* (2010), if four major components are considered when undertaking a transfer of the neonate. These include a multidisciplinary team to plan and coordinate the transfer process, a needs assessment by the facility to determine the health requirements of the patient based on the availability of resources, a standardised transfer plan, and timely re-evaluation of the plan to maintain quality of care. Likewise, a systematic review of published electronic sources from 1998 to 2009, by Fanara *et al.* (2010) found that transfer systems should be evaluated on a regular basis to ensure the quality of patient management, especially with the critically ill patient. This was also supported by Bigham *et al.* (2014), Romanzeira and Sarinho (2014), and Bigham and Schwartz (2013).

Miller *et al.* (2008) investigated the processes and support for inter-hospital neonatal patient transfers by undertaking a preliminary study. The findings showed that systematic issues, including time delays and inadequate transport processes, were associated with increased neonatal mortality. Two studies performed in India (Narang *et al.* 2013; Kumar *et al.* 2010) lent support for this as they found higher mortality rates in babies transported for longer periods, than those subject to shorter

transfer times. Neonates transferred for a period of between two and more than six hours displayed statistical significance (p -value = <0.01) with the prediction of mortality, noted in the study by Narang *et al.* (2013). The choice of transferring these neonates using ground ambulances, over the distances covered may be attributed to poor coordination processes. Ideally, the mode of transport for longer distances should be air ambulance. Both studies identified the unavailability of air ambulances in India. However, this is not confined to resource-poor settings such as India, as Akula *et al.* (2016) in California, also found that a median duration of 2.5 hours or more for a transfer, puts the neonate at greater risk for adverse events. It is evident that shortened inter-healthcare facility transport time and the implementation of appropriate systems in order to select the appropriate mode of available transport may lead to improved outcomes for the smallest and most critically ill or injured neonates.

In Switzerland, McEvoy *et al.* (2017) reported that standards of neonatal care were defined in 2011, with accreditation only occurring in 2015. It is not surprising that countries like South Africa (Ashokcoomar and Naidoo 2016) and other resource-limited settings such as India (Dalal, Vishal and Solanki 2013; Narang *et al.* 2013) have little or no developed programmes available, with most existing practices having been adopted from international standards that lack consideration of the resource constraints and the unique challenges of each country. Each country thus needs to strategise their action, based on the local situation, within the context of ongoing initiatives and a view to what works (Watts 2008). Accordingly, Gunz, Dhanani and Whyte (2014) stated that the inter-healthcare facility transfer of a critically ill neonate must be guided by best practice programmes developed to meet the unique needs of a specific context. Therefore, in a resource-poor setting like South Africa due consideration must be given to the human and financial constraints that exist.

2.4.1 Specialised dedicated transport teams and units

Within the UK (Senthilkumar *et al.* 2011 and Lim and Ratnavel 2008) and other developed European countries such as Switzerland (McEvoy *et al.* 2017), where EMC services are well established, the use of specialised neonatal units are routine practice for the transfer of critically ill neonates. Chang (2008) argued that the use of

specialised transfer teams and units is associated with improved outcomes during transportation, especially enhanced neonatal survival. There is enough data to suggest that adverse events are reduced during neonatal transfers that make use of specialised teams (Pan 2017). However, studies performed with dedicated teams in developed countries recognise adverse events linked to human error, as seen in section 2.2.3 of the literature review (Senthilkumar *et al.* 2011; Lim and Ratnavel 2008). Although the risk of adverse events exists when using a dedicated team Hancock and Harrison (2018) cites reports and studies in developed countries such as London (Orr's 2009), Europe, (Edge *et al.* 1994) and the USA (McPherson *et al.* 2014) that highlight different opinions. Hancock and Harrison (2018 cited Edge *et al.* 1994) suggested that the rate of adverse events, decreases significantly from 20 to 2% when using specialised teams. Similarly, Orr *et al.* (2009) noted a rate of 9% of adverse events when using dedicated teams as compared to 23%, when non-specialised teams were used. McPherson *et al.* (2014) reported similar statistics in their paediatric study, where they found that every seven times a generalised team was used rather than a specialised team a child might die. Significantly more adverse events, including airway problems, the need for cardiopulmonary resuscitation, hypotension and loss of vascular access, occurred when a nonspecialised team transported paediatric patients (Orr *et al.* 2009). This is in keeping with various studies undertaken in other developed countries such as the USA (Stroud *et al.* 2013; American Academy of Pediatrics 2012; Miller *et al.* 2008). This is consistent with the studies in the USA (Miller *et al.* 2008; American Academy of Pediatrics 2012; Stroud *et al.* 2013). The use of dedicated neonatal teams and units ensures safe, quality and expedient neonatal-focused critical care responses. This was established by Droogh *et al.* (2012), who compared the outcomes of transfers with dedicated mobile intensive care units, to transfers performed using standard ambulances.

Similarly, Kue *et al.* (2011) reported a reduction in adverse events ranging from 60 to 70 %, when using a dedicated unit for the transportation of neonates. Studies have found that the majority of adverse events occurred where trained, dedicated transport providers are not used, therefore "it could be inferred that the transport itself requires an additional set of knowledge and skills beyond that of standard critical care in the ICU setting". Kue *et al.* (2011) suggested the use of dedicated

transfer teams not just for inter-hospital transfers but also for intra-hospital transfers, as this will allow ICU staff to remain and focus on the neonates within the unit, and also reduce the overall number of adverse events when transfers are conducted by poorly trained staff.

In Japan, Hiroma *et al.* (2016) suggested that specialised equipment for a neonatal transfer should include incubators, respiration and heart rate monitors, SpO₂ monitors, infusion pumps, aspirators, air and oxygen blenders, artificial respirators and seatbelts for newborns. All perinatal centres who participated in their study indicated that the lack of specialised equipment made the transfer difficult in terms of monitoring vital signs, supporting ventilation and avoiding hypothermia. This was also noted in other studies (McEvoy *et al.* 2017; Droogh *et al.* 2015; Gonzalez 2014; Parmentier-Decrucq *et al.* 2013; Blakeman and Branson 2013; Baird and Ravindranath 2012; Messner 2011; Lee *et al.* 2010; Lim and Ratnavel 2008).

Transfers of neonates in other developed countries are structured and use well-developed regionalised programmes, with a cadre of appropriately skilled human resources (McEvoy *et al.* 2017). They operate under advanced medical directives with access to telephone clinical advice, preferably from senior physicians with specific neonatal and transport expertise. Jackson and Skeoch (2009) indicated that a skilled and experienced transfer team functions as an extension of the downstream healthcare facility to bring expertise to the bedside of the referring facility. There is considerable diversity in terms of those who undertake the neonatal transfer. These include combinations of physicians, paediatricians, neonatologists, respiratory therapists, anaesthetists, nurses and paramedics. Although there are no published studies comparing professions, studies have recommended the use of specifically trained personnel for critically ill neonatal transfers, as they are the key to safe transport, irrespective of the profession (Gente *et al.* 2015; Kue *et al.* 2011; Chang *et al.* 2008).

Studies by Fenton and Leslie (2009) in the UK and McEvoy *et al.* (2017) in Switzerland also noted a range of staffing models for neonatal transport. However, unlike the USA and Canada where paramedics have been primarily involved in these transfers, the UK commonly uses teams consisting of a doctor with paediatric training and a nurse (Fenton and Leslie 2009) and Switzerland (McEvoy *et al.* (2017)

uses a team composed of a neonatologist and a nurse with specialised training in neonatal intensive care. However, the team composition in Switzerland was seen as a disadvantage to the hospital system as these specialists were required to leave the NICU. This compromised the NICU, leaving it short staffed. In addition, the feasibility of having a 24-hour, cost-effective, readily available transport team with this composition was a major concern. Regardless of the composition of the teams in the aforementioned studies, competency and training with regard to neonatal transport are crucial. This was highlighted in studies done by Whyte and Jefferies (2015) in Canada and Fenton and Leslie (2009) in the UK, which found that there was no evidence to suggest that improved outcomes for a transfer are associated with a specific profession. Nevertheless, education and training in neonatal care were found to be essential to improve the outcomes of transfers. Having a stand-alone team also enhances familiarity with neonatal-specific processes and equipment, which results in the care for critically ill or injured neonates being uncompromised by a lack of staff availability and competency. Specialised neonatal transfer teams showed improved overall transit time (Whyte and Jefferies 2015; Wieggersma *et al.* 2011; Jackson and Skeoch 2009; Ohning 2008). This was also found in several studies (Messner 2011; Orr, Felmet and Han 2009).

Specialised dedicated transfer teams and units for critically ill neonates do not exist in many developing countries, hence the transfer is done by staff with little experience and insufficient equipment, thus increasing the risk of complications during the transfer (Sabzehei *et al.* 2016). Mori *et al.* (2007) determined the associations between the duration of inter-healthcare facility neonatal transport and its outcomes in India. The results showed that neonates who spent a longer time in transit while being transferred had a 79% higher odds ratio of death than those being transported for a short duration. There was strong evidence that those transported for more than 90 minutes had more than twice the rate of neonatal death (95% CI), and some evidence that those transported for between 60 and 89 minutes had an 80% higher rate of neonatal death (rate ratio 1.81, 95%), both times being compared with those transported for between 30 and 59 minutes. The study concluded that a significant association could be made between longer transport times and neonatal mortality. In Jamaica, Henry and Trotman (2017) found a significant relationship between the distance travelled and mortality rates of neonates transported

($p = 0.037$). Those transferred over longer distances (equating to increased time frames) died within 48 hours of arrival at the receiving institution, as compared to those who travelled shorter distances. In addition, Henry and Trotman (2017) wrote that the main reason for transferring the neonates was to ensure a higher level of care owing to inadequate medical expertise at the referring hospital. However, the personnel involved in the transfer were based at the referring hospital, indicating a lack of specialised care during the long transfers.

In South Africa, the Metro Emergency Medical Services in Cape Town introduced a dedicated maternal and neonatal Flying Squad service programme in 2006 to provide better pre-hospital care for mothers and children. To assess the success of this initiative, a retrospective study reviewed the calls handled by a non-dedicated Flying Squad service from 1 January to 31 December 2005 and compared the outcomes of the calls handled by the new neonatal Flying Squad service from 1 January to 31 December 2008. Although this unit was not specifically for critically ill neonates, the study revealed a significant improvement in all transit times in 2008. The performance improved from 11.7% in 2005 to 46.6% in 2008, with regards to all incidents dispatched within four minutes ($p\text{-value} = < 0.0001$). The response time performance at the 15-minute threshold did not demonstrate a statistically significant improvement ($p\text{-value} = 0.4$). The improvement in the 30-minute performance category was statistically significant in both maternity and neonatal incidents, with the maternity incidents displaying the greatest improvement, increasing from 30.3% in 2005 to 72.9% in 2008. The neonatal transfers displayed a reduction in total pre-hospital mean times from 177 minutes in 2005 to 128 minutes in 2008. It was concluded that the introduction of the Flying Squad programme resulted in a significant improvement in the transit times of both neonatal and obstetric patients (De Vries, Wallis and Maritz 2011).

Therefore, in developing countries such as Jamaica (Henry and Trotman 2017), South Africa (Ashokcoomar and Naidoo 2016), Iran (Borimnejad *et al.* 2012) and India (Ramnarayan *et al.* 2010), it is suggested that the use of specialised dedicated inter-healthcare transfer units and teams can reduce mortality during the transfer process, and possibly improve transport times, particularly for critically ill neonates.

2.4.2 Communication and coordination

Kronforst (2016) emphasised that inter-healthcare facility transfers of critically ill neonates requires effective communication and coordination between multiple parties to ensure that the neonate arrives at its destination in a stable condition. The multiple parties include the healthcare providers at both the referring and receiving facilities, the transfer team (ground and/or air), and other support services (Fortune *et al.* 2017; Foronda, Van Graafeiland and Davidson 2016). Riesenber, Leitzsch and Massucci (2009) agreed that teamwork and effective communication and coordination across the health care continuum are essential for providing efficient, quality care that contributes to the enhancement of neonatal outcomes. Subsequently, Weaver *et al.* (2010) indicated that communication is a primary contributing factor leading to medical errors. Furthermore, Fendya *et al.* (2011) and Bigham *et al.* (2014) asserted that communication extends beyond the transfer process. Accompanying family members must also be informed about the transfer and its processes, and the referring and consulting healthcare providers involved with the transfer require appropriate and timely feedback (Gilpin and Hancock 2016). However, Price-Douglas, Romito and Taylor (2010) stated that the nature of critically ill neonatal transport presents many challenges in the area of communication and coordination and this is often overlooked. In addition to the transport challenges, Pan (2017) indicated that most medico-legal problems are a result of poor communication and the provision of inadequate information. Vanderbilt *et al.* (2017) stressed that in order to achieve the highest levels of neonatal safety and quality of care during the transfer process, communication and coordination between the necessary role players should be as good as possible.

Although health care professionals in developed countries like the USA are overwhelmingly trained in neonatal transfer specialised settings (Vanderbilt *et al.* 2017), studies by Lim and Ratnavel (2008) and Knight *et al.* 2015 noted cases of miscommunication. An investigation of the difficulties of inter-hospital transfer by Knight *et al.* (2015) in the USA, showed poor communication between healthcare facilities and transport teams, to be one of the common risk factors associated with adverse events from delayed intubation resulting from logistical issues. A review by Lim and Ratnavel (2008), on adverse events during emergency inter-hospital

transfers of neonates, within the London Neonatal Transfer Service, identified miscommunication as a common problem during the transfer. The study showed that of the 205 transfers that experienced adverse events, 49 occurred due to problems with communication at various stages of the transfer process. Inaccurate information about the neonate was given to the transfer team before they arrived at the referring unit in 25 transfers, and in 14 transfers there was miscommunication at handover between the transfer team and the receiving team.

According to Lim and Ratnavel (2008), communication failures commonly occur at every phase of the transport process, especially at the time of handover between teams. This was consistent with findings from other studies by Knight *et al.* (2015) and Price-Douglas *et al.* (2010). A structured format for communication, such as SBARR (situation, background, assessment, recommendations, read-back), enhances communication, reduces errors and should be used for handovers. Wilson (2018), implemented and evaluated the SBARR training for inter-facility neonatal and paediatric transports performed by registered nurses, respiratory therapists and physicians. The training proved to be effective in improving telephone communication by registered nurses, respiratory therapists and physicians and has been included in the educational curriculum of transport programmes to enhance communication.

Horowitz and Rozenfeld (2007) recommended that there should be direct communication between the necessary role players, and all communication should be recorded. The Emergency Management Communication Centers (EMCC), which serves as a central communication system to coordinate personnel and resources, should facilitate the transfer process via the transport coordinator. Woodward, Insoft and Kleinman (2007) and Miller *et al.* (2008) stated that specialised transfers of neonates are a high risk, therefore communication centre staff in the USA are trained specifically in transport medicine, emergency medical care and communication to deal with critically ill neonatal transfers. Fortune *et al.* (2017) stated that sharing experiences, information and advice on transportation can improve the standard of care in inter-facility neonatal transport. Miscommunication, poor coordination and the lack of understanding of roles and responsibilities are potential causes of medical

errors (Vanderbilt *et al.* 2017; Fortune *et al.* 2017; Foronda *et al.* 2016; Riesenber *et al.* 2009; Miller *et al.* 2008).

However, poor or failed communication and coordination in developing countries are common occurrences (Greisen 2007). In Brazil, Balbino and Cardoso (2017) expressed that the absence of communication between healthcare professionals is associated with time delays and greater consumption of transport team materials. A study by Albuquerque *et al.* (2012) found that communication before and during transport in Brazil were the key deficiencies in the neonatal transfer process. In India, Dalal *et al.* (2013) found that 33% of the transfers were referred without proper pre-referral documentation or communication. In Nigeria, Abdulraheem *et al.* (2016) noted that communication in the transport of neonates was suboptimal, hence hospitals were not prepared for the arrival of these babies.

In South Africa, Ashokcoomar and Naidoo (2016) highlighted that inexperienced telephone operators, who accepted and dispatched critical neonatal transfers without clinical supervision, created many problems. A common problem was time delays, resulting from a lack of familiarity with the appropriate personnel and the equipment required for critically ill neonatal transfers. Of 120 transfers, 22 were unnecessarily delayed by dispatching the incorrect transfer teams and 17 transfers were dispatched with the incorrect equipment. In Johannesburg, Vincent-Lambert and Wade (2018: 32) noted that communication between the relevant stakeholders involved in arranging and carrying out the transfers was ineffective, and described it as “appalling”. The study also showed that there was no standardisation of the transfer process between the doctors at the receiving and the referring facilities and the transfer system.

2.5 Training needs for a programme that will guide neonatal transfers in South Africa

Inter-healthcare facility transportation of a critically ill neonate requires skilled healthcare professionals operating within a programme designed for the specific needs of the neonate. In order for the programme to be effective, education and training, specific to these needs should be at the forefront. Delegates at the National Paediatric and Neonatal Transport Leadership Conference (Woodward *et al.* 2007)

felt that despite having experience with critically ill paediatric and adult patients, healthcare providers should not consider themselves competent to transfer critically ill neonates, unless they have specific education and training in this area. Although courses and training that augment critical care experience and expertise exist, for example advanced paediatric life support (APLS), neonatal resuscitation programmes (NRP), advanced cardiac life support (ACLS) and advanced trauma-like support (ATLS), they are insufficient to prepare a healthcare provider for neonatal critical care transfers. In addition, the delegates agreed that extensive, well-developed training programmes are needed, in addition to experience if healthcare providers are to deal with the intensive care neonatal transfer.

In recent years, the establishment of specialised retrieval units and teams has been associated with a decline in adverse events, reduced transportation time frames, increased familiarity with transport-specific procedures and equipment, and improved communication and coordination (McEvoy *et al.* 2017; McPherson *et al.* 2014; Stroud *et al.* 2013; Kue *et al.* 2011; Chang *et al.* 2008). This is evidenced in sections 2.3 and 2.4, which have reviewed the impact of training programmes and state-of-the-art practices, that guide the transfer of critically ill neonates. Apart from the clinical and technical skills and specialised equipment required to deal with the neonate, additional skills to perform assessment and stabilisation are recommended (Henry and Trotman 2017; Sabzehei *et al.* 2016; Ashokcoomar and Naidoo 2016; Sethi and Subramanian 2014; Alvarado-Socarras 2014; Dalal *et al.* 2013; Porwal *et al.* 2013; Dalal 2013; Narang *et al.* 2013; Borimnejad 2013; Goldsmit *et al.* 2012; Senthilkumar *et al.* 2011; Mgcini 2011).

Transfers of critically ill neonates generally require more interventions and involve more complications when compared with other paediatric age groups and patient populations (Whyte 2015). Karlsen *et al.* (2011) indicated that the acquisition and maintenance of competency in critical care neonatal procedures is challenging, and these skills need a longer time to master. Therefore, Fortune *et al.* (2017) wrote that assessing competence using an objective structured assessment of technical skills, checklists and global rating scales was ideal. Carreras-Gonzalez and Brió-Sanagustin (2014) added that retaining competencies requires regular practice and refresher courses. Although operational practice experience remains the “gold

standard” for learning intubation, transport teams should also be turning to simulation and task trainers as a necessary adjunct.

For a successful neonatal transfer programme to exist, teams need to be trained in the administrative requirements of the programme. These include quality control through the completion of necessary documentation and quality assurance and improvement through feedback in order to direct policies and procedures once reviewed. This would allow for the development of research areas within neonatal transport medicine. It is also crucial for transfer teams to be trained to acknowledge the accompanying family member and provide the necessary support. Therefore, the transfer of an ill neonate requires a specific skill set that can only be obtained through training, either via simulation or traditional clinical exposure, and education allowing for sub-specialisation.

2.5.1 Neonatal assessment and stabilisation

According to Karlsen *et al.* (2011), the main goals of neonatal-paediatric transport teams are early stabilisation and the initiation of advanced care at the referring institution, with continuation of critical care therapies and monitoring en route, so as to improve the safety of the transport and the neonates’ outcome. Woodward *et al.* (2007) added that the neonate’s condition should not deteriorate as a result of preventable issues during transport. Messner (2011) stated that despite the inherent tendency to expedite the transfer process, all too often it is forgotten that in an emergency, speed is no substitute for the time invested in resuscitating and stabilising the neonate before leaving the referring facility. There is rarely a need for haste and panic, as this often results in morbidity or mortality. Numerous studies, both in resource-limited (Henry and Trotman 2017; Ashokcoomar and Naidoo 2016; Deepak *et al.* 2015; Dalal *et al.* 2013; Borimnejad *et al.* 2012) and developed settings (Gilpin and Hancock 2016; Whyte and Jefferies 2015; Fenton and Leslie 2009) emphasise this point. All these studies found that the level of training of transfer teams to perform high-level interventions for stabilising the neonate before transfer and the continuous advanced care and monitoring during the transfer reduces the risk of adverse events. These studies also found that despite pre-transport stabilisation and packaging and the best preparation, neonates may

deteriorate in transit and the transport team should be skilled and equipped to clinically manage these situations.

According to McEvoy *et al.* (2017), stabilisation and resuscitation has an important bearing on the survival of the critically ill neonate and their ability to tolerate the transfer. The neonatal assessment and pre-transfer stabilisation process begins when the emergency medical team arrives at the patient's bedside, at the referring facility. Stabilisation times vary, however; in the study by McEvoy *et al.* (2017) it was noted that stabilisation times observed in lower-level care facilities were longer (average of 62 minutes) than higher-level care facilities (average of 57 minutes). It can therefore be assumed that additional interventions at lower-level care facilities are required, resulting in longer stabilisation times.

The ideal environment for pre-hospital stabilisation, as highlighted by Gilpin and Hancock (2016), is not only the NICU, but also operating theatres and emergency departments owing to the availability of resuscitation equipment and senior specialist input. Stabilisation prior to transport is important as it allows the neonate to remain in a stable condition for a longer period of time, thus reducing transfer stress, as interventions are difficult to administer during transfers. With this in mind, Messner (2011) reported that optimal pre-transport stabilisation, resulted in a lesser chance of the neonate deteriorating during transfer. Inadequate pre-transfer preparation has been highlighted by Lim and Ratnavel (2008), who found that human-related adverse events accounted for 67% of all adverse events, with 50% of all events occurring as a result of poor preparation and stabilisation.

Currently, in developed countries a number of stabilisation programmes exist, with Fortune *et al.* (2017) reporting on the ACCEPT (assessment, control, communication, evaluation, preparation/packaging and transportation) and SCRUMP (shared assessment, clinical isolation, resource limitations, unfamiliar equipment, movement and safety and physiology) programmes in the UK. Karlsen *et al.* (2011) described the STABLE programme in the USA, as representing sugar, temperature, airway, breathing, laboratory and emotional support. These programmes have been designed to focus on the post-resuscitation and pre-transport stabilisation of a neonate with the STABLE programme being taught in both developed (USA) and under-resourced countries (Iran) (Borimnejad *et al.* 2012; Karlsen *et al.* 2011).

Specialist paediatric intensive care teams using structured approaches to stabilisation and transfer have improved the outcomes of transfers. In the programmes listed above, assessment is a key factor. This is achieved by using the ABC (airway, breathing and circulation) approach (Fortune *et al.* 2017). This approach is not only relevant to this study, as Carreras-Gonzalez and Brió-Sanagustin (2014) also highlighted the need for the ABC approach for appropriate pre-transport stabilisation of a neonate in Spain. In addition, Gilpin and Hancock (2016) added a “D” (disability) to this approach.

Davidson (2018) stated that the Transport Risk Index of Physiologic Stability Version II (TRIPS II) tool is commonly used in developed countries, to describe the severity of illness, in neonates transported prior to, during and after transport, to validate a seven-day mortality rate from NICU admission. In the USA, the Transport Risk Index of Physiologic Stability, version II (TRIPS-II) score is used to measure four empirically weighted items (temperature, blood pressure, respiratory status and response to noxious stimuli) to predict mortality at seven days and total NICU mortality. A prospective study by Lee *et al.* (2012), involving 17 075 infants admitted to 15 NICUs, from 2006 to 2008, showed that the TRIPS-II is a valid benchmarking tool for assessing neonatal illness severity at admission or up to 24 hours thereafter. This is consistent with Lucas da Silva’s (2012) study, which included all consecutive outborn infants admitted to a single NICU over a three-year period. The study concluded that TRIPS-II is a useful triage tool if applied at the time of first contact with a transport service.

Recently, Pan (2017) assessed strategies and protocols for the safe transport of critically ill patients. Clinical conditions such as hypoglycaemia, hypothermia, poor perfusion and hypoxia have been shown to be associated with high mortality in transported neonates. He recommended the mnemonic TOPS (temperature, oxygenation, perfusion, sugar) as a simplified assessment guide to address these conditions. However, Messner (2011) argued that although many neonatal transport programmes exist in developed countries, rather than taking them over, they should be designed and developed to suit the resources of a country and should consider the context in which they are developed.

2.5.2 Support for the accompanying family member

Expectant family members joyously anticipate the birth of a healthy baby, but their dreams are may be shattered when they are confronted with a critically ill neonate (Mosher 2013). Immediately after the birth of their baby, family members, particularly the mother, may assume the role of the primary caregiver, thereby suffering anxiety, depression and post-traumatic stress disorder (Del Fabbro 2016). The greatest source of stress experienced by the mothers in the NICU is being separated from their baby (Woodward *et al.* 2014). Lappälä (2010) wrote that transporting a neonate to the NICU affects the parents and their ability to bond with their infants. In instances where mothers are separated from their babies as a result of intensive care requirements, it has been found that 39 to 63% of such mothers experience postpartum depression (Mile 2007). In contrast, O'Hara (2013) noted a lower rate of postpartum depression, (13 to 19%), in mothers who did not have babies requiring intensive care. The findings relating to higher anxiety and depression in mothers of critically ill babies is corroborated by Misund *et al.* (2013), who assessed 29 mothers of critically ill babies over a period of two weeks after pre-term childbirth. This Norwegian study showed that all mothers experienced symptoms of depression and anxiety related to concerns about the babies' appearance and condition (Misund *et al.* 2013). Similar findings have been reported at the Christchurch Women's Hospital in New Zealand (Woodward *et al.* 2014) by mothers' who faced similar circumstances. Such experiences were followed by feelings of helplessness and an inability to protect their baby from pain or painful procedures. In addition, Brett *et al.* (2011) stated that feelings of guilt about not carrying to term and fears for the child's survival added to the mothers' depression and anxiety and decreased their confidence in their role as a mother.

Despite the limited literature on the accompanying family members' perspective during the transport of the ill neonate, a few writers showed that the process involved in transferring, to a higher level of care often intensifies the depression and anxiety of family members (Van Manen 2012; Fidler and McGrath 2009). Whyte and Jefferies (2015) asserted that the NICU environment, the transfer process and the stresses of the pre-hospital environment can be a frightening, confusing and difficult experience for family members. Fidler and McGrath (2009) added that the transport

of a critically ill neonate, either by ground or air, planned or emergency, can be stressful and tense for both the health care providers and the family members. While the transfer team may consider the transport process routine, parents have a markedly different perspective and generally perceive the transport as a negative experience (Van Manen 2012; Fidler and McGrath 2009). The findings of Van Manen's study in Canada, showed that the transfer was associated with psychological distress, specifically anxiety and worry by all 12 participants, of which eight were mothers and four were fathers.

Bearing in mind the possibility of anxiety and depression and the perceptions of the transfer process, it is imperative that the team be trained to acknowledge and communicate with the accompanying family member, in order to reassure and prepare them for what may be expected during the transfer, especially when highly specialised interventions need to be performed. Awareness of overall communication from the perspective of the accompanying family member is a key component in developing transport teams to effectively manage the accompanying family. A study by Mullaney (2014) evaluated the communication practices of a transport team from the perspective of the parents. Twenty-seven parents completed open-ended questionnaires, with approximately 40% of parents citing separation from their baby as very concerning and causing distress, 40% stated that at least one parent should accompany the baby during the transport, 11% expressed fear that their baby would die, 26% were uncertain about what was happening to their infants, and 30% wanted reassurance that their baby "would be okay". However, even though parents did not accompany their babies, 48% of parents had photographs of their babies which helped reassure them, 67% received telephone calls informing them that the neonate had arrived safely at the receiving facility, 85% mentioned that the transport team introduced themselves to them, and 89% recalled being given the opportunity to ask questions of the team before the transfer.

The significance of effective communication between the transport team and parents has been highlighted in a study in Australia, by Rowe and Jones (2008). They explored and critiqued current practices used to support parents during transfers. They reported that the negative experiences of the neonatal transport by parents could be changed by providing understandable information in a fashion that allows

for two-way communication. Simple explanations and sensitivity to mothers' cognitive functions, which are often altered by anaesthesia, fatigue and anxiety, should be considered to avoid misconceptions. This is consistent with Williams *et al.*'s (2018) study which showed that effective communication between parents, hospital staff and the transport team could help to enhance the transport experience for parents. Pan (2017) and Teasdale and Hamilton (2008) further supported these findings, suggesting that accurate information about the clinical condition and prognosis of the neonate, be given to parents and that they be given an opportunity to ask questions. Poor communication was noted in the study by Fidler and McGrath (2009), where family members experienced feelings of loss of control and mentioned that they felt as if they were being "left out of the loop" during the transfer of their neonates. They also felt that they did not receive updates and the information that they desired in a timely manner or, in some instances, not at all. A total lack of communication resulted in an abrupt separation from the child when acute transfers were required, resulting in anxiety and confusion for the family.

According to the National Neonatology Forum Clinical Practice Guidelines of India (2011), parents must be provided with clinical and prognostic information and be made aware of the anticipated time frame of the transfer and details of the receiving hospital. This should include the contact details of the NICU along with a specific person to contact. This is in keeping with the Transfer Policy for Neonates, Infants and Children developed by the Western Health and Social Care Trust of Ireland (2015). Fidler and McGrath (2009) highlighted that important information about the neonate is sometimes not discussed with the family, because it is assumed that someone else has discussed it, be it hospital staff or health care providers. These issues demonstrate the importance of clear communication and team coordination in the transfer situation and therefore the need for training is essential. In addition to attending to emotional needs, the mother, must also have her basic medical needs, attended to, particularly if she requires medical intervention (Mosher 2013; Latour *et al* 2010). However, there is only a limited body of research that has focused specifically on the medical needs of the mother during transfer. In South Africa and other developing countries, literature on support for the accompanying family member during the transfer is limited or outdated.

2.5.3 Quality assurance and improvement

Quality assurance and the improvement of neonatal transfer processes are essential for ensuring the safe outcome of a transfer. While the development and review of service policies and procedures must be carried out, adherence to these policies and procedures is key (Bigham and Schwartz 2013). Safety reporting, risk management, morbidity and mortality reviews, professional codes of conduct and uniform codes have also been recommended by Bigham and Schwartz (2013). The American National Consensus Conference of Paediatric and Neonatal Interfacility Transport cited by Stroud *et al.* (2013) recommended continuous monitoring and evaluation of quality assurance and improvement programmes to provide quality neonatal care and meet the programme standards. This is in keeping with Bigham *et al.* (2014), who added that an essential component of a quality assurance and improvement programme is regular audits which include systematic reviews of all transfers. Romanzeira and Sarinho (2014) agreed with this, concluding that quality assurance and improvement programmes allows for comparisons to be made with other similar programmes and also allows for benchmarking processes. Although programmes may not be applicable to a particular context, benchmarking can assist in identifying specific goals that could be adopted and contextualised.

Stroud *et al.* (2013) expressed that evaluating the efficiency and effectiveness of transport teams and systems can be problematic because transported patients vary in terms of illness acuity and complexity. Although neonatal transport is a key component of the continuum of care, there is a lack of suitable instruments to assess care during transport. In developed countries like the UK, the Department of Health Toolkit for High Quality Neonatal Services in 2009 and the updated 2012/2013 publication, the National Service Specification for Neonatal Transfer services, exist to guide neonatal transfers. These documents provide operational guidelines on both public and private ambulance services, allowing for standardised care to ensure the safe transportation of patients through clinical governance (Ratnavel 2013). Standard operating procedures for the transfer of neonates have also been developed by UK counties such as Devon (Northern Devon Healthcare 2017) allowing for the safe transfer of neonates to the appropriate level of care based on their illness. This is also a common occurrence in the USA where the American

Academy of Pediatrics (AAP) is well established in terms of the policies and procedures related to neonatal transfers (Mouskou *et al.* 2015). The latest Guidelines for Air and Ground Transportation of Neonatal and Paediatric Patients Manual were published in 2015, with the first being published in 1986 (American Academy of Pediatrics 2018). These guidelines not only provide tools to guide the transfer but also address aspects of the education of healthcare personnel dealing with transportation, as well as the necessary equipment for optimum transportation and the cost of it. Ethical and legal issues are also addressed and the need for documentation and checklists throughout the transfer process is also highlighted. Research developments are highlighted along with information relating to dealing with stressful cases and how to manage these, as well as the management and support of the patient's family (Mouskou *et al.* 2015).

In developing countries, standardised neonatal care is non-existent (Vincent-Lambert and Wade 2018, Pan 2017, Ashokcoomar and Naidoo, 2016; Sabzehei *et al.* 2016; Kumar *et al.* 2010). The need to develop transfer programmes is essential to reduce the high mortality and morbidity rates noted in countries such as India (Pan 2017; Kumar *et al.* 2010), Iran (Sabzehei *et al.* 2016) and South Africa (Vincent-Lambert and Wade 2018; Ashokcoomar and Naidoo, 2016). The abovementioned studies highlight the adverse events encountered in neonatal transport that are physiological, equipment and human related.

2.5.3.1 Research programmes

The process of neonatal transfers in developed countries such as the UK (Ratnavel 2013, Senthilkumar *et al.* 2011, Lim and Ratnavel 2008), USA (Stroud *et al.* 2013; American Academy of Pediatrics 2012; Miller *et al.* 2008), Canada (Whyte and Jeffries 2015; Bérubé *et al.* 2013) and Australia (Shee and Gleeson 2018) are constantly changing and thus need to be measured and compared. Whyte and Jefferies (2015) added that research is essential to evaluate existing and new transfer systems and programmes, to stay up to date with the current literature, evidence-based medicine and practice, and to develop new programmes in an effort to provide quality healthcare. Research programmes are one of the foundations of good clinical practice, and although patterns of service may vary considerably, data on inter-healthcare facility transfers may pave the way for national and international

standards to improve care in this field. Existing evidence from developed countries, as indicated by Shee and Gleeson (2018), Smith *et al.* (2009) and Miller *et al.* (2008), shows that where programmes have been developed for neonatal transfers, better health outcomes result.

Whyte and Jefferies (2015) and Breathnach and Lane (2017) stated that health research draws on multiple disciplines and adopts a population perspective to produce reliable and valid data for appropriate, cost-effective, efficient and acceptable health services. Kage and Akuma (2012) echoed these sentiments and saying that health research describes and assesses the performance of the healthcare system and its framework for classifying topics and issues. They also stated that this encompasses structure (availability, organisation and financing of health care programmes, population characteristics, and the environment), process (transactions between patients and providers and health risks), as well as intermediate and ultimate outcomes. Healthcare research is crucial for educating and training healthcare professionals and producing new knowledge.

Rogers (2011) argued that EMC worldwide is heterogeneous, but that it is important to note that what might be appropriate in education and training in a developed country may not be appropriate in a developing one. He further stated that the theory–practice gap has existed for many years, and is multifactorial and includes issues such as poor access to literature and evidence, organisational restrictions, lack of critical appraisal skills, lack of resources and individual inability, and an unwillingness to change. Irrespective of the continent, Rogers (2011) asserted that without education, no country can grow and gain respect within the medical community.

In South Africa, a priority exists in the health sciences to improve the quality and scientific power of research. Health sciences have a range of research communities with varying histories, value sets and preferences for their research questions. According to the 2011 National Health Summit (South Africa, Department of Health 2011c), health research is essential as it can improve health outcomes by establishing the effects of healthcare interventions and promoting the development of optimal healthcare programmes, policies and practices. The revitalisation and strengthening of health research is therefore of national importance, in order to

ensure the appropriate use of resources so that they are effectively used to promote health equitably and rationally (South Africa, Department of Health 2010)

Naidoo (2011) indicated that although South Africa has a relatively well-developed EMS system compared to other African countries, there is still much work to be done in EMS research, regarding the quality of service provision, and the education, training, standardisation and professionalisation of emergency medical care and rescue. Healthcare research provides theoretical foundations for any discipline and helps in its development. MacFarlane, Van Loggerenberg and Kloeck (2005) and Thomas (2005) highlighted that EMS research in South Africa is in its infancy compared to other healthcare disciplines. Despite the importance of the pre-hospital scope of practice, there is a paucity of literature in EMS research in South Africa, and that which does exist, focuses on investigations or case studies. There has been a growing interest in inter-healthcare facility transfers in South Africa, with specific reference to neonates. However, much of the research is focused on the criteria for transfer and not the transfer process. South Africa should therefore contextualise its healthcare needs to what works from evidence in practice, as international research findings are not necessarily transferable to its context.

2.6 Chapter summary

The inter-healthcare facility transfer of the critically ill neonate is a complex, tightly connected, multi-phase process. It is extremely risky due to the fragile and vulnerable nature of the neonate. Evidence from several studies presented in this review found that inter-healthcare facility transfers of critically ill neonates carried out by inexperienced staff and non-specialised transport teams, as well the use of inappropriate or malfunctioning equipment, have been associated with adverse events in many incidents. Such transfers also require the preparedness of EMC providers to deal with the family members who accompanies the neonate. Only then can a transfer service achieve clinical excellence. A programme that emerges from evidence-based practice creates an important starting point for making a difference and achieving clinical excellence, as well as improving the quality of care provided to neonates during the transfer process in South Africa and in resource-limited settings.

The transfer processes and organisational structures of an inter-healthcare transfer programme must be addressed. These include communication, personnel, equipment and monitoring. The development of a holistic multidimensional programme for the inter-healthcare facility transfer of critically ill neonates should address all facets of the organisational structures and transfer processes, and detail relevant knowledge, skills and attitudes, as well as the ability to provide basic psychosocial support for the accompanying family member.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methodology used to guide this study, specifically the Developmental Research and Utilization (DR&U) model and the critical realism paradigm. The operationalisation of the steps in the DR&U model are also presented. In this study, the DR&U model, in conjunction with critical realism, was used to develop an appropriate emergency neonatal transfer programme. As an ALS paramedic, the researcher has had extensive experience in critical clinical care and in neonatal transfers in particular. This resulted in a deeper appreciation of the need to understand the experiential challenges involved in providing such care, rather than focusing simply on the technical or procedural aspects.

3.2 The Developmental Research and Utilization Model

The DR&U model, as developed by Edwin Thomas (1981), is a feature of intervention research and provides a scientific and systematic guide for designing, testing, evaluating and refining social technology, and for disseminating empirically based programmes. The model consists of five phases: analysis, development, evaluation, diffusion and adoption. However, it is not necessary for all phases to be implemented. The model provides a framework for the type and order of processes that are needed to be followed, to develop an intervention, with each researcher deciding for themselves what components are relevant for their outcome.

In terms of this model, developmental research (DR) includes the three phases of analysis, development and evaluation, while the two other phases, diffusion and adoption, are termed 'utilisation research' (Thomas 1981). The full sequence in the five phases are referred to as the DR&U model. However, as the primary aim of this study was to develop a programme to guide the transfer of critically ill neonates, only the first three phases were included, namely, analysis, development and evaluation. The researcher's intention is to implement the last two phases after completion of this study.

De Vos *et al* (2012) stated that the concept of intervention research grew from the collaboration between two pioneers in the field of developmental research, Edwin Thomas and Jack Rothman. Although intervention research has expanded and been modified since the 1980s to include intervention knowledge utilisation (KU), intervention design and development (D&D) and intervention knowledge development (KD), its focus is the development of knowledge about an innovative intervention (Rothman and Thomas 1994; McBride 2016). These models belong to the genre of applied research, including pure or basic research and a specific intervention mission. De Vos *et al.* (2012) stated that developmental research is aimed at the development of a technology, or rather a technology item essential to the profession of medicine, nursing, psychology and social work as well as other fields dealing with applied and practical matters. An important common feature of DR is the integrated model of D&D, which contributes to the uniqueness of intervention research.

Developmental research focuses not only on meeting specific demands of the population and addressing complex problems, but also on programme quality relevant to educational practice (Kelly *et al.* 2008; Plomp 2010; Engeström 2011). The use of intervention research, is growing in health sciences with the purpose of producing knowledge on treatment, services, programmes or strategies intended to promote or improve health (Smith 2014; Hansen 2016; Ebbels 2017). Consequently, reports on intervention or developmental research are lengthy, often prohibiting publication of the full study. However, such reports can often be found in doctoral theses indicating the use of the framework. In South Africa, intervention research has been used in doctoral studies by Bhagwan (2002), Herbst (2002), Strydom (2002) and Drenth (2008).

In order to best achieve the aim of the study, i.e to develop an inter-healthcare facility transfer programme for critically ill neonates, the use of the DR&U model to design and develop the intervention was deemed most suitable. The researcher chose this framework because it flowed with designing and developing the intervention relevant for practice. Developmental research is conducted iteratively with the collaboration of researchers and practitioners in a real-world setting, and follows a holistic approach that does not emphasise isolated variables. It integrates

state-of-the-art knowledge from prior research and follows an iterative, stepwise design process (Plomp 2010).

Each phase of the developmental model has two areas that guide the development of the desired outcomes, these being material conditions and operational steps. The material conditions establish the real-world outcomes that need to be addressed, while the operational sequential steps describe the execution of the process. The model provides guidelines in terms of the completion of the phases. However, in instances where difficulties are encountered or new information is obtained, it allows the researcher to loop back to earlier phases or steps. The first three phases of the model (analysis, development and evaluation) and any revision activities are iterated until a satisfying balance between the ideas (the intended) and realisation has been reached (Thomas 1981). The phases, material conditions and operational steps are represented in Table 3.1.

Table 3.1: Phases, material conditions and operational steps of the DR&U model (Adapted from Thomas 1981)

Phases	Material Conditions	Operational Steps of the DR and U Model
1. Analysis	A. Problematic human condition B. State of existing technology C. Technological information & resources	1. Problem analysis and identification 2. State-of-the-art review 3. Conduct feasibility study 4. Select technological resource 5. Select information resource
2. Development	D. Relevant data E. Material design of social technology F. New product	6. Gather & evaluate technological resources 7. Design of social technology 8. Technological realisation
3. Evaluation	J. Trial and field implementation K. Outcome & use	9. Trial use 10. Collect evaluation data 11. Evaluate social technology 12. Redesign as necessary & repeat steps 6-12
4. Diffusion	L. Diffusion media	13. Prepare for diffusion media 14. Disseminate product information
5. Adoption	M. Broad use	15. Implementation by user

3.2.1 Phase 1: Analysis

This stage consists of three material conditions, namely, problematic human condition, state of existing technology and technological information and resources.

The findings from this stage determined whether the second development phase would occur and the direction it took.

Step 1: Problem analysis and identification

In order to develop a programme, or for any developmental activity to occur, a problematic human condition must be shown to exist. In addition, interventions that are found to be non-existent or somehow deficient nationally and internationally also allow for interventional innovation (Rothman and Thomas 1994; McBride 2016). In this phase, the problems experienced during the inter-healthcare facility transfers of critically ill neonates in South Africa were identified to establish whether they were important enough to warrant the development of a transfer programme. This was accompanied by a review of the literature to identify the nature and extent of adverse events that have occurred during the transfer process in the country and the rest of the world. This research was enabled by the researcher's personal experiences of working as an ALS paramedic and being the Principal of the College of Emergency Care and overseeing emergency medical care and rescue efforts, the MDG4 and SDG3, and the pertinent South African legislative prescripts for the health sector.

Step 2: State-of-the-art review

Plomp (2010) indicated that based on the analysis of the problem, relevant state-of-the-art reviews are used to understand what is happening locally and internationally to address similar problems. Without a critical review of the state of existing information, human, material and technological resources or interventions, the development of the programme cannot be charted. The purpose of this review was to determine what relevant interventions exist throughout the world, their strengths and limitations, and whether further development or modifications are required to address the identified problem. Rothman and Thomas (1994) noted that the review and appraisal of existing technology may include relevant literature, and having discussions with knowledgeable informants or attendance at conferences and workshops where new developments are presented.

Step 3: Conduct feasibility study

In this step, existing information, resources and technology within the context being considered, is used to determine whether the developmental effort is technologically feasible. Sufficient technological data and resources must be in place to justify the developmental effort (Rothman and Thomas 1994; McBride 2016). The processes engaged in during the first and second operational steps of the current study indicated that sufficient technological data, as well as human and material resources, existed to guide and support the development of a transfer programme.

Step 4: Select technological resource

This step requires the technological components that are related to the new social technology to be developed, which entails establishing human and material resources. For the purposes of this study, this consisted of team dynamics, management structures, intensive care neonatal transfer equipment and ground and air ambulances.

Step 5: Select information resource

This step entailed selecting the information resources needed to develop the desired output. These can be derived from a variety of sources (Thomas 1985), specifically by establishing what others have done to address similar problems. Knowledge acquisition requires the identification and selection of relevant sources of information about what and how to apply and integrate relevant information. Information resources used in this study consisted of individual interviews, focus group discussions and a questionnaire with the participants to obtain primary data, as well as written text as a secondary source.

3.2.2 Phase 2: Developmental

Thomas (1981) stated that this phase is central to the developmental research model, as it is during this phase that the interventional innovation is created through a series of operational steps, with data being transformed and shaped into a new product. This phase consists of three steps (steps 6–8):

Step 6: Gather and evaluate technological resources

This step entailed nine potentially relevant sources that constitute the basic raw material used in the formulation of an intervention design. These consist of basic and applied research, scientific and allied technology, legal policy, programmes, indigenous information, practice experience, and personal and professional experience (Thomas 1984). In this study, basic and applied research, knowledge from relevant stakeholders, as well as state-of-the art reviews of inter-healthcare facility transfers of critically ill neonates, served as the main sources of information for the innovation. The personal and professional experiences of the researcher also served to guide the design of the innovation.

Step 7: Design social technology

This step entailed designing the intervention. According to Thomas (1984), the following activities are involved in the design process: determining the objective of the innovation; identifying the requirements of the innovation; selecting information sources; gathering and processing the information; assembling the design components; and describing how the innovation might be used. The intervention contains a rationale for the programme, and specifies the knowledge and skills required by ALS paramedics, as well as the appropriate structures, processes and programme objectives. The process of assembling the design components included identifying the core modules for the programme and building relevant material into each.

Step 8: Technological realisation

Technological realisation is the final step in the developmental phase and involves developing the interventional innovation programme, based on the outcome of the findings. It entailed taking the technological resources from step 6 and the design from step 7 to establish the most suitable method for presenting the innovation programme. The technological realisation was presented as a programme for inter-healthcare facility transfers of critically ill neonates in the South African context.

3.3.3 Phase 3: Evaluation

The evaluation phase of the DR&U model requires the intervention that has been developed to be evaluated for relevance by relevant stakeholders and to be revised if necessary (Thomas and Rothman 1994).

Step 9 and 10: Trial use and collection of evaluation data

Thomas and Rothman (1994) wrote that trial use of the interventional innovation follows its development and enables the collection of data in an appropriate setting to establish whether it achieves the objectives it is required to meet. Cozby (2009) noted that a pilot test determines whether the intervention will work and identifies elements of the programme that may need revision. When access to real settings is difficult, researchers sometimes test prototypes in analogous situations and undertake a programme assessment theory evaluation. This involves the collaboration of researchers, service providers and prospective clients of the programme in order to determine the purpose of the intended programme.

It was not the intention of this study to pilot the intervention, as this was beyond the scope of the current study. However, the programme was appraised by a group of clinical and academic experts in its relevant field.

Step 11 and 12: Evaluation of social technology and redesigning as necessary

These two steps entail the evaluation of the social technology and redesigning the programme. Evaluation allows for appraisal of the innovation in terms of criteria such as achieving the objectives, its efficiency and effectiveness, and its costs and benefits (Thomas 1981). A group of experts in the field of healthcare involved in inter-facility transfers of critically ill neonates evaluated the overall programme for relevance, strengths and weaknesses, content and intervention (Cozby 2009). Thomas (1981) noted that if indicated, it may be necessary to revise the innovation, repeat the trial use, collect new data, evaluate the data and reappraise the revised product. Only when the evaluation process has been completed and the innovation deemed to be acceptable can the programme be endorsed and disseminated.

3.3 Critical realism paradigm

Critical realism was also drawn upon on as a guiding paradigm. Asking the right questions about reality is fundamental to the credibility of the research (Clark, Lissel and Davis 2008). Critical realism was used to explore the nature of reality (ontology) and how to gain knowledge of it (epistemology) in this study. Easton (2010) wrote that critical realism assumes a stratified ontology, a constructionist epistemology and a generally emancipatory axiology. It involves the process of thoughtful in-depth research, with the objective of understanding why structures and processes exist in the shape and form they do. Its strength as a research paradigm has resulted in it being used in many disciplines, such as economics (Moura 2008), sociology (Fletcher 2016), criminology (Edwards 2015), linguistics (Wright 2010), religious studies (Gironi 2012), psychiatry (Pilgrim 2014), social work (Craig 2015), management (Fox 2008) and health (Angus 2012 and Walsh 2014). Fletcher (2016) stated that there are numerous views and approaches to critical realism, whilst Roberts (2014) argued that it is relatively tolerant of and compatible with a wider range of research methods than positivism and interpretivism. Therefore, the selection of critical realism added an extra dimension to the research process and steered the path for the transformation work, that is, the development of a programme – a locally relevant programme for critically ill neonatal transfer.

Aliyu (2014) stated that a positivist paradigm focuses exclusively on observable events and fails to take full account of the extent to which these observations are influenced. Positivism also deals with relationships between the various elements of social systems in isolation but fails to take account of the interactions between mechanisms and the contexts in which they occur. According to Yanow (2011), interpretivism focuses on discourse, human perception and motivation, as human reasons can serve as causal explanations. However, Willis (2007) argued that interpretivism fails to relate discourses to the underlying social structures that may enable or constrain the actions of individuals or to the social networks in which social actors are embedded. Morehouse (2011) emphasised that participants may be partial or even misguided under this paradigm.

This is in contrast to critical realists, who contend that reality exists independent of human conception and that there are unobservable events that cause the observable

ones such as the social world. These can only be understood if people understand the structures that generate such unobservable events (Fletcher 2016). Therefore, unlike the traditional positivist and interpretivist mode of inquiry, critical realism critiques existing social structures and envisages new possibilities by addressing the empirical level effectively. These factors reinforced the application of critical realism for exploring the experiences of ALS paramedics, EMC lecturers and neonatologists who are the experts in neonatal transfers, as well as the experiences of the accompanying mothers during the transfer. This ensured that information was obtained from appropriate, information-rich sources, within the socially structured and process content, aimed at developing a programme for inter-healthcare facility transfer of critically ill neonates in the South African context.

Critical realists argued that the real world operates as a multidimensional open system instead of following a set order. Consequences arise as a result of the interaction between social structures, mechanisms and human agency and are a result of the tendencies that are produced by underlying social structures and mechanisms instead of empirical generalisations (Fletcher 2016). This is underpinned by the logic referred to as retrodiction, which Olsen and Morgan (2004: 10) defined as “a mode of analysis in which events are studied with respect to what may have, must have, or could have caused them”. From a critical realist perspective, this means asking “why events happened the way they did”, with explanations always being potentially open to revision. Accepted theories may be rejected if alternative theories are better able to explain phenomena and generate theoretical implications that are actually realised, with the process likely to be iterative (Sayer 2011).

Critical realism implies that the particular choice of research method should depend on the nature of the object of study and what one wants to learn about it (Bhaskar 1978). The four components of critical realism, as they relate to this study, are further reviewed: stratified ontology (nature of reality), constructivist epistemology (the relationship of the researcher to the phenomenon being researched), axiology (role of values) and methodology (the research process).

3.3.1 Stratified ontology

Walsh (2014) said that the ontological assumption of critical realism is that there exists a reality 'out there' independent of observers. The strata, or modes of reality, are distinguished between three domains of (a) the **empirical** events that can be captured and recorded (what can be observed/can be captured or recorded), (b) the **actual** events that are created by the real world (what is known but cannot always be seen) and (c) the **real** world (the hidden but necessary precondition for the actual and empirical). Given the importance of ontology, critical realism shows ontological appropriateness.

Critical realists argued that the real world has entities (organisations, people, relationships, attitudes, resources, inventions and processes) which have the power to act and are liable to be acted upon by others. These 'entities' can also have internal structures, such as departments and individuals, who in turn have their own powers. Entities have relationships that form the basis of their individual and relative powers. The relationship among entities that is thought to cause **empirical** events (first domain) is called a mechanism (way in which entities act and cause particular events).

The application of the three ontological domains to inter-healthcare facility transfers for critically ill neonates in South Africa is illustrated using the tree representation.

- I. The '**empirical level**' is the first and most superficial domain which consists of what can be observed or experienced, for example the leaves and branches. This domain includes observable experiences (those aspects of reality that can be experienced either directly or indirectly or what can be observed and captured). At this level, **adverse events** (physiological, equipment and/or human) during the transfers of critically ill neonates were observed in the analysis phase.
- II. The '**actual level**' lies beneath the empirical level. It shows what is going on that may not be observed, but regulates the empirical level, for example a tree trunk obscured by a wall. This domain includes events that have been generated by mechanisms (those aspects of reality that occur but may not be experienced, or what is known but cannot be seen, factors that regulate the

empirical). Having an ALS paramedic with advanced education and training to deal with critically ill neonatal transfers may not address the theory–practice inconsistencies if it is not supported by appropriate organisational structures and transfer processes.

- III. Finally, beneath the actual level is a final '**real level**' layer. This level includes the unseen mechanisms, as they are not open to observation, that underpin the actual events (hidden mechanisms that generate phenomena for the actual and empirical that are not fully explanatory). The lack of an inter-healthcare facility transfer programme for critically ill neonates formed the precondition for the actual (inappropriate organisational structures and transfer processes) and empirical (adverse events).

Figure 3.1 illustrates the tree representation of the ontological domains of real, actual and empirical levels, as applied to the inter-healthcare facility transfers for critically ill neonates in South Africa.

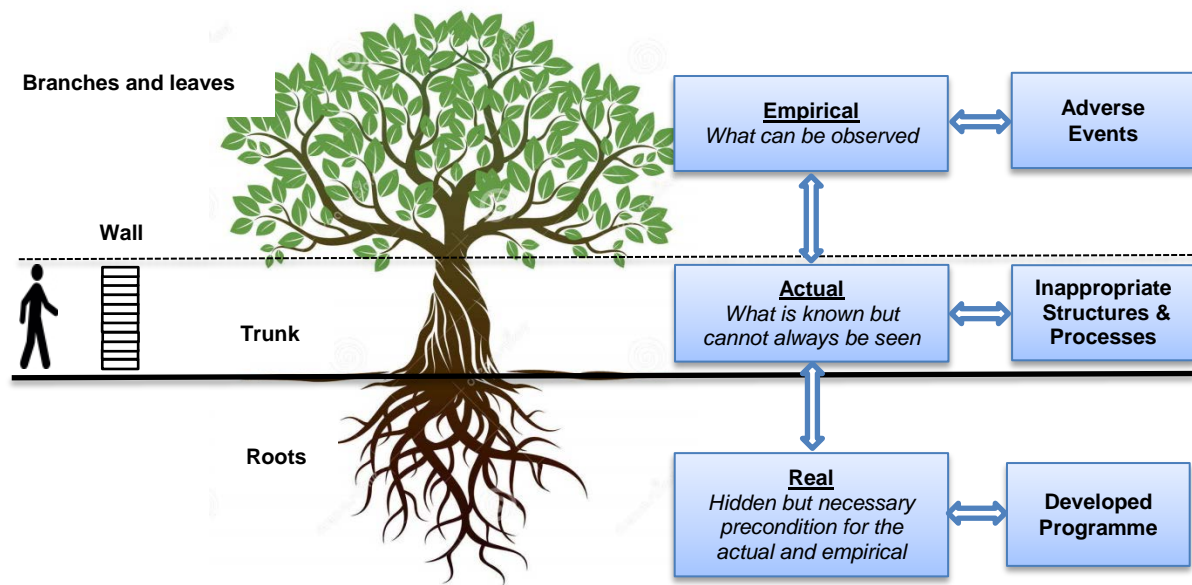


Figure 3.1: Tree diagram of the three ontological domains
Adapted from Bhaskar (1975) and Walsh and Evans (2014)

3.3.2 Constructionist epistemology

Bhaskar (1978) suggests that critical realism has a stratified rather than a flat ontology, which has major epistemological implications (e.g. for the relationship of the researcher and the phenomenon being researched). In new research, knowledge of the stratified layers of reality is always partial, incomplete and revisable. Easton (2010) asserted that the reason for this is that generative mechanisms (how entities affect events) are never fully explanatory, and that interpretive lenses (our interpretation of events) filter information as we receive and respond to it. An interpretive lens operates at individual and social levels, and is therefore influenced by a variety of factors. Knowledge is literally constructed as the complexity of phenomena is discovered and uncovered, which results in people who have or observe the same experience relating it differently.

Critical realism uses multiple perceptions on a single reality, and allows a researcher to use outside reality, based on what they want to find out about the predetermined event. In this study state-of-the-art reviews, contributed to the inter-disciplinary approach, to obtaining relevant information about the three domains, and consisted

of the ALS paramedics, EMC lecturers, neonatologists and accompanying mothers to provide the required multidimensional perspective. This inter-disciplinary approach was intended to increase the understanding of the inter-healthcare facility transfer of critically ill neonates so as to develop a holistic programme that either prevents adverse events or is able to address them as they occur. The views contributed by the ALS paramedics and EMC lecturers are within the EMC scope of practice and the state-of-the-art reviews, while the accompanying mothers and neonatologists are outside realities.

3.3.3 Axiology

Sayer (2011) referred to axiology as values or morals that underpin the research endeavour. The ontological and epistemological positions discussed in the previous subsections shaped the decision-making processes of the research, which was premised on the effective transfer of critically ill neonates. Maxwell (2012) wrote that Bhaskar's conception of critical realism sought to enhance human freedom by exposing the generative mechanisms (social structures) that may be oppressive or controlling of individuals and groups.

3.3.4 Methodology

Critical realism believes that there is a 'real' world to discover even though it is only imperfectly apprehensible, largely autonomous and created by us (Walsh and Evans 2014). Critical realism is subjective, with participants being studied because they provide a window onto a reality beyond perceptions, being a relevant paradigm for many qualitative researchers. It relies on multiple perceptions about a single reality to get a deeper level of explanation and understanding. Data is collected from in-depth information research tools with probing questions being asked to enable participants to unpack their experiences. Critical realism allows the use of both quantitative or qualitative research approaches, with the former being used to establish the nature and extent of the problem and the latter to meet the requirement of critical realism.

3.4 Chapter summary

The DR&U model provided order and systematically brought together all relevant components to develop the intervention. In so doing, it highlighted predetermined steps, each designed to achieve a specific purpose towards achieving the study aim. Within this framework, the critical realism paradigm guided the data collection to ensure that the information obtained, analysed and utilised during the various steps was of sufficient substance to achieve the aim, namely, to develop a locally relevant programme. Each phase was responsibly executed to ensure that it provided an appropriate platform for the next phase. This conceptual framework offered insights and the deeper level of understanding that was necessary to develop the desired intervention.

CHAPTER 4

RESEARCH METHODOLOGY CONTINUED

4.1 Introduction

In this chapter the phases of the developmental model are outlined, and the study population and sampling strategy used are described. This is followed by a discussion of the data collection instruments and processes applied, as well as the analytical methods applied. The chapter concludes with a review of reliability and validity issues that were addressed, as well as the ethical considerations taken into account. The objectives, the samples used and the phases around which this chapter is structured are detailed in Table 4.1.

Table 4.1: The objectives, samples used and phases of the study

	Objectives	Samples	Phase
1	To analyse the current inter-healthcare facility transfer of critically ill neonates in KwaZulu-Natal	a. ALS paramedics <i>Preliminary analysis of the transfers over 1 month</i> b. ALS paramedics <i>8 Individual interviews</i> c. Accompanying mothers <i>7 Individual interviews</i>	1
2	To investigate the state-of-the-art practice that guides the transfer of critically ill neonates	Literature review and best practices	
3	To explore the views of ALS paramedics, family members, neonatologists and EMC lecturers with regard to all aspects that need to be operationalised in a programme that will guide the inter-healthcare facility transfer of critically ill neonates in South Africa.	c. Accompanying mothers <i>From phase 1</i> d. Operational ALS paramedic <i>4 Focus group discussion</i> e. EMC lecturers <i>3 Focus group discussion</i> f. Neonatologist <i>7 Individual interviews</i>	2
4	To develop a programme that will enhance the EMC profession's ability to deal with the multidimensional issues facing inter-healthcare facility transfer of critically ill neonates in South Africa.	Draft programme (framework)	
5	To evaluate the newly developed programme in inter-healthcare facility transfer of critically ill neonates.	g. Group of experts <i>1 Focus group discussion</i> Developed programme	3

4.2 Study design

A qualitative research approach was applied to collect data and to generate the new intervention. The data collections methods included individual in-depth interviews and focus group discussions. In addition, a preliminary analysis was conducted, as the starting point of the study in order obtain an overview of the context. For this purpose, a quantitative designed questionnaire was used to obtain data that would provide a clear idea of the transfer dynamics.

4.2.1 Population

Purposive sampling was used to recruit participants who were knowledgeable and informative (information-rich participants) to address the research problem and achieve the aim of the study. This was deemed to be the most appropriate method as it enabled the researcher to select experts involved in inter-healthcare facility transfer of neonates (ALS paramedics, EMC lecturers and neonatologist) and specific individuals (accompanying mothers) to inform the study. Table 4.2 shows the samples used in the three phases.

Table 4.2: Study samples used in the three phases

Samples used	Description of the samples
Phase 1. Analysis	
Site: KwaZulu-Natal	
a: ALS paramedics <i>Preliminary analysis</i>	ALS paramedics who undertook the transfer during the preliminary analysis over a period of 1 month, from 1 to 31 December 2015.
b: ALS paramedics <i>8 Individual interviews</i>	Selected ALS paramedics from the preliminary analysis from urban and rural, private and public, and ground and aeromedical ambulances.
c: Accompanying mothers <i>7 Individual interviews</i>	Mothers who accompanied the neonate during the transfer in the preliminary analysis
Phase 2. Development	
Site: South Africa	
d: ALS paramedics <i>4 Focus group discussions</i>	Operational ALS paramedics who were actively involved in transferring critically ill neonates
e: EMC lecturers <i>3 Focus group discussions</i>	Lecturers who were actively involved in EMC lectures
f: Neonatologists <i>7 Individual interviews</i>	Experts specialising in neonatology in the public health sector
Phase 3. Evaluation	
Site: South Africa	
g: Group of experts <i>1 Focus group discussion</i>	Operational ALS paramedics, EMC lecturers and neonatologist

4.2.2 Data collection tools used

The tools used for the semi-structured interviews and focus group discussions (FGD) were designed to address the organisational structure and transfer processes involved in the inter-healthcare facility transfer of neonates. The semi-structured interview technique was chosen in order to explore the participants' beliefs, views and experiences of the transfer. The interview schedules were flexible owing to their semi-structured nature and this allowed clarity to be provided where participants did not understand questions and an opportunity to probe for more information when needed. The tools were adapted, from the work of a few researchers (Ratnavel 2013; Stroud, Trautman and Meyer 2013; Fendya et al. 2011; Messner 2011; Kage and Akuma 2012; Jackson and Skeoch 2009; Miller et al. 2008; Horowitz and Rozenfeld 2007). By bringing together participants who shared a similar background and interest in the study, the FGD created opportunities for participants to engage in a meaningful conversation and generate active exchanges to develop this programme. Individual in-depth interviews were held where focus group discussions were not possible.

4.2.3 Thematic analysis

Thematic analysis was used to analyse the qualitative data gathered during the study. The following phases describe the process applied to the individual interviews and focus group discussions.

Phase 1: Familiarise yourself with the data. The audio files obtained from all interviews using a voice recorder, were actively transcribed verbatim by the researcher to enable the thematic analysis to be done. Once the transcriptions were completed, the researcher checked them against the original voice recordings for accuracy. Thereafter, the researcher spent time reading through the data carefully in its entirety to familiarise himself with it and to note down initial ideas.

Phase 2: Generate initial codes. The researcher generated an initial list of ideas about what was in the data and what was interesting about the contents. Codes were then generated to categorise the data. Categorising entailed a process of organising the data using words, short phrases or segments that were similar in important ways.

Phase 3: Search for themes. This phase began once the data had been coded and a long list of the different codes identified across the data set. This phase re-focused the analysis at the broader level of themes, with some codes forming sub-themes or miscellaneous categories with no data being rejected.

Phase 4: Review themes. Phase 4 involved two levels of reviewing and refining the themes. In the first level, it became clear as follows: i) which of the initial themes were not really themes (e.g. if there are not enough data to support them), or the data was too diverse, ii) which themes cohered together meaningfully (e.g. two apparently separate themes might form one theme) and iii) which themes should be broken down into separate themes. Once the researcher was satisfied that the themes appeared to cluster meaningfully, and that they captured clear and identifiable distinctions, the researcher moved on to the next level of refinement.

The second level involved a similar process but in relation to the entire data set. This level of refinement had two purposes: i) to establish whether the theme map accurately reflected the meanings evident in the whole data set, and ii) to code any additional data that was overlooked in earlier coding stages.

Phase 5: Define and name themes. After the themes had been refined, and the researcher was satisfied with the theme map of the data, he returned to the collated data extracts associated with each one and identified their essence. A detailed analysis for each theme was conducted and included as follows: i) the story that each theme tells, ii) how it fits into the broader overall story about the data, and iii) whether it contains sub-themes. At the end of this phase, the researcher clearly defined what were and were not themes. The themes were given working titles that were concise and gave a sense of their content.

Phase 6: Produce the report. Phase 6 involved the final analysis and write-up of the report, which explained the story of the data in a way that convinces the reader of the merit and validity of the analysis. By selecting relevant examples or extracts that capture the essence of what is described, it contained sufficient evidence from the themes to demonstrate their prevalence. However, extracts entailed more than a mere description of write-ups, and were embedded within an analytic narrative that

illustrates the story about the data. The findings were reported in the narrative writing style with direct quotations from the data.

The relationship between the three phases and the five objectives are indicated in Figure 4.1. The figure also indicates which methods were used and the size of the samples. The first phase of analysis consisted of a thorough context and problem analysis of the inter-healthcare facility transfer of critically ill neonates and a review of existing state-of-the-art practices. The second phase enabled the development of a programme in a stepwise iterative fashion, using multiple perceptions of implicit and explicit realities. The final phase appraised the programme that had been developed to establish to what extent it would address the originally identified problem. The programme was subsequently evaluated by experts who were able to appraise not only the structures and processes, but also the human and psychological processes that emerge during these transfers.

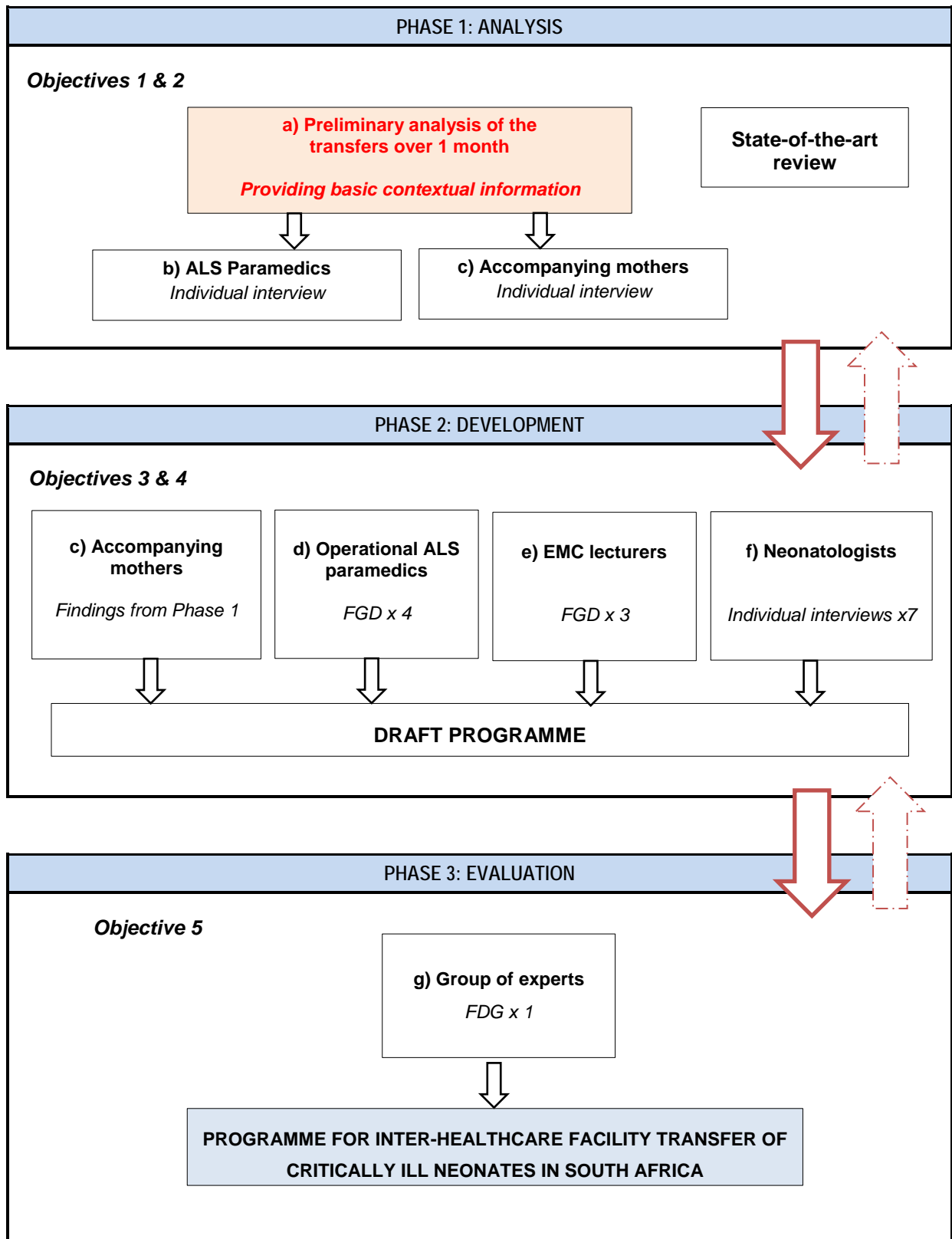


Figure 4.1: The objectives, participants and methods for the three phases of the DRU model.

The association between developmental research, critical realism and the qualitative methodology is presented in Table 4.3.

Table 4.3: Association between developmental research, critical realism and qualitative research methodology

Element	Developmental research	Critical realism	Qualitative method
Ontology	<ul style="list-style-type: none"> To develop an intervention <i>(to address real-life issues in South Africa)</i> Holistic approach <i>(human and material resources, structures and processes)</i> 	<ul style="list-style-type: none"> Ontological appropriateness <i>(empirical, actual and real)</i> Entities and generative mechanisms <i>(people, structures, processes, organisation & resources)</i> 	<ul style="list-style-type: none"> Individual in-depth interviews Focus group discussions Semi-structured interviews Schedule & probing questions Intangible reality
Epistemology	<ul style="list-style-type: none"> Construct a programme using phases in a step wise fashion <i>(Analysis, Development and Evaluation)</i> Iterative process <i>(until a satisfying balance between ideas and realisation is reached)</i> Multiple perspectives <i>(ALS paramedics, EMC lecturer, neonatologist and accompanying mothers)</i> State-of-the-art-reviews 	<ul style="list-style-type: none"> Constructionist epistemology Stratified ontology <i>(to get a deeper level of understanding)</i> Multiple perceptions Implicit (inside reality) <i>(ALS paramedics, EMC lecturer)</i> Explicit (outside reality) <i>(neonatologist, accompanying mothers and state-of-the-art-reviews)</i> 	<ul style="list-style-type: none"> Knowledge is constructed via social interaction and understanding Triangulate data
Axiology	<ul style="list-style-type: none"> Aims to attain better health outcomes, values & morals to relieve human suffering 	<ul style="list-style-type: none"> Shapes decision-making processes & exposes generative mechanisms 	<ul style="list-style-type: none"> In-depth fieldwork Trustworthiness Construct validity Analytic generalisation <i>(thematic analysis: develop rather than just theory testing)</i> Interpretation on meaning

4.3 Phase 1. Analysis

The analysis phase consisted of two objectives, the first being an attempt to understand what occurs during a neonate transfer and the second a state-of the-art review (Table 4.4). This phase began with a preliminary analysis using a

questionnaire to source baseline information and an overview of the context, structures and processes for the inter-healthcare facility transfer of critically ill neonates. This was followed by individual semi-structured interviews with ALS paramedics who undertook such transfers, and with family members, specifically the mothers, who accompanied their neonates. The state-of-the-art review (objective 2) was conducted simultaneously with the activities of objective 1 and throughout the study. The intention was to provide local and international perspectives on best practices. These perspectives were needed to inform the new programme and to establish the suitability of current practices. Both objectives were required to feed into phase 2, namely, the developmental phase.

Table 4.4 Objectives and methods for phase 1: Analysis

Objectives		Methods
1	To analyse the current inter-healthcare facility transfer of critically ill neonates in KwaZulu-Natal	a. Preliminary analysis of the transfers over 1 month (39 transfers)
		b. Operational ALS paramedics (8 individual interviews)
		c. Accompanying mothers (7 individual interviews)
2	To investigate the state-of-the-art practice that guides the transfer of critically ill neonates	Literature review & best practices

4.3.1 Objective 1

To analyse the current inter-healthcare facility transfer of critically ill neonates in KwaZulu-Natal

Objective 1 consisted of three components, the first being a preliminary analysis of the transfers of critically ill neonates over one month. A questionnaire was used to analyse the transfers conducted by the ALS paramedics during the period 1 to 31 December 2015 in KwaZulu-Natal (KZN). This was to provide an overview and describe the context of the transfer. This preliminary analysis also allowed the researcher to purposefully select the participants for the analysis phase and establish a rapport with them.

This was followed by holding in-depth interviews with the ALS paramedics and accompanying mothers to provide insight into their experiences and gather their

views regarding the transfer. The study area for this phase was the province of KZN. This context is described in the following section. The data collection methods are then explained. By addressing this objective an understanding of the context was obtained and an analysis of the problem in relation to the inter-healthcare facility transfer of critically ill neonates was conducted. This also provided an understanding of the associated organisational structures, transfer processes and outcomes.

4.3.1.1 Study area and sample

Phase 1 of the study area involved the 11 health districts of KZN. This context was considered suitable as it comprises both urban and rural areas, a network of district hospitals, as well as air and ground transfer facilities, both public and private, which could reflect other geographical regions. The sample consisted of ALS paramedics who had undertaken emergency neonate transfers, during the month of December 2015 and the mothers who had accompanied them. The samples for the three data collection exercises for this objective are described below.

Table 4.5: Study samples used in phase 1

Samples	Description of the samples	Site
a: Preliminary analysis	ALS paramedics who undertook transfers over a period of 1 month, from 1 to 31 December 2015.	KwaZulu-Natal
b: ALS paramedics <i>8 individual interviews</i>	Selected ALS paramedics from the preliminary analysis from urban/rural, public/private, & ground/aeromedical ambulances.	
c: Accompanying mothers <i>7 individual interviews</i>	Mothers who accompanied the neonate during the transfer in the preliminary phase.	

a. Preliminary analysis of the transfer

The sample used for the preliminary analysis of the transfer questionnaire comprised the ALS paramedics. These consisted of the pre-hospital specialist and transfer team leaders from the public sector and one private EMS in KZN (Table 4.6).

Table 4.6: Criteria for transfers to be included in the preliminary analysis

Inclusion criteria for transfer events	Exclusion criteria for transfer events
<ul style="list-style-type: none"> Critically ill inter-healthcare facility neonatal transfer events (infants no older than 28 days). Manned by ALS qualified as Critical Care Assistants, National Diploma in Emergency Medical Care and Emergency Care Practitioners. Manned by ALS paramedics in public EMS and one major private EMS (Netcare) services. 	<ul style="list-style-type: none"> Transfers where the infants were older than 28 days. Manned by Emergency Care Technicians; this was because of their limited skills in this scope of practice for transferring critically ill neonates. The second major public EMS did not consent to participate and was therefore excluded. Three transfers were excluded as two neonates were too unstable for transfer which was thus cancelled, and one neonate died before the paramedic arrived at the referring hospital.

b. ALS paramedics

Selected ALS paramedics who completed the preliminary analysis were invited to participate in individual in-depth interviews to provide additional information as well as descriptive details about issues that arose from the data gleaned from the preliminary analysis of the transfers. Using purposive sampling, ALS paramedics were selected from various context, for example rural and urban, ground and air, and private and public ambulance services in KZN (Table 4.7). This sampling frame was selected in order to analyse the transfer process from all angles of EMS. Participants were selected and interviewed until common themes emerged and data saturation was reached. This occurred after eight paramedics had been interviewed.

Table 4.7: Inclusion and exclusion criteria for the ALS paramedics

Inclusion criteria	Exclusion criteria
ALS paramedics who had completed the preliminary analysis and were willing to participate in an individual interview.	ALS paramedics who participated in the situational analysis but did not accept the invitation to an individual interview.

c. Accompanying mothers

Once the preliminary analysis was completed, the family members who had accompanied the neonates during the transfer were identified to participate in in-depth interviews. All the participants who had accompanied neonates were mothers and they had used the public sector transfer EMS (Table 4.8). The mothers were interviewed after their baby had been discharged from hospital and when they felt comfortable about participating in an interview.

Table 4.8: Inclusion and exclusion criteria for the accompanying mothers

Inclusion criteria	Exclusion criteria
Only the family members who accompanied the neonate during the transfers in the preliminary analysis were included. All the family members were mothers, hence the use of the term 'mothers' in this study.	Families where the neonate had died during or after the transfer were excluded for ethical reasons. The type of information required for this sample could also be sourced from participants who had not experienced a neonatal death during or after the transfer. No neonatal deaths occurred during the study period.

4.3.1.2 Data collection tools

Three data collection tools were designed for this phase. The first was a questionnaire with close-ended questions, which investigated issues related to the transfers. This was followed by in-depth interviews. The first was conducted with eight paramedics (sample b) and the second with seven accompanying mothers (sample c).

a. Preliminary analysis

An English language questionnaire was used as the data collection instrument for the preliminary analysis. The questionnaire (Annexure 7) consisted of questions regarding the organisational structures and transfer processes. The options presented enabled a descriptive analysis of the transfer issues.

The design of the questionnaire was informed by the literature reviews, experts' opinions, and the researcher's experience with transfers of critically ill neonates. A pilot study was conducted on 18 September 2015 at the College of Emergency Care, McCord Hospital Campus in the eThekweni Health District in KZN. Seven ALS paramedics and six EMC lecturers were asked to comment on the length, structure, content and wording of the tool, which took approximately 10 minutes to complete. The participants were generally satisfied with its content and layout and made a few amendments. These suggestions were adopted for the final version. The questionnaire was also adapted from the questionnaire used in the researcher's EMC Masters study, which showed good validity and reliability. The participants and data from the pilot study were excluded from the main study.

b. ALS paramedics interviews

An semi-structured interview schedule was used to collect data from sample b. The interview schedule was developed by the researcher to enable him to understand the ALS paramedics' experiences of the transfer of critically ill neonates (see Annexure 17). To obtain data from these paramedics regarding their experiences during transfers, semi-structured in-depth face-to-face interviews were conducted. The interview schedule used consisted of questions that focused on

- i. their thoughts regarding the current inter-healthcare facility transfer
- ii. the challenges experienced during the transfer
- iii. the current processes in the five stages
- iv. their education and training preparedness and recommendations
- v. the accompanying family member.

The interview was important to gathering relevant information to develop the programme. The questions were worded so as to address the issues identified through the researcher's experience, the literature and state-of-the-art reviews, and preliminary analyses. The interview schedule was appraised by the researchers supervisors, paramedic researchers from Durban University of Technology (DUT) with modifications being made as necessary.

Probing allowed the researcher to identify and clarify any relevant issues raised by the participants, and helped them to recall information. It also enhanced the interaction between the researcher and participant, broke down any personal barriers, reduced tension and encouraged respondents to express their thoughts freely and spontaneously.

c. Accompanying mothers

To obtain data from the accompanying mothers regarding their experience during transfers, face-to-face interviews were conducted (Annexure 20). The semi-structured interview schedule contained a number of main and probing questions related to

- I. their personal transfer experiences: communication, medical needs

- II. their experience with the clinical team
- III. difficulties they experienced
- IV. their recommendations.

4.3.1.3 Data collection process

The data collection processes for the three tools described above are presented below. The specifics for each group of participants are described. Data was first collected from the preliminary analysis, as this provided the situational background for the two other tools to be developed, after which the ALS paramedic interviews were conducted, followed by those of the accompanying mothers.

a. Preliminary analysis

The KZN provincial and private EMS head offices provided the researcher with the ALS paramedics contact details. To ensure that the participants were aware of the study, the researcher made presentations at the KZN provincial ALS forums which were held monthly at the College of Emergency Care (COEC) in KZN. The researcher contacted each paramedic telephonically or email advising them about the nature of the study, and indicated that it was only for those who had participated in neonatal transfers during December 2015. The questionnaire was sent to all participants via email, post or fax or were hand delivered. They were accompanied by a copy of the letter granting ethical approval, gatekeeper approvals and permission letters to the relevant EMS in KZN informing them about study, its requirements and date of commencement. Attached to the questionnaire was an information letter and a consent form that they were required to sign and send back to the researcher before participating in the study (Annexure 6). Participants were requested to complete and return the questionnaire to the researcher via e-mail or post or hand collection.

Once a transfer had been accepted by the EMS communication centres during December 2015, the communication officer on duty at the time of the transfer contacted the researcher to inform him about the transfer. The researcher established a database of all the transfers undertaken in KZN during that month and cross checked it against all EMS communication centres to ensure that no transfers were missed. At the end of every transfer, the researcher contacted the ALS

paramedics to remind them about completing the questionnaire, which was promptly received. By the end of the month, 39 questionnaires had been received from 33 participants, as some had undertaken more than one transfer. Each questionnaire was to analyse a single transfer and hence more than one was collected.

b. ALS paramedics

Once the preliminary analysis had been completed and the data analysed, the researcher wrote to all the ALS paramedics who had participated in completing the analysis of the transfers undertaken and sent them a detailed letter (via email, post, fax or hand delivered) requesting their participation in the interview component. Details of the nature of the interview and what they would be asked were clearly highlighted in the invitation letter. Once confirmation of participation had been received, purposive sampling was used to select specific participants with certain qualifications from rural and urban, public and private, and ground and air ambulances. Thereafter, the researcher made logistical arrangements to access a meeting space at the appropriate Department of Health premises, so that the interviews could be conducted at the participant's convenience. A letter of information and consent was emailed to the selected participant (Annexure 16) with directions to the venue.

With the permission of the participants, interviews were audio recorded, which enabled the researcher to pay attention to the participants rather than to manually record the responses. Recording the interview gave insight into the performance of both the researcher and the participant. In addition, digital recording reduced the potential for researcher error, had this been done manually. Furthermore, access to the nuances of the interactions between researcher and participants helped validate the accuracy and completeness of the data collected.

The researcher travelled to meet the participant to conduct face-to-face interviews. Privacy was maintained in neutral venues which were conducive for recording. Each interview lasted between 60 and 90 minutes. Refreshments and snacks were offered to the participants before the interview began, when time was also allowed for reading and understanding the documents. Prior to conducting the interview, all participants completed an informed consent form, and issues of confidentiality and

research ethics were discussed before confirming their voluntary participation (Annexure 16). None of the participants were coerced in any way and they were told that they could withdraw from the study at any time. A semi-structured interview was used and all interviews were conducted in English. The interviews embraced developing a trusting relationship, where the participants were respected and accepted in a positive atmosphere. Once data saturation was achieved, no more ALS paramedics were invited to participate.

c. Accompanying mothers

Once the ALS interviews had been completed and the data analysed, seven mothers who had accompanied their babies during the transfer, as established from the situational analysis of the transfer, were contacted by the researcher and invited to participate in individual interviews. The mother's contact numbers were obtained from the gatekeeper. All mothers agreed to participate and arrangements were made to meet them at Department of Health premises for their convenience. Directions to the venue were sent to them via sms, as most had no internet access or postal address.

On contacting the mothers, the researcher established that English was an appropriate language of communication and it was consequently used during the interviews (Annexure 18). However, the consent form and information sheet were also provided in isiZulu (Annexure 19), the local language. A translator and a trained counsellor accompanied the researcher to assist in the event of a need for translating or trauma debriefing, neither of which were required at any time. Although data saturation was reached with six participants, the researcher interviewed all seven participants owing to the small sample size.

A room was made available at the selected facilities in which the interviews were held, with refreshments being provided on arrival. The interviews took place with a translator present, and confidentiality and other ethical issues were addressed at the outset. The mothers were assured that their replies would in no way compromise any future services, given the role of the researcher in EMS in the province. They were requested to be as honest as possible, given that their replies would be important for informing the programme that was to be developed for national purposes. They were

thanked for their contribution on completion of the interview and offered the services of a counsellor. All however declined. They were offered transport costs, which four had accepted. The others declined as the venues were close to their homes.

4.3.1.4 Data analysis

The data analysis consisted of the preliminary analysis of each transfer as per questionnaires collected. This was followed by thematic analysis of the data from the two groups of in-depth interviews.

a. Preliminary analysis

On return of the questionnaires, each was uniquely coded for easy identification and confidentiality. The data was entered into a Microsoft Excel spreadsheet for analysis, which was done using the computer software programs SPSS Statistics version 20.0 (IBM, USA) and Statgraphics Centurion 15.1 (Statgraphics, USA). The services of a professional statistician was used to analyse the raw data. The questionnaire consisted mainly of close-ended questions, which allowed for descriptive and analytical analysis.

b. ALS paramedics and c. accompanying mothers

In this study, the foundational steps for qualitative data analysis involved inductive reasoning to analyse the empirical data dictated by the thematic analysis (as described in 4.2.3 above). Data analysis took place alongside data collection to allow questions to be refined as avenues of inquiry developed. The research produced large amounts of textual data in the form of transcripts, which were analysed using the six phases of thematic analysis.

4.3.2 Objective 2

To investigate the state-of-the-art practice that guides the inter-healthcare transfer of critically ill neonates

The state-of-the-art review was conducted simultaneously with the analysis of the transfers and interviews that were required for objective 1 (Table 4.9). The purpose of the review was to establish what other programmes had been developed

elsewhere in the world, what issues they addressed, and what best practices they recommended. The researcher's experience in the field made it possible for him to understand the available literature relating to organisational structures and transfer processes and their relevance and appropriateness for a new neonatal transfer programme in a developing country.

Table 4.9: Methods associated with objective 2

Objective		Methods
2	To investigate the state-of-the-art practice that guides the inter-healthcare transfer of critically ill neonates.	Literature review Conferences/workshops

To understand various theoretical and practical aspects governing the critically ill neonatal transfer process, a thorough search of relevant state-of-the-art programmes was conducted. The best practices, as evidenced in the literature, formed a data source in the programme developmental process. State-of-the-art reviews comprise of continuous assessment of literature, systematic reviews, attendance at conferences and conventions, workshops, forums and seminars where new developments and challenges were presented. In this regard the following activities were undertaken:

- I. A critical review was undertaken of the literature related to inter-healthcare facility transfers of critically ill neonates and related programmes. Particular attention was given to published articles that explored the programme content and other issues relevant to the specific programme. Aspects that could make a contribution to this programme were identified and to ensure that the programme contained state-of-the-art best practices.

- II. While developing this programme, the researcher attended workshops and seminars, mainly ALS forums, both national and provincial, and quarterly national education and training meetings to balance theory and practice. These activities were Continuous Professional Development (CPD) compliant and accredited by the Health Professions Council of South Africa (HPCSA). The researcher is a member of the National Emergency Education and Training Committee and attends quarterly meetings. This forum is responsible for the education and training of EMC providers in South Africa. It was at these forums

that the researcher identified relevant challenges and gaps, gained relevant insights and shared common interests in the subject matter with EMC and other healthcare providers.

- III. The researcher attended the 2016 pre-hospital Emergency Care Conference in Cape Town, South Africa. Its purpose was to bridge the gap between theory and practice in EMC. Speakers at this conference indicated that EMC education and training at higher education institutions (HEIs) does not inform the pre-hospital industry, noting the discrepancies between training and the real world. Discussions with educators, healthcare providers, specialists and authors of neonatal and related articles, made the researcher more aware that a transfer programme was essential to guide neonatal transfers and would contribute significantly to enhance their healthcare in South Africa.

The data from the phase 1 enabled the developmental phase, of the study to proceed. The process between the two phases was iterative, with an ongoing state-of-the-art review, as new literature was found and engagement with others in the field occurred. Furthermore, the data analysed from the accompanying mothers were included in phase 2.

4.4 Phase 2. Development

This phase relates to objectives 3 and 4 of the study, as indicated in Table 4.10. The developmental phase is central to the DRU model, during which the innovation is created, in this case, the inter-healthcare facility transfer programme for critically ill neonates. The study participants had different professions, roles and responsibilities, education, training and experiences with regards to neonates. Focus group discussions (FGD) and in-depth interviews were used to collect data from these different sample groups.

Table 4.10: Phase 2: Objectives and methods

Objective		Methods
3	To explore the views of ALS paramedics, family members, neonatologists and EMC lecturers with regard to all aspects that need to be operationalised in a programme that will guide the inter-healthcare facility transfer of critically ill neonates in South Africa.	c. Accompanying mothers <i>(findings from interviews is phase 1)</i> d. Operational ALS paramedics <i>(4 focus group discussions)</i> e. EMC lecturers <i>(3 focus group discussions)</i> f. Neonatologists <i>(7 individual interviews)</i>
4	To develop a programme that will enhance the EMC profession's ability to deal with the multidimensional issues facing the inter-healthcare facility transfer of critically ill neonates in South Africa.	Draft programme (Framework)

4.4.1 Study area and sample

Phase 2 was done nationally to accommodate the diverse South African culture and urban/rural contexts. Given this and in order to save time and cost, the researcher divided the nine provinces into four regions, for the focus group discussions. Operational ALS paramedics nationally were invited to attend one of the four focus group discussions. The four regions selected for the focus group sites were Free State, Gauteng, KwaZulu-Natal and Western Cape province (Figure 4.4). These regions have more established EMS and are commonly used as central points, and were more accessible for the participants. Furthermore, to ensure a wide range of opinions, the regions represented included rural and urban areas, air and ground, and public and private ambulance services.

The samples used in this phase were as follows: 35 operational ALS paramedics in four focus group discussions, 21 EMC lecturers in three focus group discussions, and seven neonatologists in semi-structured interviews. Each group is detailed below in Table 4.11 with the type of data collection tool used.

Table 4.11: Samples used in phase 2

Samples used	Description of the samples	Site
d: Operational ALS paramedics <i>4 focus group discussions</i>	Operational ALS paramedics who were actively involved in the transfer of a critically ill neonate	South Africa
e: EMC lecturers <i>3 focus group discussions</i>	Lecturers who were actively involved in EMC lectures	
f: Neonatologists <i>7 individual interviews</i>	Expert specialists in neonatology	

d. Operational ALS paramedics

The operational ALS paramedics consulted were actively involved in the transfer of critically ill neonates from the public sector and one private EMS services nationally. These paramedics were divided into four focus groups. Participant selection was again done using purposive sampling and the sample for each focus group discussion included participants from rural and urban, public and private, and ground and air ambulances in South Africa in order to analyse the transfer process from all aspects of EMS. The ALS paramedics inclusion and exclusion criteria are indicated in Table 4.12.

Table 4.12: Inclusion and exclusion criteria for operational ALS paramedics

Inclusion Criteria	Exclusion criteria
<ul style="list-style-type: none"> Operational ALS paramedics working in the public EMS and one major private EMS (Netcare) ALS actively involved in transporting critically ill neonates ALS from which gatekeeper approval was granted by 8 of the 9 provinces (KwaZulu-Natal, Eastern Cape, Free State, Gauteng, Limpopo, Mpumalanga, Northwest and Western Cape) 	<ul style="list-style-type: none"> Non-operational ALS paramedics. Operational ALS not actively involved in transporting critically ill neonates. The second major public EMS did not consent to participate. Northern Cape Province did not grant gatekeeper approval due to limited ALS in the province. Those who participated in the situational analysis phase of this study.

e. EMC lecturers

The lecturers consisted of Emergency Medical Care (EMC) staff directly involved in providing instruction at one HEI and three public Colleges of Emergency Care (COEC) that are accredited by the HPCSA PBEC, offering Continued Professional Development Programmes to ALS paramedics. EMC lecturers in Gauteng, Western

Cape and KZN with minimum lecturing experience of two years were included. They were interviewed to explore the issues surrounding education and programme development in inter-healthcare facility transfers of critically ill neonates.

The lecturers from the Colleges were involved in the education and training of operational ALS paramedics (Table 4.13). They understood the needs and challenges in the teaching and learning programmes specific to the pre-hospital environment, as they aimed to inform EMS practice and are directly involved in neonatal transfers. The lecturers were selected from the larger Provincial Colleges of Emergency Care located in the provinces, with three focus group discussions taking place at these venues. The Durban University of Technology was the only higher education institution included in the study, as its lecturers joined the KZN focus group discussion. These lecturers had experience in formal EMC education, hence their knowledge was important in developing this programme.

Table 4.13: Inclusion and exclusion criteria for the EMC lecturers

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> • EMC lecturers with a minimum of 2 years' experience directly involved in EMC lectures were included • ALS lecturers with an ALS qualification • Only the Colleges of Emergency Care that are currently teaching ALS programmes and updates 	<ul style="list-style-type: none"> • EMC lecturers with a minimum of an Emergency Care Technician as an ALS qualification • EMC lecturers with less than 2 years' experience • Lecturers from Free State College of Emergency Care were excluded because they were not teaching ALS programmes and updates

f. Neonatologists

Neonatologists from across the county who work in the public health sector were invited to participate. There are very few neonatologists in South Africa, therefore the availability of this sample was challenging. Those included were located in KZN, Gauteng and Western Cape provinces. The inclusion and exclusion criteria for this sample is presented in Table 4.14. The intention was to interview the specialists until saturation was achieved. This was reached after seven participants had been interviewed.

Table 4.14: Inclusion and exclusion criteria for the neonatologists

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none">• Neonatologist in the public sector	<ul style="list-style-type: none">• Neonatologist in the private sector

4.4.2 Data collection tools

Focus group and interview schedules were developed by the researcher, with input from the supervisors and other EMC researchers, and were very similar for all three groups. This was necessary to triangulate the data for developing the new transfer programme. The operational ALS paramedics and EMC lecturers participated in focus group discussions, while the neonatologists' experiences and opinions were explored in individual in-depth interviews. The tools were developed bearing in mind the knowledge and experiences of the various groups, as well as the contribution that they could make to the final programme.

No pilot studies were done for the three tools, as they were informed by the researcher's experience, the results of the previous phase, and the outcome required informing their content. The general nature of the questions was considered broad enough to allow probing as the sessions progressed, given the semi-structured nature of the enquiry.

d. Operational ALS paramedics

A focus group schedule was developed to guide the ALS paramedic focus group discussion with regard to their experience of transfers and recommendations for a programme for inter-healthcare facility transfers, of neonates (Annexure 22). The data collection tool consisted of the following sections:

- I. Thoughts on the current inter-healthcare facility transfer for critically ill neonates
- II. The organisational structures
- III. Knowledge about the five phases of transfer (ground and air ambulances)
- IV. Preparedness of the ALS to deal with the critically ill neonate
- V. Clinical governance
- VI. The psycho-social needs of the family member during the transfer

e. EMC lecturers

The questions for the EMC lecturers were slightly different from the ALS paramedics, given their areas of expertise (Annexure 24). They included specifically a theoretical component. The data collection tool consisted of the following broad aspects:

- I. The current education and training for inter-healthcare facility transfer for critically ill neonates
- II. Knowledge required to link theory to best practice in critically ill neonate transfers
- III. Procedures to ensure that competency in skills is reached
- IV. The attitudes and confidence of the transfer team
- V. Support programmes
- VI. Improvements to critically ill neonatal transport programmes

f. Neonatologists

An interview schedule was developed by the researcher to enable the neonatologists to provide information related to their experiences of the transfer of critically ill neonates, as well as indicating the context of these situations (Annexure 26). No pilot study of the schedule was undertaken given the limited number of neonatologists in practice. However, the researcher was confident that the tool adequately addressed the issues under consideration, based on his experience, the results of the analysis phase and through engagement with best practice established in the state-of-the art reviews. The tool was adapted as the interviews progressed and its semi-structured nature allowed for considerable probing once the initial questions had been asked. The tool consisted of the following broad aspects:

- I. Thoughts on the current inter-healthcare facility transfer for critically ill neonates
- II. Specific knowledge the ALS practitioner should have about the transfer process
- III. ALS paramedic preparedness to deal with the critically ill neonate
- IV. A more effective transfer programme
- V. The psycho-social needs of the family member during the transfer

4.4.3 Data collection process

The data collection process for phase 2 is presented with respect to the d. operational ALS paramedics, e. EMC lecturers and f. neonatologists.

d. Operational ALS paramedics

Once phase 1 had been completed, the researcher forwarded a detailed letter (via email, post or fax) about the study and its requirements to operational ALS paramedics who were directly involved in neonatal transfers, inviting them to participate in a focus group discussion. This was done three weeks before the intended focus group discussion in their area, and was accompanied by a copy of the ethics approval letter (Annexure 15) and gatekeeper approval (Annexure 3, 8-14). Thereafter, the researcher made logistical arrangements in the four regions for venues to ensure participant availability and convenience, and provided the participants with directions to the venue. The researcher also contacted the participants telephonically to advise them further about the nature of the study and what was required of them. One week before the focus group discussion, the researcher emailed and telephoned the participants to remind them of the appointment.

On the day of the focus group discussion, the participants were given an information and consent form to complete (Annexure 21 and 23) on their arrival. The researcher ensured that the participants were reimbursed for their travel costs, and refreshments and snacks were offered before the focus group began, allowing them time to go through the information and consent form. The aim of the study was explained to all participants, and they were given an opportunity to ask questions, after which the consent forms were completed. This was done before the focus group discussion started, to allow them to withdraw if they wished to do so. A unique ID number was then allocated to each participant to ensure that their input remained anonymous after they all agreed to participate.

The focus group discussions were conducted in natural settings that were comfortable for the participants and conducive for recording; these included boardrooms at Department of Health premises. The schedule was developed and used by the researcher to stimulate the discussions. A focus group moderator was

selected to assist the researcher to keep the discussions within the boundaries of the topic. The criteria for the moderator was an ALS paramedic who had experience in qualitative research and focus group facilitation, as well as experience in the inter-healthcare facility transfer for critically ill neonates. The moderator encouraged participants to share experiences, give opinions and get involved in the discussions. The researcher also had a research assistant on hand to take notes and manage the voice recorder. Discussions lasted between 90 and 120 minutes.

e. EMC lecturers

Once the analysis of the interviews with the operational ALS paramedics were complete, the researcher forwarded a detailed letter about the study and its requirements via email to EMC lecturers at the three public Colleges of Emergency Care and Durban University of Technology, inviting them to attend a focus group discussion. Attached to the email was the ethics letter (Annexure 15) and gatekeeper approval (Annexure 3, 8-14). Following participant agreement, seven participants were recruited.

f. Neonatologists

On completion of phase 1, the researcher identified neonatologists working in the public sector and sent those selected, an email inviting them to participate in an interview. The participating neonatologists were generally heads of the neonatal intensive care units (NICU). Once they had accepted the invitation, the researcher travelled to meet with them at their respective institutions at their convenience. A letter of information and consent was emailed to the selected participants before the interview (Annexure 25).

4.4.4 Data analysis

The data for the three categories of participants was thematically analysed per focus group or interview to ensure that all relevant remarks were recorded. This followed the same process of thematic analysis as described in 4.2.3. The result was four transcriptions for the ALS paramedics focus group discussions, three for the EMC lecturer focus group discussions, and seven for the neonatologists interviews, a total of 14 documents of varying lengths.

4.4.5 Objective 4

To develop a programme that will enhance the EMC profession's ability to deal with the multidimensional issues related to the transfer of critically ill neonates

The findings from objectives 1 to 3 were reviewed for material that was relevant for developing a programme to guide the transfer of ill neonates for the South African context. Triangulating the findings from the various respondents and the state-of-the-art review resulted in a large volume of data (Table 4.15)

Table 4.15: The methods used to implement Objective 4

	Objectives	Methods
4	To develop a programme that will enhance the EMC profession's ability to deal with the multidimensional issues facing inter-healthcare facility transfer of critically ill neonates in South Africa.	<ul style="list-style-type: none">• Data triangulation• Theory incorporation

4.4.5.1 Data triangulation

Developing a transfer programme for the South African context required an understanding of all the factors that should be considered for same, hence the inclusion of multiple voices in this study. The initial preliminary analysis provided an overview of the context of the study, identified problematic areas and those areas that were effective. The use of a qualitative enquiry enabled an understanding of all the factors that impact on the organisational structures and processes and, thus, have to be accommodated during the transfers. Triangulation provided an appropriate way to distil and extract relevant information, and to integrate it into a coherent collection of themes and sub-themes that could be used in the programme. The use of triangulation is informed by the DRU model steps 7 and 8, while the use of critical realism uncovered the three components required to really understand a problem – empirical, actual and real. Triangulating the qualitative data made it possible to develop a programme that addresses the concerns raised by all participants and incorporated all the recommendations relevant to such a programme.

This study used knowledge from multiple professionals (ALS paramedics, EMC lecturers and neonatologists), the views of accompanying mothers and state-of-the-

art reviews of inter-healthcare facility transfers of critically ill neonates. These served as the main sources of information for the innovation. The personal and professional experiences of the researcher also served to guide the design of the innovation.

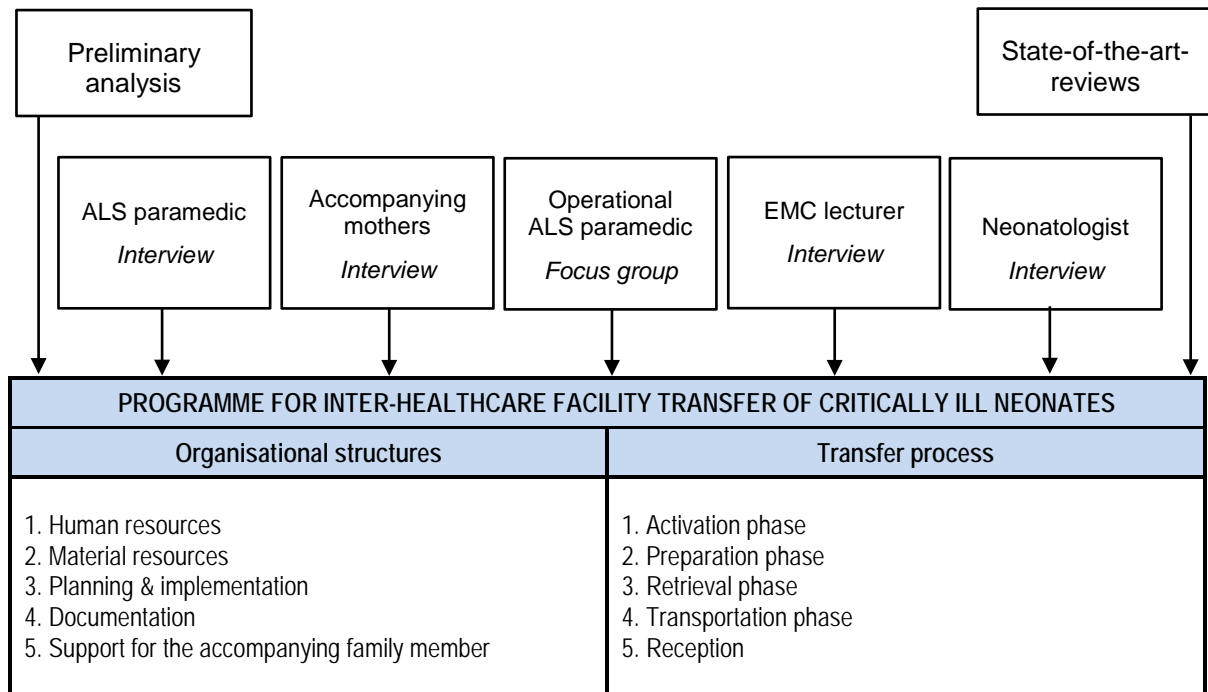


Figure 4.2: Data triangulation that informed the programme

4.5 Phase 3. Evaluation

The evaluation phase entailed the newly developed programme being appraised by a group of experts involved in the emergency transfer of critically ill neonates. Evaluation is an integral part of the innovative process, as is indicated by phase 3 of the DRU model. In this study, it was used to appraise and, where appropriate, revise the innovation, and thus addressed objective 5 (Table 4.16).

Table 4.16: Phase 3: Objectives and methods

Objective		Methods
5	To evaluate the newly developed programme in inter-healthcare facility transfer of critically ill neonates.	g. Group of experts (1 focus group discussion)

4.5.1 Study area

The participants were invited to participate in the final focus group discussion being held in KZN and were selected using purposive sampling. For logistical and financial reasons, the FGD was held in KZN province.

g: Group of experts

This sample constituted a group of three operational ALS paramedics, one EMC lecturer and one neonatologist; these were all experts involved in the inter-facility transfer of critically ill neonates (Table 4.17).

Table 4.17: Group of experts

Phase	Samples used	Description of the samples	Site
3.Evaluation	g: Group of experts 1 focus group discussion	3 x operational ALS paramedics 1 x EMC lecturers 1 x neonatologist	KwaZulu-Natal

As indicated in Table 4.18, participants who were included had not been involved in any of the previous study phases. Participants were required to have at least three years of relevant experience in the transfer process or in lecturing on the subject to ensure that their comments were based on relevant experiences.

Table 4.18: Inclusion and exclusion criteria for the group of experts

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none">• ALS paramedics directly involved in inter-healthcare facility transfer of critically ill neonates with a minimum of 3 years of experience• EMC lecturers directly involved with EMC modules with a minimum of 3 years of experience• Neonatologists from the public health sector	<ul style="list-style-type: none">• Participants who had participated in the previous phases of the study were excluded.

4.5.2 Data collection tool

A focus group schedule was used to guide the discussions about the relevance and appropriateness of the newly developed programme (Annexure 28). The data collection tool consisted of the following questions, each with a number of probing sub-questions:

- I. Thoughts regarding the newly developed programme
- II. Inclusions or exclusions to the newly developed programme
- III. Views on the layout of the programme
- IV. Recommend or not recommend

4.5.3 Data collection process

Once the developmental phase was complete, the researcher forwarded a detailed letter (via email) about the study and its requirements to the operational ALS paramedics, EMC lecturers and neonatologists nationally who were directly involved in neonatal transfers, inviting them to participate in the group of experts discussion. The participants' details were obtained from the researcher's original database of people but only those who had not participated in the previous phases were invited. Once the participant had accepted the invitation, purposive sampling was used to select the participants with a minimum of three years' experience in their field of practice. Thereafter, the researcher made logistical arrangements at specific Department of Health premises to ensure participant convenience. A letter of information, the consent form and the draft programme were hand delivered to the selected participant (Annexure 27) two weeks prior to the focus group discussion,

together with directions to the venue. Thereafter the process described in 4.4.3 for the focus group discussion was followed.

4.5.4 Data analysis

The clinical and academic experts in the specific field were required to comment on whether the programme was locally relevant and appropriate, and could be used. The experts evaluated and appraised the overall programme for strengths and weaknesses, content and intervention, and suggested minor amendments, which were addressed by the researcher. Overall, the programme was found to be acceptable and suitable for dissemination across South Africa.

4.6 Maintaining methodological rigour in the qualitative research process

This study used developmental research methodology which entailed a rigorous research process to develop this programme.

4.6.1 Validity and reliability

Within the framework of developmental research methodology, the validity of the interviews was assured by the following:

- I. Firstly, the semi-structured questions were relevant and directly related to the purpose of this study. The researcher used interview schedules for each sample in the different phases. The questions in the initial interview schedules were derived from the literature and state-of-the-art reviews, the opinions of experts, the researcher's own experience with transfers of critically ill neonates and the preliminary analysis of this study. These schedules were appraised by the research supervisors, researchers from DUT and the DUT Santrust pre-doctoral programme. Furthermore, as the study followed a sequential and a stepwise process, some questions were also derived from the previous phases and, thus, the original schedule was refined before a new step of the study began. Amended interview schedules were appraised after careful consideration and discussions held at different meetings by the research supervisors and researchers from DUT before the interviews.

- II. The second issue was the timing of interviews. Participants were contacted at least three weeks before the interviews took place in order to confirm a time and place that was convenient for them. The researcher also followed up with reminders. All interviews were carried out according to these arrangements without any problems. No complaints were received.
- III. Thirdly, the researcher displayed professional conduct, was friendly and polite, and had good communication skills. This was especially important, given the painful recall of the mothers' experiences. These approaches are believed to have facilitated and increased the acquisition of valid qualitative data.
- IV. Finally, validity may be affected by problematic respondent behaviour and recording problems. The researcher and the moderator (for FGD) sought to observe any issues with the questions asked. Any inconsistencies in the responses were carefully noted and clarified at the time. A backup recording device was also used and all recordings were clear and captured truthfully.

Semi-structured interviews were employed with each sample, hence, the reliability of the data was ensured by probing. This allowed the researcher to identify and clarify any relevant issues raised by the participants. It also helped participants recall information, enhance the interaction between the researcher and participant, reduce tensions and maintain a relationship that encouraged the participants to express their thoughts freely and spontaneously.

4.6.2 Trustworthiness

The overarching method used was developmental research which embraces systematic and rigorous stepwise processes in the three phases of analysis, development and evaluation. The study was also informed by critical realism which critiqued the existing social structures and acquired knowledge from deeper levels of explanation and understanding to envisage the new programme. This study did not use isolated variables. It followed a holistic approach involving iterative processes that included the collaboration of experts and the inclusion of necessary role players in a real-world setting. Furthermore, this research integrated state-of-the-art knowledge from prior research in the design process. This is a key process in qualitative inquiry and it allowed the researcher to relate the study findings to the

existing body of knowledge. A preliminary analysis was also done at the start of the research in order to establish a preliminary familiarity with the research. This starting point provided an overview of the context of critically ill neonatal transfers, allowing the researcher to build on the knowledge from that point. This well-established research method included the use of rigorous and iterative processes, the application of prior research, as well as early familiarity to ensure the trustworthiness of the data. This included the following:

1. Credibility (in preference to internal validity)
2. Transferability (in preference to external validity/generalisability)
3. Dependability (in preference to reliability)
4. Confirmability (in preference to objectivity).

4.6.2.1 Credibility

The credibility of this study was addressed by clearly describing the research participants, multiple perspectives, use of data and convergence of data sources. The participants were experts involved in multidisciplinary teams within the healthcare and education systems (ALS paramedics, neonatologist and EMC lecturers) and were all involved in inter-healthcare facility transfer of critically ill neonates. In addition, the study recognised alternative interpretations of events from other participants (mothers who accompanied their babies during the transfer). These samples proved the best information for the study. Together with the empirical evidence, state-of-the-art reviews were used to contextualise knowledge for the programme. The above processes showed that the findings are credible. The following provisions were made by the researcher to augment the credibility of the study:

a. Background, qualification and experience of the researcher

The researcher has been an ALS paramedic in the South African setting for approximately thirty years and is currently the principal of the KZN College of Emergency Care (COEC). He is also well experienced in inter-healthcare facility transfers of critically ill neonates by ground and air ambulance and has research experience. The researcher is well established within the Department of Health and abides by his core values of integrity and humility, respect, honesty, discipline,

accountability, professionalism and compassion. The researcher's interest in the study was to meet the developmental objectives of the study without any vested interest.

b. Established researcher authority

The researcher contacted the participants both via email and telephonically to introduce himself, the study and its requirements. On the day of data collection and prior to the commencement of focus group discussions and individual interviews, the researcher introduced himself to the participants and described the nature of the study. He told the participants about his knowledge, experience, passion for and interests in the study.

c. The adoption of a well-established research method

The specific procedures employed in this study, such as the semi-structured interview schedules, the data collection methods and the data analysis processes, were derived from well-established methods that have previously been successfully used in research projects.

d. Early familiarity with the study

The researcher is familiar and well experienced with the nature and context of the study. Prior to the study, the researcher had undertaken a descriptive analysis in this field for a master's degree and published an article describing the shortfalls in neonatal transfers. This provided the impetus for the current study. In addition, this study began with a preliminary enquiry to provide baseline information and an overview of inter-healthcare facility transfer of critically ill neonates.

There was also prolonged engagement between the researchers and the participants to gain adequate understanding of certain organisations and to establish a relationship of trust between the parties. Prior to data collection, the researcher wrote and contacted various provinces and obtained gatekeeper approvals. The researcher is also well known in the pre-hospital environment nationally and is in constant communication with the gatekeepers of the provinces and the participants involved. Developmental research methodology utilises prolonged engagement of

stepwise phases and iterative processes. This prolonged process ensured that the researcher had enough time to design and develop this programme. The researcher maintained his professional judgement throughout the study and the study findings were grounded in the data.

e. Negative case analysis

Negative case analysis involves the process of revising and understanding data in hindsight. The participants were selected from a multidisciplinary range (ALS paramedics, EMC lecturers, family members and neonatologists) and from various sectors (urban and rural, ground and air, public and private) to ensure holistic data. When the data was analysed and synthesised, the researcher revisited the data to look for typologies in order to confirm that all the data was accounted for.

f. Tactics to help ensure participants' honesty

There was no coercion or pressure exerted on participants to participate in the study. All participants were given opportunities to refuse to participate or withdraw from the study at any time during the research, without an explanation to the researcher, so as to ensure that the data collection sessions involved only those who were genuinely willing to participate and prepared to offer data freely. From the outset of each interview, the researcher encouraged the participants to be frank and honest, established a rapport in the opening moments and indicating that there were no right or wrong answers to the questions that were asked. The independent status of the researcher was emphasised. As such, the participants contributed ideas and spoke of their experiences without fear of reprisal from managers of their organisation.

g. Iterative questioning

Iterative and probing questions were used as specific ploys to uncover deliberate untruths and to elicit detailed data. This meant that the researcher returned to matters previously raised by a participant and extracted related data through probing questions. The researcher did not detect any contradictions or falsehoods during the data collection process.

h. Frequent debriefing sessions

The researcher had the privilege of being supervised by two well-experienced and established qualitative research supervisors. Through individual and collaborative discussions with his supervisors, ideas were clarified and insights provided for the study. It helped the researcher to recognise any biases and preferences.

i. Peer scrutiny of the research project

The data was professionally scrutinised by the researcher's experienced peers and academics. This process allowed the peers to challenge assumptions made by the researcher and provide a fresh perspective. Questions and observations enabled the researcher to refine his methods, develop a greater explanation of the research design and strengthen his arguments in the light of the comments made.

j. Member checks

Member checks was used as a strategy to take back the feedback to the participants and ask, "Does this ring true to you?" This gave them an opportunity to review the research report and to verify that their perspectives and experiences were acceptably represented. This process was used in each data collection group, where participants in that specific group were randomly selected to check if the data was correct.

k. Examination of previous research findings

Previous literature was examined using literature reviews and state-of-the-art-reviews to assess the degree of congruence with those of past studies. This process forms part of developmental research methodology.

l. Thick description to convey the findings

The researcher used thick descriptions to convey the actual situations that were investigated. This study included many perspectives – ALS paramedics, EMC lecturers, mothers and neonatologists –from which data was collected to convey the actual situation that was investigated.

4.6.2.2 Transferability

The processes used to develop this programme provided a detailed description of the research setting and the research design and methods, together with appropriate referencing and a well-established sequential stepwise framework. This will allow other researchers to decide whether this programme can be used in their setting. The study sought to contribute to a limited body of knowledge in the field of EMS within a developing countries.

4.6.2.3 Dependability

The processes within the study were reported in detail, thereby enabling a future researcher to repeat the work, if not necessarily to gain the same results. Thus, the research design may be viewed as a prototype model. Earlier in this section, the researcher discussed the study design and its implementation in depth to allow the reader to assess the extent to which proper research practices have been followed. This in-depth coverage also included the operational details of data gathering and the reflective appraisal of the programme. In order to enhance consistency, the researcher clearly focused on the study objectives, used appropriate databases to search for literature, and the inclusion and exclusion criteria and the risks and benefits were reported. The clear methodological and analytical choices provided meant that an audit trail was established. The audit trail included raw data, coding and analysis. Hence, the process followed made this study dependable.

4.6.2.4 Confirmability

This study provided a detailed methodological description to enable the reader to trace the course of the research step by step via the decisions made and the processes described by the researcher. Raw data included interview transcriptions and focus group transcriptions. In addition, the developmental research process gave rise to a stepwise iterative process that could be followed to track the study. This study followed the verification strategies in a rigorous fashion to ensure the trustworthiness of the research processes and, thus, produced a credible qualitative enquiry.

4.7 Ethical considerations

Full ethical approval was obtained from the Institutional Research Ethics Committee (IREC) of the Durban University of Technology (DUT). Research Ethics Clearance Number: **101/15** (Annexure 15). The study was conducted following the guidelines of the DUT ethical consideration for the conduct of research in the Faculty of Health Science's Policy document (Section C: Ethics).

4.8 Permission to conduct research

Once ethical approval had been obtained from the DUT Institutional Research Ethics Committee (IREC), permission was sought from all Provincial Department of Health gatekeepers via the National Health Research Database (Reference number: FS 2015RP12 685) and the private sector EMS head office.

4.9 Chapter summary

To ensure the development of a transfer programme that accommodated locally relevant circumstances, multiple perspectives were used to provide in-depth qualitative data. The data was thematically analysed to identify issues relating to the structures and processes that needed to be included in the programme. Participants from across the country were included to ensure that the programme was broadly relevant. State-of-the-art reviews were also used to contextualise knowledge for the programme.

CHAPTER 5

FINDINGS AND DISCUSSION OF THE ANALYSIS PHASE

5.1 Introduction

This chapter presents the research findings and discussion from phase one. In this phase, data was collected from three samples. The first sample for the preliminary analysis was sample a: ALS paramedics. Thirty nine transfers were undertaken in December 2015 and this provided a snapshot of the transfer context and its dynamics. Thereafter, sample b, the ALS Paramedics who participated in the preliminary analysis, were interviewed (n=8), followed by seven mothers (sample c) who accompanied their babies on the transfers (Table 5.1).

Table 5.1: Samples used for the analysis phase

Samples used	No of Participants	Sector of the ALS Paramedics
a. Preliminary analysis of the 39 transfers during December 2015: ALS Paramedics	31	36 x Public ground ambulance 2 x Public air ambulance 1 x Private ground ambulance
b. ALS Paramedics interviews	8	6 x Public ground ambulance 1 x Public air ambulance 1 x Private ground ambulance
c. Mothers interviews: Mothers who accompanied their neonate on the transfers during preliminary analysis in December 2015	7	7 x Public ground ambulance

5.2 Preliminary analysis of the transfers

There were 39 transfers over the preliminary analysis with 31 ALS paramedics participating, as some undertook more than one transfer. The questionnaires were completed, shortly after each transfer, as they were reported to the researcher by the emergency management communication centre, as per prior arrangements made for this study. The questionnaires spoke to the transfer dynamics and hence did not

include questions for the paramedics per se. The findings from each sample are followed by a discussion of same.

5.2.1 Findings from the preliminary analysis

The type of services provided is discussed first, followed by the time frames of the various stages, after which details relevant to the structures and processes of the five phases of the transfer are noted. The last section outlines the adverse events that occurred during the transfer of the critically ill neonates.

Of the 39 inter-healthcare facility transfers of critically ill neonates, 38 were undertaken by the public sector ambulance service, with one being conducted by a private sector ambulance. Air transfers accounted for two of the 39 transfers, which was undertaken by the public sector fixed wing aircraft ambulance. Most transfers (36) were from urban areas and two were from rural areas, with seven mothers accompanying their babies. The highest Emergency Medical Care (EMC) qualification of the ALS Paramedics, who undertook the transfers was 24 CCA's, while 10 had NDIP's and five had Bachelor of Technology degrees.

5.2.1.1 Time frames

The findings from the preliminary analysis showed that the mean (standard deviation (SD) time to complete an inter-healthcare facility transfer was 4 h 38 min (01:43) (range 4 h 04 min – 5 h 11 min), with a minimum of 2 h 00 min and a maximum of 8 h 43 min. The factors contributing to these times delays, were associated with dispatching the ALS paramedic and preparing the neonate for transfer. The mean (SD) time to dispatch the ALS paramedic for the transfer was 1:28 (01:27) (range 00:59 - 1:56), with a minimum of 00 h 00 min and a maximum of 5 h 51 min. The mean (SD) time to preparing the neonate for transfer was 00:49 (00:31) (range 00:38 - 00:59), with a minimum of 00:08 and a maximum of 2 h 15 min.

5.2.1.2 Activation phase

The activation phase of each transfer began with initial contact from the referring healthcare facility personnel to the emergency management communication centre and the dispatch of the transfer to the ALS paramedic. According to the ALS

paramedics, the dispatch details were incorrect in 13 of the transfers analysed, were not clear in six, not understood in four and inaudible in two. The details that were not dispatched to the transfer team leader by the dispatcher of the communication centre were mostly the referring and receiving doctors contact information, followed by each neonate's name, gestational age, medication required, any special conditions, neonate's weight, infusions required, neonate's vital signs, equipment required, neonate's diagnosis and neonate's age. The most common diagnoses were mainly respiratory distress syndrome followed by hyaline membrane disease, meconium aspiration syndrome, neonatal sepsis, asphyxia, congenital pneumonia and apnea.

There was no clinical assurance manager available for any of the transfers. There was also no transfer coordinator for the ground ambulances. They were available for only the two aeromedical transfers.

5.2.1.3 Preparation phase

The data revealed that emergency services in KZN, do not have dedicated units and teams for inter-healthcare facility transfer of critically ill neonates. It also found that the teams who were dispatched varied in their composition. The team consisted mainly of 4 - 6 members, followed by 2 - 4 members. Of the 39 transfers, the qualification of the team leaders were as follows: Critical Care Assistants (CCA) followed by National Diploma in Emergency Medical Care (NDEMC) and Emergency Care Practitioners (ECP). Their assistants were mainly Basic Life Support (BAA) followed by Intermediate Life Support (ILS) qualified.

The analysis revealed the following with regard to the 39 transfers: before proceeding to the referring facility, the team leaders did not undertake a team pre-brief session. This was for 34 transfers. In 23 transfers they did not complete a pre-transfer checklist and in 10 transfers, no pre-transfer equipment check was undertaken. The equipment was not secured in the ambulance on four transfers and the battery powered equipment was not connected into the external power source, in twenty four transfers analysed. Of the twenty six transfers, the team leader did not inform the communication centre or transfer coordinator of the estimated time of arrival at the referring facility. Some transfers reflected more than one activity described above. The equipment requested for the transfer by the referring hospital

was unavailable for 10 transfers. There was also defective equipment, and equipment that was not compatible. Some transfers reflected more than of the aspects described above.

5.2.1.4 Retrieval phase

In this phase, data related to the condition of the neonate and the skills interventions undertaken are presented. Nine neonates were found to be unstable for transfer, with the leading reason being desaturation, followed by respiratory and cardiac related problems. Team leaders had to undertake life sustaining skill interventions on these nine neonates, at the referring hospital before transferring the baby. The most common skill interventions were oxygenation via a bag valve mask, suctioning, intubation, administration of fluids, adjusting the endotracheal tube depth, administration of pharmacological agents and naso-gastric tube insertion.

During the assessment processes at the referring facility, there was no history taking rubric for twenty two transfers and no neonatal assessment rubric for thirty two transfers. An ABCDE approach of the critically ill neonate was not followed, for two transfers. The team leader did not check and verify the neonate's name tags for four transfers, did not read the medical notes for five, did not review the charts for eleven, and did not complete a pre-departure checklist for twenty five. Before departing to the referring hospital, the communication centre was not contacted for nineteen transfers.

5.2.1.5 Transportation phase

Data for the transportation phase reflected the transfer process done before proceeding to the receiving hospital, the skills interventions undertaken and the communication that occurred during the transfer process by the transfer team. Before proceeding to the receiving hospital, the transfer equipment was secured and/or strapped in for all transfers. Battery powered equipment were not connected into the external power source for twenty three transfers, while neonates were not secured in the incubator during six transfers. Most paramedics reported that they monitored the neonate continuously during transport, which was followed by monitoring after every ten minutes, every fifteen minutes and every five minutes.

Team leaders had to undertake life sustaining skill interventions during the transport phase on seventeen neonates, which entailed more than one skill in some instances. The most common skills were oxygenation via bag valve mask, followed by suctioning and administering pharmacological agents and fluids. Two neonates were accidentally extubated and re-intubated by the team leader. There was a lack of communication between the transfer team and emergency management communication centre for twenty seven transfers analysed. Doctors from healthcare facilities were not available for twenty transfers to offer paramedics clinical advice.

5.2.1.6 Post-transportation phase

Data for the post-transportation phase was collected regarding the processes involved. Once the transfer was complete, a neonatal transfer satisfaction or complaints form was not given to the receiving personnel to complete for thirty seven transfers. Once the handover was complete, a team debrief was only undertaken for thirteen transfers, and the equipment used was not cleaned and sterilised on completion of four transfers.

5.2.1.7 Adverse events during the transfer process

Seventeen of the thirty nine neonates experienced life threatening adverse events during the transfer process, the majority being related to their physiological status, followed by equipment problems. Of the physiological factors, seven were respiratory deterioration, four were temperature related and sixteen were desaturation. Of the equipment factors, two related to oxygen supply, five were with regard to ventilators, three with regard to the endotracheal tube and seven with the incubators.

5.2.2 Discussion of findings: the preliminary analysis of the transfers

There were 39 inter-healthcare transfers of critically ill neonates from 1 to 31 December 2015 (average 1.26 per day), the majority of which were undertaken by the public ambulance service. Recently published data for critically ill neonatal transfers for other provinces within South Africa was not available. However, taking into consideration that the data was only from one of the nine provinces, this is a relatively high incidence compared to other countries such as Switzerland (McEvoy 2017), Colombia (Alvarado-Socarras *et al* 2014), Brazil (Vieira *et al* 2011) and

London (Lim and Ratnavel, 2008), where between 0.561, 1.04, 0.878 and 1.98 transfers take place per day, respectively. In Iran, Sabzehei et al. (2016;) and Nakhshab and Vosughi (2010) reported 0.273 and 0.808 of transfers per day, respectively. The higher incidence of transfers in the KwaZulu-Natal South Africa can be attributed to a lack of resources (human and material) by lower level healthcare facilities, specifically when specialist clinical interventions are needed for the critically ill neonate (Vincent-Lambert and Wade 2018; Ashokcoomar and Naidoo 2016; South Africa, Department of Health 2013). It points to possible poor maternal care prior to birth resulting in the need for emergency neonatal transfers. Practice in neonatal inter-healthcare facility transfers in developed countries continues to expand, using sophisticated state-of-the-art critical care during neonatal transfers (Whyte and Jefferies 2015; Stroud *et al.* 2013). In contrast data from the study's preliminary analysis reflect an unprepared service for transferring critically ill neonates, which appears chaotic and one which is bereft of appropriate organisational structures and transfer processes.

5.2.2.1 Time frames

According to the KwaZulu-Natal Department of Health and the Standing Operation Procedures of the KZN EMS, the dispatch time for an inter-healthcare facility transfer should be within three minutes of the request (South Africa, KwaZulu-Natal Department of Health 2012c). In an interview on 14 July 2017, the National Director Emergency Medical Service, Mr R Naidoo, indicated that there is no national standard dispatch time for inter-healthcare facility transfers, however three minutes is considered as a benchmark in South Africa. During the study period, only three transfers were dispatched to the paramedics within this time, with the average time being 1 h 28 min. The lack of dedicated specialised transfer units meant that once the transfers were accepted by the Emergency Management Communication Centre (EMCC), it was dispatched on an ad hoc basis to the closest ALS paramedic who was available at that time to undertake the transfer. Thereafter, the paramedic waits for the next available ambulance, with its allocated staff for that shift, who are already on board to undertake the transfer. In addition, specialised equipment required for the transfer are fetched from their respective bases once the request is processed. This results in considerable time delays in proceeding to the transfer

thereby severely compromising the chance of survival and or compounding existing health problems.

According to the ALS paramedics, neonates were not adequately prepared pre-transfer, therefore they had to be stabilised and prepared by the paramedics before departure to the referring hospital. The data showed the average time to prepare the neonates for transfer was 00 h 49 min, which also delayed the departure time. The onus is on the medical personnel of the referring healthcare facilities to stabilise and prepare the neonates to ensure that they are ready for transfer when the ambulance arrives in order to expedite the transfer (South Africa, Department of Health 2012a). It must also be noted that KZN EMS does not have a transfer co-ordinator in the Emergency Management Communication Centre (EMCC) to provide the necessary advice to the referring personnel on pre-transfer stabilisation, preparation, and the requirements for transfer.

5.2.2.2 Activation phase

The activation phase is the first link in the chain of survival, and begins with the initial contact of the referring facility and the EMCC. Whyte and Jefferies (2015) indicated that the telephone operators form the liaison between the inter-healthcare facilities and must therefore clearly understand the transfer's process and its requirements. Although the current study did not analyse the EMCC, many inconsistencies and delays were noted in dispatching the transfer to the teams. Stroud *et al.* (2013) wrote that it is vital that team leaders understand the neonate's history, clinical condition and know what relevant equipment is required to prepare for a transfer. However, the sample indicated that the dispatch details by the EMCC were inaudible, not clear, incorrect or not understood. Vital information was therefore not relayed to them, and in many instances there were no transfer coordinators to verify and screen these transfers. Again, these are hugely significant issues that can impact on the neonates ability to survive the transfer.

5.2.2.3 Preparation phase

The data showed severe shortfalls in the transfer team and process, which included the lack of pre-briefing sessions and not completing a pre-transfer checklist and undertaking equipment tests. According to Lupton and Pendray (2004), transfer

teams must be thoroughly prepared and need to familiarise themselves with the transfer before proceeding. This involves a pre-briefing to understand the neonate's condition, identifying the equipment required and other transfer issues. According to Horowitz and Rozenfeld (2007) and Ratnavel (2009), a pre-departure checklist and equipment test must be done to ensure that no equipment is left behind, that it is clean and sterile, fully charged and in excellent working order. The study also found that equipment was not secured in the ambulance. Kemply *et al.* (2007) cautioned that unsecured equipment can become projectiles which could be extremely hazardous. Furthermore, in some cases, the transfer team did not inform the communication centre of their estimated time of arrival, meaning that the neonate was not prepared for transfer. Again these resultant time delays have serious implications for the survival of the neonate where time is of the essence and where adequate preparation could ease the transfer journey.

5.2.2.4 Retrieval phase

Fanara *et al.* (2010) indicated that the retrieval phase was the most important phase of the transfer process. Stabilising a critically ill neonate, is crucial to the clinical outcome and its ability to tolerate the transfer due to the environmental challenges and the stresses of transfer. Performing clinical procedures on a critically ill neonate during transportation is a difficult process, that is associated with very high levels of risk due to the hazardous environment. Therefore, it is vital that the critically ill neonate is stabilised at the referring hospital, before transferring them to the ambulance (Carreras-Gonzalez and Brió-Sanagustin 2014). Data reflected that the neonates were clinically unstable and not prepared for the transfer, when the team arrived at the referring hospital. This resulted in them undertaking emergency interventions prior to transportation. This increased overall time delays that could have been avoided if a transfer coordinator, had been giving advice to the referring facility. Variations in the assessment processes and documentation were also noted.

5.2.2.5 Transportation phase

Significant deficiencies were also identified during the transportation phase of the study, as compared to practice in the UK (Senthilkumar *et al.* 2011 and Lim and Ratnavel 2008), Switzerland (McEvoy *et al.* 2017), USA (Stroud *et al.* 2013;

American Academy of Pediatrics 2012; Miller et al. 2008), Canada (Bérubé et al. 2013) and Australia (Shee and Gleeson 2018). Whilst the latter are more developed countries, there are no reasons to justify, the variations in the intervals of clinical monitoring and evaluation by the transfer teams. This is because there needs to be continuous clinical monitoring and evaluation throughout the transportation phase to maintain that continuum of intensive care. Lack of support from experts during the actual transfer further isolated, the paramedics, in terms of dealing with the critically ill neonate, during the transfer process. Moreover their potential lack of preparedness professionally and due to deficiencies in their education could have left them powerless to handle the types of clinical emergencies and challenges that could arise during the transfer.

5.2.2.6 Post-transportation phase

Inconsistencies and variations were also noted in the post transportation phase. Of most significance was that there were no team debriefs on completion of many transfers. Horowitz and Rozenfeld (2007), Ratnavel (2009) and Hankins (2010), agreed that team debriefs are an important session, normally conducted by the ALS paramedic, for information sharing. It interrogates the transfer in its entirety, identifies its strengths, weaknesses and challenges for future improvements and enables teamwork among health care professionals. More significantly it can allow for personal psychological debriefing especially when paramedics may themselves have endured stress brought on by attempting to preserve life and simultaneously support the accompanying mother.

Globally, neonatal health is a important issue in addressing the survival of children under five years old, particularly in low- and middle-income countries (Dorrington *et al.* 2016). An important proportion of neonatal mortality is attributable to infections and sepsis (Liu *et al.* 2015). Worldwide, specifically in developed countries, infection prevention and control in neonatal care continues to evolve, with the use of disposable equipment and strict adherence to guidelines and policies. It is disconcerting to note that the equipment used in the transfers in this study was not cleaned and sterilised. This was after the completion of four of the transfers analysed, suggesting a total disregard for disinfection procedures, despite a mandate that clean and sterilised equipment is used during and after transfers to

prevent cross-infection (South Africa, Department of Health 2010). The use of unsterile equipment places the already fragile neonate at further risk and calls into question, professionalism given the blatant disregard for such protocols. This calls for further interrogation with regards to whether sterilising agents are available, whether time features as a constraint or whether it has become a norm not to sterilise.

5.2.2.7 Adverse events during the transfer process

Ideally, neonates in an intensive care environment require intense, continuous and stringent monitoring and care, by appropriately educated and trained transport teams (Okoroh *et al.* 2016). Neonatal deterioration should therefore not occur, and if it does occur should be related to illness of the neonate rather than the physical transfer or care being provided. The data however identified life threatening physiologically related adverse events, which related to the transfer, particularly equipment failure which contributed directly to the neonate's deterioration. Equipment failure and iatrogenic mortality or morbidity should not be the issues that present itself during a transfer. It was noted that equipment failure was mostly associated with the ventilators and incubators, mainly due to battery failure. Moreover there was no back up power sources to connect the battery operated equipment, during transportation. It was also found that there were problems with the oxygen supply and the endotracheal tube. These again are preventable and require regular inspection and replacement so that they are fully functional to deal with neonatal emergencies. It brings to light the need for a dedicated unit and a special co-ordinator to undertake these routine inspections. The adverse events encountered in this study however are not unique to the EMS in KZN, but also appear to exist within the ambulance services worldwide. Carreras-Gonzalez and Brió-Sanagustin (2014) in Spain and Caitriona Gilleece McEvoy (2017) in Switzerland also reported similar challenges thereby prompting the need for an interrogation of reasons for same and the need to put in place mechanisms to attend to the quality, safety and efficiency of the transfer of a critically ill neonate.

5.2.3 Section summary

This preliminary analysis provided an overview of the transfer context and its dynamics. It was necessary to justify the developmental effort of the study. It identified the shortfalls, inconsistencies and variation in the structures and processes of inter-healthcare facility transfers of critically ill neonates. The shortfalls identified included the lack of a dedicated transfer unit, time delays, equipment problems including poor infection control, inadequate documentation, poor co-ordination and communication, shortage of human resources, including management structures, and the lack of quality assurance. Of concern however was the uncovering of life threatening adverse events during transfer, warranting the need for serious consideration of the neonatal transfer programme by government structures.

5.3 Findings and discussion : Sample b

Once the preliminary analysis was concluded, eight ALS Paramedics who had completed the questionnaire for the preliminary analysis (Sample a) were invited to participate in the semi-structured interviews. Participants were selected from different contexts (air and ground ambulance, rural and urban area and private and public services) within the neonatal transfer programme, to analyse the transfer process holistically. These paramedics constituted sample b of the study.

5.3.1 Findings made

Seven participants were from the public sector and one from the private sector. All those from the public sector had experience with ground and air ambulances, and most had experience working in both rural and urban geographic locations. The paramedics from the private sector worked solely on the ground ambulance. Table 5.2 reflects the demographic data.

Table 5.2: Demographic information: Sample b

ALS Paramedics Sample size	Sector	Ambulance	Geographical location	Qualification
8 x Participants	7 x Public Sector 1 x Private Sector	7 x Ground Ambulance 1 x Air Ambulance (Public)	6 x Urban Area 1 x Rural Area 1 x Aeromedical	6 x CCA 2 x ECP
<i>CCA = Critical Care Assistant</i> <i>ECP = Emergency Care Practitioner (Bachelor of Technology in EMC or Professional Bachelor Degree in EMC)</i>				

Thematic analysis of the data from this sample resulted in the generation of 6 themes and sub-themes. This is presented in Table 5.3.

Table 5.3: Themes and sub-themes derived from sample b

THEMES		SUB-THEMES
1	Organisational structural deficiencies	a. Lack of a specialised transfer team b. Inappropriate managerial structure c. Documentation needed for the transfer d. Gaps within the aeromedical unit e. Inadequate quality assurance
2	Deficiencies in specialised transfer equipment	a. Malfunctioning, incompatible or insufficient equipment b. Lack of equipment maintenance or service plan c. Lack of infection control d. Deterioration of the neonate
3	Personal issues of helplessness	a. Exhaustion, burnout and demotivation b. Intimidation by others
4	Challenges associated with the transfer process	a. Poor preparedness of the communication centre b. Pre-transfer preparation of the fragile neonate c. Challenges en-route to the receiving facility d. Poor communication and lack of clinical advice
5	Lack of preparedness	a. Anxiety and fear b. The lack of sub speciality programmes
6	Support for mothers during transfer	a. Fear and anxiety of the mother b. Psychological needs of the mother c. Clinical incidences related to the mother

5.3.1.1 Theme 1: Organisational structural deficiencies

All the participants expressed that they encountered challenges associated with the current structure relate to neonatal transfers, with some alluding to the total absence of an organisational system to oversee the transfers. They said as follows :

“We are lacking in the entire system. We are lacking resources. Things are a mess....Firstly, let’s have to look at what resources we have, it is not conducive and very basic for critical babies. Our systems lacks from the start to the end. We are detrimental to neonatal transfers.” [ALS Interview 2, Page 2]

“There is no structure for neonatal transfers. In each shift, any paramedic who is available is dispatched on the transfer and we then look for the equipment

because we don't have it or it does not work...The entire structure for neonatal transfer is non-existent."

[ALS Interview 6, Page 3]

a. Sub-theme 1: Lack of a specialised transfer team

It emerged that that a specialised neonatal transfer service does not exist in KZN, and that transfers were undertaken on an ad hoc basis by random paramedics, who have to leave other duties to effect a transfer. This highlighted the total lack of preparedness on the part of a paramedic, who seemingly is plunged into effecting a transfer without the equipment being available. This not only impacts on the transfer negatively but leaves other emergencies in limbo, highlight serious ethical issues related to patient care. This is evident in the following excerpt :

"...there are so many transfers that we are undertaking. Because we do not have special units for these transfers, I have to leave my normal operational duties and do these transfers because there is a shortage of ALS staff. Picking up and dropping of equipment, waiting for the ambulance and crews delays the transfer and my time to get back to my operational duties. This means that other emergencies are not attended to."

[ALS Interview 3, Page 1]

Participants also expressed concern regarding staff shortages and those who lack competence to effect a transfer as part of the neonatal transfer team. The following excerpts highlight this :

"Sometimes we are required to undertake a transfer alone at the back of the ambulance with a critically ill baby. The baby is on a ventilator and eight syringe drivers. How is this possible to deal with this baby alone? This is dangerous for the baby. We have no choice but to comply and do the transfer"

[ALS Interview 2, Page 4]

".....there are times that we are alone with the patient at the back and there are times that we have a crew. Our crews are mostly BLS trained. Sometimes they are inexperienced in neonatal transfers because we don't have a set team, we go on the transfer with whoever is available at the time"

[ALS Interview 1, Page 3]

b. Sub-theme 2: Inappropriate managerial structures

All participants expressed that the lack of a manager who was appropriately trained to oversee neonatal transfers. Those acting as managers have no clinical and managerial experience to address the overarching issues that may impact on the neonatal transfer process. They said as follows :

“We have managers but they are mostly Intermediate Life Support trained. They don’t understand critical transfers. It’s out of there scope of practice”.

[ALS Interview 6, Page 3]

“It is because of that poor management that we are having system problems, equipment problem, communication problems and so on. We have the resources but they are not managed and used appropriately, this is why we failing.”

[ALS Interview 7, Page 3]

“...there’s no managers, no coordinators for transfers who are ALS qualified. As paramedics, we are actually short-staffed. Staff in the control centre are mostly basic or intermediate trained.”

[ALS Interview 3, Page 2]

c. Sub-theme 3: Documentation needed for the transfer

Participants also expressed that the documents used for neonatal transfers were either inadequate or inappropriate for neonatal transfers. Documents that are in use are standard patient report forms, designed for all age groups patients and not for neonates. The lack of a special checklist to capture neonatal demographic and clinical information was non-existent. Participants said as follows :

“The STATS (South African Trauma Score) book that we write in is not adequate enough to put in all those information that we need to put in on those forms. We definitely need better documentation. There’s not enough space for writing especially neonatal transfers. There’s so much information that you can write and the documentation is definitely not enough”.

[ALS Interview 3, Page 3]

“....there’s no specific information on the ambulance form, say infusion, what infusion, ventilation modes and so on, very basic form”.

[ALS Interview 6, Page 4]

“Once we had a checklist there but now there’s no checklist, there’s nothing, we just go and we just pick up what we think we need you know and there’s no formal checklist, there’s no special documentation, we just from past experience we just pick up what we need to and then we go”.

[ALS Interview 7, Page 3]

d. Sub-theme 4: Gaps within the aeromedical unit

The data reflected specific issues when the aeromedical unit was used in conjunction with ground transport for neonatal transfers. Air ambulances had similar problems in terms of equipment, but moreover the aeromedical service appeared to work in total isolation. Poor co-ordination and communication also existed between the aeromedical service and ground ambulances, creating unnecessary delays, which was exacerbated when the referring or receiving hospitals had unroadworthy conditions. The following excerpts reflect this :

“...There are lengthy delays when we outreach airfields. Delays are also because of the roads being in terrible conditions and the ambulances are in appalling conditions.Some of the stretchers can’t move because the wheels are broken. You can’t even load an incubator properly, you have to carry an incubator directly into the ambulance....We travel in this unsafe, unstable ambulance to long distances...”.

[ALS Interview 5, Page 5]

“.....aeromedical transfers are being currently misused, and mismanaged because we are being dispatched to areas where there is no resources, either no ambulance or staff are available, instead of a patient who really needs our service, our management call it resource allocation. This is incorrect, I call it waste of resource, aircrafts are very expensive ambulance and to use as a first line resource allocation when it’s not needed is simply abuse and waste of tax payer’s money”.

[ALS Interview 2, Page 5]

5.3.1.2 Theme 2: Deficiencies in specialised transfer equipment

Multiple issues were reflected in the data with regards to equipment that was malfunctioning, incompatible, or unavailable. The most critical point raised was that the ambulances itself was ill designed for the transfers and specialised equipment for the transfer lacking. Participants said as follows :

“Our equipment is hazardous, we are killing babies....but before I talk about the equipment, and our most valuable equipment is the ambulance. It is not designed for transfers. The oxygen ports are faulty, the stretchers are faulty, we have poor lighting in the back of the ambulance, and the ride at the back of the ambulance is bumpy. The alternate power source socket, the plug in point, does not work, how do we keep our equipment charged. There is no place to place the equipment during the transfer. It’s difficult to secure. We should not be transferring any patients let alone the critically ill neonate”.

[ALS Interview 2, Page 5]

“The equipment is really failing us, not us, it’s failing the neonate. Sometimes we have to transfer the babies who are very unstable, sometimes we have long transfers. The equipment always fails. Batteries don’t hold charge. Our equipment is old and outdated”.

[ALS Interview 1, Page 3]

a. Sub-theme 1: Malfunctioning, incompatible or insufficient equipment

All participants lamented that mechanical ventilators, incubators and syringe pumps, were either insufficient or malfunctioning on most transfers. What was crucial was the delay of the transfer because equipment had to be sourced elsewhere before the transfer could be effected. Moreover the back-up power source to charge or maintain the battery powered equipment was unavailable. Some participants indicated that they were forced to use defective equipment.

“The basic challenge is, let’s start with the incubator. Most of our incubators do not work properly. They don’t retain heat. Basically we are battling with faulty equipment....Sometimes we put a hot water bottle inside, I don’t know if that’s allowed but we try and keep the heat...It’s not only the incubator, our

ventilators does not work properly as well. Often the battery just dies, modes go off and we cannot do the settings according to the hospitals....”

[ALS Interview 7, Page 3]

“...we don't have proper monitoring equipment to monitor vital signs and end-tidal CO₂, at the moment we just using a portable pro-pack monitor, that gives you stats monitoring, it give you BP monitoring, there's no end-tidal CO₂, it cannot defibrillate. That's one of the challenges and we got others. Our syringe pumps are not serviced and they don't buy the proper administration sets for it, so we have to basically make a plan, we jam the sensor section with syringe just to make sure the thing doesn't beep all the time”.

[ALS Interview 6, Page 4]

“There were instances where we had to do back to back transfers on the same ventilator, a four hour mission with a baby on a ventilator. This will obviously bring the ventilator battery life down to about a quarter and then, you asked to bring another ventilated baby back with quarter battery life. It started to give us a low battery and low pressure warning so I revert back to BVM (bag valve mask) and bag the baby. You got no control in the aircraft, you don't know if you are hyperventilating or you going to cause more baro-trauma. It is difficult in an aircraft to get out of your seat to bag the baby.” [ALS Interview 5, Page 9]

“Once we are at the transferring hospital we have to transfer the patient onto our ventilator or adapt our equipment because our equipment does not work with the hospitals. We don't have the same circuits and equipment as the hospitals, so you often have to sometimes improvise.”

[ALS Interview 4, Page 5]

“The portable oxygen cylinders are not compatible to the ventilator gauges because we have a new company that issue us with oxygen. Since then we did not get new gauges. We adapted our old gauges so that it fits. Sometimes it leaks and does not have enough pressure to drive the ventilator”.

[ALS Interview 8, Page 2]

b. Sub-theme 3: Lack of equipment maintenance or service plan

Participants also indicated that there was no maintenance or service plans for life saving equipment.

"...no matter where we work, in air or ground, the equipment is not simply serviced. All the syringe drivers that we putting on, it says, require service do you wish to continue, we just press yes and continue. We don't have a choice, we have to do it and we are transferring babies with multiple infusions, lifesaving...critical infusions". [ALS Interview 2, Page 6]

"There is no maintenance plan, if there is we don't know about it.... The last we sent our incubator for service; it was in 2013, so now its 3 years since its last serviced and it is used almost daily." [ALS Interview 8, Page 2]

c. Sub-theme 4: Lack of infection control

Another significant issue emerging from the data was the lack of infection control, as infection policies were not adhered to and there was no proper disinfection procedure. Cross contamination through the use equipment borrowed from other hospitals also appeared to exist.

"There is an infection control policy but our service is not enforcing it. The policy is for health, hospitals and clinics, to my knowledge there is no policy for EMS". [ALS Interview 8, Page 2]

"We don't have proper sterilizing equipment to clean the incubators.....All our incubators don't have any proper disinfectant to disinfect the incubators, we use hibitane, which is not a proper disinfectant, its alcohol based....The incubator takes filters, it has not been changed for years. I think from the time the incubator has been at the base those filters hasn't been changed and the same with the ventilators as well." [ALS Interview 3, Page 2]

"We are borrowing equipment from hospitals, equipment like incubators and syringe drivers. This equipment is taken from one hospital to another. We are cross contaminating the hospital by using equipment from one hospital to the next". [ALS Interview 1, Page 3]

d. Sub-theme 5: Deterioration of the neonate

The data reflected that deterioration of the neonate, including death can be attributed to equipment malfunction during the transfer process. They said :

“Because of this equipment failure the patients deteriorate during transfer. It happens often you know. We battle with our equipment, we try and set it to the best of our ability, the doctors help us set it as well. Babies desaturate along the way, and then we change to an ambu-bag. When we get to hospital, they put the baby on their ventilator and immediately see the saturation picks up”.

[ALS Interview 7, Page 4]

“....most of the time the babies are very unstable for transfer and the doctors wants these babies to be moved and the equipment most of the time fails. The vehicles don't have inverters and stuff like that on it so if you doing a transfer and get caught in traffic, now you sitting hours in traffic and your equipment starts to fail and then the babies lives are at stake. This happens always, babies desaturate, become distressed, heart rate drops, get cyanosed and stuff like that”.

[ALS Interview 3, Page 3]

Some participants reported tracheal tube blockage, accidental tracheal extubation, loss of monitoring, loss of intravenous access, and exhaustion of oxygen supply during the transfer. These occurrences were common when switching equipment at hospital or moving the neonate in and out of the ambulances.

“.....you have to be so careful when doing this because many time the tubes and drips get pulled out when we loading or offload.....This process is very dangerous because there all this life saving equipment attached to the baby, they are attached to the baby via the pipes and tube. If the pipes or tubes get pulled it can be life threatening. These are critical babies”.

[ALS Interview 3, Page 2]

“It is so bumpy at the back of the ambulance, even worse in the heli. Lines get pull off, tubes get dislodged or displaces. Therefore, we make sure that the

tubes and lines are strapped properly. Some time I put my hand in the incubator and hold the tube all the way to hospital”.

[ALS Interview 1, Page 7]

5.3.1.3 Theme 3: Personal issues of helplessness

Participants expressed helplessness, due to several reasons. They stated as follows;

“These challenges affect me as a paramedic, because I know that I am not optimal in transferring these critical babies. I know that I am detrimental to these babies...If a baby demises because of sub-optimal care...I have to live with that guilt. It really worries me to know that we are not doing everything we can as professionals to transfer the babies.”

[ALS Interview 5, Page 2]

“...I am so nervous and insecure because I am dealing with a neonate that has a life threatening condition. I don't know what to expect next with these babies, we are so insecure because we are not prepared and we do what we can....Transferring sick babies is my greatest fear.”

[ALS Interview 1, Page 8]

a Sub-theme 1: Exhaustion, burnout and demotivation

Participants from the public sector also expressed feelings of exhaustion, burnout and demotivation all of which could lead to mistakes that could jeopardise the neonate.

“With the increase work load between operational duties and transfers, we are exhausted, we are burnt out and very demotivated. This is a disaster waiting to happen”.

[ALS Interview 3, Page 4]

“We are exhausted working at this pace. There are so many transfers, the system is very poor, paramedics are fatigued in this current context. Mistakes are bound to happen in this system.”

[ALS Interview 2, Page 13]

b Sub-theme 2: Intimidation by others

Paramedics also expressed feeling intimidated by doctors into undertaking the transfer of unstable neonates and from management and the aeromedical coordinators, especially when pilots put pressure on them due to daylight hours, shift changes or weather conditions. They also indicated that having no voice within the system.

“You know, at times I feel much intimidated because I deal with professionals, handing over and taking over the babies from me”.

[ALS Interview 5, Page 9]

“On the aeromedical unit we are always pressured and sometime forced to do transfers, even if the neonate is unstable for transfer. This also happens on the ground unit but not as bad when working aeromedical. Doctors transfer the unstable babies because it is not there responsibility any more. As much as we advise them that the neonate is unstable for transfer, they insist that we continue. We don’t have the power to disagree because the air ambulance is an expensive unit. Complaints escalate to high levels and we will get in trouble for refusing the case. No one speaks for us. We get pressured from the aeromedical coordinator and EMS managers who make poor decisions based on what information is given to them telephonically, yet they do not listen to us even though we are with the patient and describing what we are seeing. We stress that this is an unstable patient for transfer but we are forced to do the case.”

[ALS Interview 6, Page 4]

5.3.1.4 Theme 4: Challenges associated with the transfer process

Other challenges associated with the transfer processes can be seen within the following four sub-themes.

a. Sub: theme 1: Poor preparedness of the communication centre

All participants expressed that the dispatch details given to them about the neonates and the transfer requirements, lacked vital information, were incorrect or were misunderstood by the staff in the communication centre. This was related to the fact

that staff at the communication centre lacked seniority or were inexperienced, and did not understand neonatal transfers. This resulted in relevant information being omitted or not obtained from the referring doctor or from the communication centre to the transfer team. This resulted in paramedics arriving at the referring hospital without appropriate or sufficient equipment. Participants said as follows :

“If I get all the information.....I quickly familiarise myself with what’s going on with the patient so I’m prepared for that patient. As far as the diagnosis, if there is anything that I am concerned about, I quickly do some research on what the pathology is that I’m dealing with, quickly go over the infusions and stuff like that, so I have a better understanding. Neonatal transfers are hectic you know, so we need all the information to do all of this”. [ALS Interview 6, Page 5]

“...sometimes control gives us false information. When you go to hospital you realise that the doctor requested equipment but they didn’t tell us. We now have to go back to get the equipment or make a plan”.

[ALS Interview 2, Page 5]

b. Sub-theme 2: Pre-transfer preparation of the fragile neonate

Participants reported that neonates were often unstable before a transfer and required lifesaving intervention to be stabilised, before being transferred. Paramedics reiterated as in the previous subsection that they are sometimes forced to transfer unstable neonates. They said as follows :

“.....often critically ill neonates are not packaged properly or not packaged at all. We need to package patients appropriately before leaving the hospital, sometimes the hospital staff are not familiar with the procedures we have to undertake”. [ALS Interview 2, Page 5]

Some participants also mentioned that in level 1 and 2 healthcare facilities in particular, doctors lacked knowledge about the transfer process and had little confidence in their own life saving skills, which results in them waiting for the paramedics to attend to the neonate.

“...There is lack of skills and knowledge even by doctors that is really hampering or making life difficult for us, especially in referring hospitals, the district and rural hospitals. They do not intubate and ventilate the patient because they wait for us to come to treat the babies. Its either they not confident with their skills or they don't have equipment or don't understand their equipment. There are a lot of junior doctors around and it depends on which hospital you go to. We don't have problems with specialists”.

[ALS Interview 2, Page 5]

Similarly, participants who worked on air ambulances expressed the importance of stabilisation before transfer. They expressed that doctors specifically from the outreach areas, do not understand the importance of pre-transfer stabilisation.

“Critical babies don't do very well in flight, therefore they must be stable before the flight, some doctors don't understand that. They just get carried away by the heli and the plane. Our biggest challenge is the doctors in the outreach areas. They have no idea on how to treat a critical patient, let alone treating a critical patient in flight. They need to be workshopped in pre-hospital care.. once we take off we cannot just pull over and stabilise the patient, the patient must be fully stabilised for flight”.

[ALS Interview 5, Page 9]

c. Sub-theme 4: Challenges en-route to the receiving facility

Paramedics reported experiencing multiple challenges en-route to the receiving facility. This included managing the critically ill neonate alone in the ambulance and struggling with dysfunctional equipment and the dynamics associated with providing care in a moving vehicle.

“There's no one assisting me, if something does go wrong then I'm stuck with the patient alone. When we do the transfer with crews, the transfer works well and is not so much of a hassle”.

[ALS Interview 3, Page 6]

“.....equipment moves all over, we try our best to secure the equipment but our ambulances are not properly designed...equipment failure during transport is our biggest issue right now.”

[ALS Interview 7, Page 7]

d. Sub-theme 4: Poor communication and lack of clinical advice

Participants also mentioned that poor communication between the referring and receiving facilities, the communication centre and the transfer team, during the transfer posed other challenges. Of importance was the lack of immediate clinical advice for the paramedic when the neonate deteriorates during the transfer.

“.....there's no clinical advice, if I need clinical advice if the baby deteriorates then I would be stuck. I wouldn't know what to do because we have no cell phones, no doctors contact numbers. Our only communication is through the control room but that is an issue on its own. I have never got clinical advice in all my years as a paramedic”. [ALS Interview 3, Page 6]

“...on the ground ambulance we do not have cell phones but on the aeromedical we do. The advantage of being in the aeromedical is the cell phone, but during flight we got no signal or can't hear anything so you without communication...” [ALS Interview 2, Page 10]

A few participants said that receiving hospitals were also not informed that the transfer team had left the referring hospital, which meant that the doctors and nurse had to hastily prepare for accepting the neonate, while the paramedics waited to hand over.

“When we go to hospitals we have to hand over to the doctor, most of the time they available to receive the patient. We do have problems sometimes when you get to hospital the doctors are not aware the patient is coming through. The doctor and nurse only start preparing the bed and the ventilator when we there, rushing and doing things like that, the doctor was not informed that the patient is coming through. So that's delay, you have to wait half an hour. We run out of oxygen sometimes while waiting to hand over”. [ALS Interview 3, Page 7]

5.3.1.5 Theme 5: Lack of preparedness

All all the participants expressed that they did not have sufficient educational training for neonatal transfers. This was stressful as once they qualified, they were

immediately required to undertake critically ill neonatal transfers, without any experience. They said :

“Due to the lack of a comprehensive programme with the correct equipment, staff, education and training, we are simply not prepared to deal with these critical babies the way we correctly should...”. [ALS Interview 2, Page 13]

“Sometimes I cannot answer the doctors questions, sometime I have no comment because we are not prepared enough to match that level of professionalism”. [ALS Interview 5, Page 9]

a. Sub-theme 1: Anxiety and fear

Some paramedics described their fear and insecurities when these transfers and said that the challenges associated with undertaking transfers led to diminished self esteem and made them more reluctant towards effecting transfers.

“The staff must have experience in neonatal transfers and want to work on the unit, not forces to do the transfers. Certain paramedics prefer trauma patients, medical patients, transfers.....so working on the neonatal transfer unit should be the paramedic’s choice because he wants to do work there. It will then mean that he will love doing transfers of critical babies. The baby will benefit.”

[ALS Interview 7, Page 8]

“.....nervousness will always be there because you are dealing with a neonate that has a life threatening condition, you don’t know what to expect next, so insecure because we are doing what we can...Transferring sick babies is my greatest fear because we are not prepared”. [ALS Interview 1, Page 8]

b. Sub-theme 2: The lack of subspeciality programmes

Paramedics highlighted that the lack of a subspeciality programme related to neonates impacted their ability to gain knowledge and experience related to transfers. They stated as follows :

“We are transferring critical patients from neonatal intensive care units, it’s a speciality on its own. Staff are trained only for that specific purpose after they

did the general training. They have a choice to specialise. Why don't we have that. We are taking over and handing over from specialists, neonatologists, NICU nurses....we are the weakest link, to strengthen the link we must have subspeciality programmes". [ALS Interview 2, Page 8]

"I believe that all paramedics should be given an opportunity to choose a sub speciality within their scope of practice, this is common practice elsewhere but not the case in EMS." [ALS Interview 4, Page 10]

5.3.1.6 Theme 6: Support for mothers during transfer

The data reflected that it is the mother who primarily accompanies their baby. She however receives little or no attention as paramedics focus more on the physical care of the neonate. Four sub-themes emerged under this theme.

a. Sub-theme 1: Fear and anxiety of the mother

Paramedics expressed that mothers presented with high levels of fear and anxiety due to the clinical condition of the neonate and the transfer process itself. They said as follows :

Its very noticeable that mothers are terrified during the transfer...they are stressed as they don't know what's happening....they see all those machines on their babies and the babies condition, you can see them worried and scared." [ALS Interview 1, Page 9]

"It is scary to see your baby in that state, being ventilated, pipes and tubes in you baby, the bumpy ride to hospital". [ALS Interview 3, Page 9]

b. Sub-theme 2: Psychological needs of the mother

The data further revealed that the psycho-social needs of the mother are often ignored as paramedics tended to prioritise care of the neonate. They expressed that :

"....usually we don't even include them that much, we don't pay attention to the mother like we should....our focus is on the neonates than the actual mother". [ALS Interview 1, Page 9]

“...we don't have training in psychology, we just learnt from experience and we do what we can. Remember the baby is critical”. [ALS Interview 7, Page 9]

A few participants noted that mothers are often overlooked not just from the transferring team, but also at the hospital.

“I don't know whether the hospital counsels the mothers, especially the critically ill, and again every hospital does things differently. But it does not matter what happens in hospital, our service should have something in place because this mother is now in our care. We need basic knowledge in counselling so we can counsel mothers. For me this is very important”. [Interview 6, Page 8]

c. Sub-theme 3: Clinical incidences related to the mother

Data also revealed that the medical needs of the mother are overlooked despite her being a patient herself.

“I would like the mother to come with us if the mother is an escort and not as a patient. Even if she is a patient, we must be aware of the fact that this is a patient, and if a patient, is she stable or unstable or unstable. But we give no attention to the mother even if she is just escort. It is sad to say this, but these babies are unstable, our priority is the baby. We are focused on the baby and with all the challenges that we face we have no time for anything else”.

[ALS Interview 2, Page 15]

Whilst the aforementioned issues were raised by those in aeromedical practice, they added that the flight itself heightened mothers levels of fear and tension, especially if they had not flown before. Prophylactic treatment was necessary to avoid motion sickness. They also noted that the size of the air ambulance, prevented them from attending to the physical needs of the mother who is prone to bleeding during the transfer. They said as follows :

“...there is not much that we can do other than comforting her in terms of the flight and just letting her know that the baby would be fine during transport and its more comforting her during flight because generally most of them haven't flown before so they are quite nervous. They look very tense when

they see the heli or the plane. Some mothers had never flown before so we have to prepare the mother for flight. We give them something for motion sickness”. [ALS Interview 5, Page 10]

5.3.2 Discussion of findings

The purpose of the ALS interviews was to elicit a more detailed understanding of the neonatal transfer process, particularly the organisational structures and deficits and other challenges associated with the transfer itself.

5.3.2.1 Theme 1: Organisational structural deficiencies

The organisational structures responsible for co-ordinating the transfer of the neonates reflected significant deficiencies that compelled immediate attention. What was interesting was that the issues remained the same regardless of it being the public or private sectors, ground or air ambulances, except that with the latter unroadworthy road conditions in rural areas exacerbated transfer delays

In the United States, the most recent national consensus document regarding neonatal inter-facility transport, provided current evidence and expert opinions on paediatric and neonatal inter-facility transport (Stroud, Trautman and Meyer 2013). According to the consensus, a neonatal transfer programme requires appropriate management structures, a well configured specialised and dedicated transfer team with specialized transfer, good communication and coordination, a quality assurance programme and appropriated documentation. This was also consistent with recommendations made in other studies within the past decade (Fortune, Parkins and Playfor 2017; Gilpin and Hancock 2016; Whyte and Jefferies 2015; Ratnavel 2013; Stroud, Trautman and Meyer 2013; Kage and Akuma 2012; Jackson and Skeoch 2009) and highlights the stark deficiencies within the South African system with regards to a proper management structure embedded within a specialised unit that manages, co-ordinates and supports neonatal transfers. As can be seen in the data proper communication between the different stakeholders was critical to providing important information to prevent delays and to provide clinical expert help when the neonate deteriorates enroute. This dedicated specialised unit can integrate the expertise of all medical providers who can execute their roles and responsibilities, adhere to recommended monitoring procedures, and a systematic

approach to continuously improving the quality of healthcare (Fortune, Parkins and Playfor 2017). This organisational structure does not exist in South Africa and other similar settings. The following sub-themes emerged from this primary theme:

a. Sub-theme 1: Lack of a specialised transfer team

Developed countries such as the United States (Stroud, Trautman and Meyer 2013), UK (Senthilkumar et al. 2011; Lim and Ratnavel 2008) and Switzerland (McEvoy et al. 2017), use specialised teams to undertake neonatal transfers. These teams include physicians, anaesthetists, respiratory therapists, paramedics, neonatal intensive care nurses, or a combination of experts from these disciplines depending, on the needs of the neonate (Chang, Berry and Sivasangari 2008). The strength of these teams lies in harnessing the unique specialised knowledge and expertise of these professionals which has resulted in a significant reduction in neonatal mortality rates abroad (McEvoy et al. 2017; Droogh et al. 2015; Gonzalez 2014; Parmentier-Decrucq et al. 2013; Blakeman and Branson 2013; Baird and Ravindranath 2012; Messner 2011; Lee et al. 2010; Lim and Ratnavel 2008). Whilst this approach can be adopted abroad, financial constraints may hinder its implementation in South Africa. Moreover the geography of developed countries, which is characterised by relatively short distances between hospitals, and adequate resources enables individual healthcare facilities to offer this service without severe disruption to their daily work. In contrast ALS paramedics in South Africa are challenged to undertake retrievals alone without the specialised help enjoyed in developed countries. Despite the contrasting contexts, the proposed new programme must endeavour to set up specialised teams to enhance the support ALS paramedics require for successful transfers.

Currently once a transfer is required, closest available paramedic becomes involved, regardless of whether they have the necessary expertise. This coupled with a diminished infrastructure and lack of equipment jeopardises the survival of an already vulnerable neonate. It is crucial then that the newly developed programme be developed with a dedicated transfer unit with a specialist team at the centre of managing and effecting the transfer.

b. Sub-theme 2: Inappropriate managerial structures

Although South Africa, has a severe shortage of resources both human and material, it is crucial that they are resources are used appropriately and optimally where required. The neonatal transfer service is one such context which demands a high level of proficiency and the need for experienced managers to manage transfers when they arise. The data found that in most instances those in control had limited educational preparedness and experience to understand how to co-ordinate and manage the transfer. It is crucial then that specialized neonatal transfer units be headed by those who have the requisite educational background and managerial skills to manage those involved in the transfer and the transfer process itself.

Sub-theme 3: Documentation needed for the transfer

Stroud, Trautman and Meyer (2013) pointed out that successful specialised programmes that have evolved in the United States, have at their core relevant and standardised documentation, unique to neonatal transfers, so as to foster quality and continuity of care. Horowitz and Rozenfeld (2007) wrote that documentation creates a means of communication between healthcare providers about health status and clinical management of the neonate, transfer quality assurance and planning. However the current study revealed that there was no unique neonatal documentation, that those used with adult population were used, meaning that important information was often not captured re the clinical condition of the neonate and other important information. The absence of a full history and assessment rubric, means that transfers are effected without a diagnosis leaving serious questions regarding management of the neonate without same.

In addition to the lack of this type of patient documentation, other documentation related to the transfer appeared absent. The study also found that pre-transfers and pre-departures checklists were not complete in many transfers. Fenton and Leslie (2012) in the United Kingdom, asserted that checklists of equipment and supplies are aide memoires, and should therefore be mandatory to ensure that all equipment is in good working order and that the requisite medical supplies required during the transfer process are available immediately. Without this as is evident in the study, ALS paramedics may be faced with providing with dealing with a deteriorating

neonate without the appropriate medical supplies. Further deficits that were uncovered, included the lack of a satisfaction or complaints form, that was not given to the receiving personnel on completion of the transfers. These issues with documentation should be addressed in order to improve the transfer system.

d. Sub-theme 4: Gaps within the aeromedical unit

Whilst aeromedical transfers in countries such as USA and Australia have become well established, not all developing countries have had this privilege due to resource constraints (Carreras-Gonzalez and Brió-Sanagustin 2014; Horowitz and Rozenfeld 2007). Other countries such as England, Wales and Northern Ireland, still are highly dependent on the use of military assets for emergency transfers. Whilst SA does have an aeromedical unit to effect neonatal transfers, huge deficits appear related to co-ordination which results in delays and the lack of equipment and medical supplies as experienced by the ground ambulance. Air ambulances simply cannot stop when the infant requires medical supplies, making it more important that the transfer process be strenuously interrogated for both functional equipment and necessary medical supplies. Jackson and Skeoch (2009) asserted the importance of rigorously abiding by strict criteria for aeromedical transfers, as they are most often distant transfers. Moreover transfers in developed countries are executed by organised, dedicated and experienced teams to ensure that they are undertaken safely and timeously, to make a difference between life and death of the neonate. Whilst resources are the hugest constraint locally, consideration must be given to the need for experienced teams for aeromedical transfers. Careful careful attention must also be paid to proper clinical stabilisation and preparation before take-off.

Aeromedical transfers also do not function in isolation, as the neonate may also require road transfer during the mission, except when helicopter landing sites are available at both receiving and referring institutions. When air ambulances land at rural areas, delays in the arrival of ground ambulances further prolongs the transfer process, which requires that paramedics have to continue clinical management for long periods on the airfield, before the ground ambulance arrives. This again requires that ALS paramedics have the necessary educational preparedness and clinical expertise to manage an ill neonate awaiting further transfer. It also points to the need for proper co-ordination and communication between the aeromedical

service and ground ambulances to prevent such delays, and ensure a more expedited transfer process. Studies in India found that the prolonged transfer of a neonate is unsafe and increases the risk of morbidity and mortality (Sethi and Subramanian 2014; Dalal 2013; Narang et al. 2013). This was supported in other studies by Hankins (2010) and Mori *et al.* (2007) who also noted that long transfers are risk factors on their own, for neonatal mortality. In fact a critically ill neonate transferred for more than ninety minutes doubles the risk of mortality, which warrants a careful consideration of how any transfer can be effected in a shorter space of time.

It was also noted that due to limited resources at health Districts in KZN, within the healthcare facilities and EMS, aeromedical transfers are used as a first line resource allocation. Aeromedical transfers should be used for the right patient, at the right time and to the right hospital. The current manner in which it is being used is incorrect as it defeats the purpose of having an air ambulance. Aeromedical transfers are very expensive and amounts to wasteful expenditure due to these challenges. The cost must be considered and should be explicit rather than hidden within EMS as a whole. Furthermore, when the air ambulance is required for an emergency, it is unavailable because it is being used inappropriately.

d. Sub-theme 5: Inadequate quality assurance

The study also found that quality assurance programmes which were crucial to monitor the performance of transfer teams, required registrations, certifications and licensing of EMS personnel, maintenance of equipment and vehicles, and safety issues are sorely lacking. More sophisticated systems abroad, undertake research as an important part of quality assurance, in order to uphold quality (Bigham *et al.* 2014). Continuous planning, regular audits, proper documentation, reporting mechanisms, professional leadership and accountability must be in place, so that the overall system allows for problems to be caught in time and issues addressed before disastrous situations are encountered (Breathnach and Lane 2017). Moreover continuous and appropriate quality assurance allows for comparisons and benchmarking processes within programmes and with other similar programmes (Romanzeira and Sarinho 2014). Policies, procedures and clinical practice guidelines

must consider the context in which the service will be operationalised and must be continuously reviewed by a group of experts (Ratnavel 2013; Bérubé *et al.* 2013).

Inter-healthcare transfers of critically neonates by ground or air ambulance are complex and do not work in isolation. Adverse events and challenges that have occurred during a transfer require earnest reflection and consideration by the entire team both to improve services and educate the team about how to manage different dynamics within the transfer. There should be open meetings by the relevant stakeholders, where staff can evaluate their performance, brainstorm new ways of functioning and be aware of issues pertaining to obsolete equipment and new organizational developments. Providers involved in the neonatal should also be familiar with the limitations and responsibilities of their scope of practice, and the legislative prescripts in EMS and health.

5.3.2.2 Theme 2: Deficiencies in specialised transfer equipment

Issues related to specialised neonatal transfer equipment were discussed in the preliminary analysis. However, data derived from this sample strengthened what was found and lent support for initial findings that the existing equipment for neonatal transfers, were a significant problem that contributed to the number of life threatening adverse events. Other studies have noted that equipment technical related problems are also common in developed countries (Goldsmith *et al.* 2012; Senthilkumar *et al.* 2011; Viera *et al.* 2011, Meberg and Hansen 2011; Lim and Ratnavel 2008), due to the nature of the pre-hospital environment. However, the data in the current study identified multi-faceted issues with equipment, which could be avoided. These ranged from equipment malfunctioning to a lack of equipment, lack of a maintenance or service plan, lack of infection control, and the deterioration of the neonate due to equipment failure.

a. Sub-theme 1: Malfunctioning, incompatible or insufficient equipment

It was disconcerting to find the huge issues around both the lack of required equipment as well as dysfunctional and unsterilized equipment. Clinical monitoring of an ill neonate, is unlike the hospital environment as the ambulance presents a challenging environment fraught with environmental hindrances, such as limited cabin space, vibration and motion, poor lighting, turbulence and high ambient noise.

Horowitz and Rozenfeld (2007) argued that, transfer teams can be dispatched to effect a transfers at any time, therefore necessitating that the monitoring equipment and medical supplies be sterile and functioning optimally. In fact as Droogh *et al.* (2015) argued equipment for the transfer of a critically ill neonate should be allocated to dedicated unit to prevnt such problems. Messner (2011) added that effective control and management of equipment is an important part of preventing equipment related issues.

The study found that equipment incompatibility was a huge problem in the South African context and detrimental to the purpose of the transfer. Paramedics were often faced with having to improvise with other equipment which can compromise life saving procedures required on a transfer. Although there is a limited market for specialised neonatal transfer equipment locally, more resources should be allocated to sourcing specialist items, equipment that is compatible with the vehicles being used for transfers. Guidelines suggested by the Australasian College of Emergency Medicine (2015) for the transport of critically ill patients indicate that equipment should be appropriate and attention should be give to the size, weight and volume of resources with consideration of the patient and the patient's condition. This suggests that the the battery life, oxygen supply and durability of equipment should also be considered based on the distance travelled, time for completion of transfer and the method of transfer. Both respiratory and circulatory support must be included along with other general supportive care equipment. Sethi and Subramanian (2014) further noted equipment for airway management, circulatory and respiratory support as well as resuscitation drugs as key elements of safe inter-healthcare facility transfers.

b. Sub-theme 2: Lack of equipment maintenance or service plan

The findings also showed a lack maintenance or service plan for equipment used in transfers. Jackson and Skeoch (2009) suggested that equipment for neonatal transfers shoud be certified for use and with aeromedical transfers, it be certified specific to the aircraft. Parmentier-Decrucq *et al.* (2013) highlighted the importance of equipment management policies which cover equipment maintenance strategies and appropriate documentation related to regular testing, procurement and replacement plans. Hence even minor defects with equipment should be investigated and repair effected immediately.

c. Sub-theme 3: Lack of infection control

Healthcare related infections often results in prolonged hospitalization, long-term disability, death, and considerable financial impact on patients, their family members and healthcare institutions (WHO 2011). No healthcare facility, including those within the most advanced and sophisticated healthcare systems, can claim to be free of the problems related to health care associated infections (Lorenzini, Costa and Silva 2013). Therefore, the WHO's 100 Core Health Indicators list reinforces the need for having national infection prevention and control (IPC) guidelines to provide a coordinated approach to prevent harm caused by infections to patients and health workers (WHO 2015). There are different levels of risk associated with infection, as they differ according to the various environments. Most infections are preventable when the appropriate infection prevention and control practices are implemented according to their specific settings and circumstances. This aids in providing quality health care for patients and a safe working environment for healthcare workers (South Africa, KwaZulu-Natal Department of Health 2012d).

Given these stringent guidelines it was disconcerting to find the following : non-compliance with the infection control policy, no proper disinfection procedures, and possible cross contamination between hospitals due to the hospital equipment being borrowed for the transfer. This is unacceptable given that neonates, are at a higher risk of acquiring healthcare related infections as a result of their immature defence mechanisms. The transmission of bacterial flora to the neonates is usually acquired through contact with the mother during delivery, and from family members, health care workers and equipment during their stay in hospital (Nicholas, David and Mills 2013). Neonates are particularly more vulnerable to infections, as they often undergo invasive procedures and are dependent on central catheters to deliver nutrition and ventilators for respiratory support. This places them at a higher risk of being colonised by strains of microorganisms present in the environment, which are most often antibiotic resistant. Equipment should therefore not be shared and single use items must be discarded after use and equipment cleaned and disinfected (South Africa, Department of Health 2012e).

d. Sub-theme 4: Deterioration of the neonate

The data also revealed that deterioration of the neonate during transfers was linked to exhaustion of oxygen supply and ventilator and incubator malfunction. Tracheal tube blockage, accidental tracheal extubation, loss of monitoring and loss of intravenous access were also common occurrences when transferring the neonate from the hospital equipment to the transferring equipment and/or in and out of the ambulances. These issues were also documented in several other international studies (Goldsmith *et al.* 2012, Meberg and Hansen 2011, Senthilkumar *et al.* 2011, Viera *et al.* 2011; Lim and Ratnavel 2008). Deterioration of the neonate due to the aforementioned factors is avoidable if there is leadership and accountability related to the use of the equipment.

5.3.2.3 Theme 3: Personal issues of helplessness

Most of the sample expressed deep feelings of helplessness when confronted with the aforementioned challenges. They also reported exhaustion, burnout and demotivation, that arose from feeling helpless. In addition, several participants experienced intimidation from other professionals and felt that they lacked a voice in the system. The following sub-themes reflect these issues :

a Sub-theme 1: Exhaustion, burnout and demotivation

Neonatal transfers are stressful because those tasked to effect same must respond to the needs of the patient and family under circumstances of extreme stress as they are faced with saving the life of the neonate. The growing evidence of poor quality in neonatal healthcare in developing (Henry and Trotman 2017; Ashokcoomar and Naidoo (2016); Deepak *et al.* 2015; Kumar *et al.* 2010), may be linked to burnout of healthcare workers (Chou, Li and Hu 2014). Stroud, Trautman and Meyer (2013) recognized that organisational factors, namely structures, processes and resources (human and material) were also responsible for demotivation and burnout. In EMS in South Africa, shortages of trained paramedics and limited resources (human and material), as reflected in this study are the potential reasons for the burnout and feelings of helplessness experienced.

A lack of educational preparedness and subspeciality programmes as evidenced within the data leaves paramedics unprepared for certain aspects of emergency care, particularly neonatal transfers. This inevitably leads to feelings of disempowerment and helplessness. Montgomery *et al*, (2011) suggested that motivation is also increased when a healthcare worker is placed in his/her field of interest. This suggests the need for paramedics to be placed within the ambit of neonatal transfers, following proper educational preparedness so that they can cope with this type of emergency. The implementation of a specialised dedicated transfer unit which is manned by those with interest and expertise is therefore recommended.

b Sub-theme 2: Intimidation by others

In South Africa, ALS paramedics are the pre-hospital specialists and the team leaders responsible for inter-healthcare facility transfers of critically ill neonates (Health Professions Council of South Africa 2014). The study found that they are often coerced to transfer unstable or inadequately prepared neonates with life-threatening conditions by other health care professionals. The study found that doctors often intimidated paramedics to effect transfers to shift the responsibility of the neonate from their facility to another. This also resulted in feelings of helplessness, especially where they are aware of the risks associated with the transfer. Paramedics of knowledge related to neonatal care also creates disadvantage, as they cannot defend reasons not to transfer due to the traditional and hierarchical order, which dictates that expertise rests amongst the doctors. Moreover, a potential lack of knowledge amongst doctors themselves, who may not have expertise related to neonates may compel them to effect transfers that are potentially risky. This further grounds the need for a specialist manager within a dedicated unit to oversee decision making. Paramedics are also intimidated by pilots and managers, to expedite the transfer due to their own or the referring facility's high workloads.

The literature indicates that "swoop and scoop" is no longer considered appropriate, with speed being viewed as detrimental, in comparison to investing in resuscitating and stabilising the neonate before the journey. Gilpin and Hancock (2016) argued that pre-transfer stabilisation and preparation may be more beneficial than rapid

delivery to a healthcare facility. The objective of the transfer team is to achieve physiologically acceptable haemodynamic and metabolic parameters before transportation. There is a rare need for haste, and panic transfers which may result in morbidity or mortality. It is the hospital or clinic that provides a less riskier environment for stabilising a critically ill neonate, than bouncing around in the back of an ambulance or in a restricted space of a noisy unstable aircraft (Messner 2011). Ratnavel (2013) therefore argued that everyone involved in the transfer process from beginning to end, including doctors, nurses, emergency care providers and support services, have a thorough understanding of the risks and processes so as to ensure that an informed decision is made, with a positive outcome for the neonate.

5.3.2.4 Theme 4: Challenges associated with the transfer process

Care during the transfer begins from the time the team leaves the referring ward, and includes loading the neonate into the ambulance, the ambulance journey and unloading the patient from the ambulance, to the handover at the receiving facility. To maintain a continuum of care the standards of monitoring and clinical management should be equivalent to a neonatal intensive care unit environment. Monitoring and evaluation must be continuous throughout the transfer. Of most significance is the fact that the trip to the receiving hospital must be safe to avoid compromising the neonate, transfer team and accompanying personnel.

Regardless of whether transfers of neonates occurs internationally or nationally, the transfer process and the principles remain the same (NNF Clinical Practice Guidelines 2010). On an international level, within the EMC context, the transfer process commonly consists of the activation phase, the preparation phase, the principles of transfer and communication (Gilpin and Hancock 2016; Messner 2011; Fendya *et al.* 2011; Miller *et al.* 2008). Kage and Akuma (2012) indicated that the transfer process is the joint responsibility of the referring hospital, the transfer team and the receiving hospital. In addition, the responsibility is shared by all those who are involved throughout the process, from beginning to end, including doctors, nurses, emergency care providers and support services (Whyte and Jefferies 2015). It is therefore important that the transfer team has a thorough understanding of the transfer process, and that a systematic, integrated approach is adopted to provide

the best service (AAGBI Safety Guidelines 2009). This supports the need for this to be co-ordinated by a specialized unit.

a. Sub: theme 1: Poor preparedness of the communication centre

According to Hillary (2015), during the initiation or activation phase of the transfer, it is essential that the EMCC receive as much information as possible about the neonate and the transfer requirements, so that this information can be relayed to the team leader to prepare for the transfer. Stroud *et al.* (2013), further indicated that the staff at the EMCC should be well trained neonatal transfers to receive these calls. However, data from this study showed that the staff in the EMCC did not take down the appropriate information, that is required for the transfer which suggests a lack of preparedness for this process. This was possibly due to junior or inexperienced staff in the EMCC. Before proceeding to the referring hospital, the transfer team familiarised themselves with the neonates condition, ensured the equipment was in good working order and that no equipment was left behind. In order to effect this, it is imperative that all relevant information be relayed to the transfer team leader. Unfortunately, this was not evident in the current study because correct and appropriate details were not given to the paramedics. This was highlighted in the previous subsection.

b. Sub-theme 2: Pre-transfer preparation of the fragile neonate

The preparation phase is undertaken by the transfer team and is done before proceeding to the referring facility. Irrespective of the retrieval system used in developed countries or under developed countries, all transfers should have a team leader who is suitably qualified and registered with the countries regulatory body to make decisions and provide the necessary leadership and medical care (Gilpin and Hancock 2016). The most senior medically qualified person on that team is automatically designated to be the team leader. Although the team leader is ultimately responsible for the transfer, all team members need to work collaboratively and understand their respective responsibilities.

Messner (2011) indicated that re-transfer preparation is a critical aspect of identifying those factors that may potentially arise and compromise the neonate before being transferred out of the referring facility. This stabilisation determines their ability to

tolerate the transfer and ensures a successful outcome (Carreras-Gonzalez and Brió-Sanagustin 2014). Although there is a tendency to expedite the transport process, the time spent on pre-transfer preparation of the fragile neonate, before leaving the referring hospital is critical to a safe and effective transfer (Kumar *et al.* 2010; Ratnavel 2009). This was discussed in the preliminary analysis and will also be discussed in detail in the developmental phase.

c. Sub-theme 4: Challenges en-route to the receiving facility

Despite pre-transport stabilisation and preparation, neonates may deteriorate during the transfer, and the transfer team should have adequate knowledge and skill to be able to clinically manage these emergency situations. Care en-route to the receiving facility begins from the time the transfer team leaves the referring ward, and includes loading the neonate into the ambulance, the ambulance journey and unloading the patient from the ambulance to the handover at the receiving facility. To maintain a continuum of care or optimal care, demands that the standards of monitoring and clinical management should be equivalent to a neonatal intensive care unit environment. This study uncovered that paramedics encounter numerous challenges en-route to the receiving facility, which requires greater preparedness to deal with any of the clinical emergencies that occur. Monitoring and evaluation should therefore occur continuously throughout the transfer. Paramedics indicated that they sometimes undertake a transfer single handedly, at the back of the ambulance. This is challenging due to the nature of the critically neonate. This demands a higher level of educational preparedness and clinical competence.

Moreover, if the mother also accompanies the neonate, then she may also require care, making it challenging to deal with two patients. Being alone with a critically ill neonate is potentially hazardous, as the paramedic must carefully monitor both the baby's condition during the journey and the following factors: ventilation and oxygenation, thermal, cardiovascular and metabolic support and provide lifesaving interventions if necessary. Dealing then with the needs of the accompanying family member makes it even more complex for one individual as the mother may also present with post-birth complications.

According to Stroud, Trautman and Meyer (2013), the team leader must undertake a transfer pre-briefing to inform the team members of the neonate's condition, and a pre-departure checklist must be completed to ensure that no equipment is left behind. Taljard (2008) highlighted that all equipment must be well secured in the ambulance before departing to the referring hospital. The team leader must inform the communication centre of the estimated time of arrival (ETA) at the referring facility, to ensure that the referring personnel are updated as to when to expect the transfer team so that they can have the neonate stabilised, prepared and ready for transfer.

d. Sub-theme 4: Poor communication and lack of clinical advice

Poor communication during the transfer process was identified as a huge concern. Proper communication between the transfer team, the referring facility and receiving facility staff is crucial to a smooth transfer. During the transfer process the ALS paramedic, is the team leader and is responsible entirely for the neonate during the process. The dispatch details given by the communication centre to the transfer team leader must be audible, clear and understood, to avoid misunderstandings, regarding the neonate's condition, treatment already undertaken, equipment required and any other information vital for the transfer (Boxwell 2010).

In the event of seeking clinical advice, there must be direct communication between transport team and the doctors from the receiving and referring facilities. However, the study found that communication this type of communication was lacking.. Furthermore, the referring hospital should be prepared and ready to accept the neonate, which was not evident in the data from this study. Due to the lack of or poor communication between EMS and the receiving facilities, paramedics had to wait for the staff to prepare the for the neonate to be handed over, because they were unaware that the baby was coming to their particular unit. This added to time delays, which meant that the paramedic and the ambulance were unavailable for the next emergency.

5.3.2.5 Theme 5: Lack of preparedness

The lack of preparedness to undertake a critically ill neonatal transfer, is discussed under the following sub-themes: anxiety and fear due to a lack of preparedness, the

lack of sub speciality programmes, and expertise gained through ongoing training and time spent in the neonatal intensive care unit.

a. Sub-theme 1: Anxiety and fear

As indicated paramedics have fear and insecurities when undertaking critically ill neonatal transfers due to their lack of educational preparedness. In developed countries, neonatal transfer programmes select team members based on their interest in the field, and provide specialised education and training to ensure that they can provide an acceptable level of care that is beneficial to the outcomes of the neonate (King *et al.* 2007). Such a programme allows a paramedic to voluntarily choose to be a part of the neonatal transfer team, hence the team members show greater interest and proficiency with regards to transfer challenges. Local literature reflects that such training or a subspeciality programme is absent in South Africa (Ashokcoomar and Naidoo 2016), leaving paramedics quite unprepared for this aspect of emergency care.

b. Sub-theme 2: The lack of sub specialty programmes

The intensive care environment is technologically very sophisticated and requires that providers have knowledge of same including clinical knowledge and a high level of decision-making skills. Viewed holistically they enable care for critical patients and their families who are in a vulnerable situation. Inter-healthcare facility transfers of critically ill neonates demands skills for the intensive care environment, which is a sub-specialty in SA. The latter provides complex and detailed health care for various acute life-threatening conditions (American Association of Critical Care Nurses 2006; de Beer, Brysiewicz and Bhengu 2011). Doctors and nurses working in the ICU's, undergo additional specialised education and training, and have a common understanding of critical care, which requires the collaboration of multi-disciplinary teams.

However, this is not the case with ALS paramedics, in South Africa. Once ALS paramedics qualify, they register with the HPCSA and can immediately enter the field of EMS, with no internship or apprenticeship programme. This suggests a huge level of unpreparedness. They may enter the workplace with a broad theoretical knowledge with skills that were acquired through supervised experiential learning.

However, this remains inadequate as they lack the expert knowledge that other specialist fields have, such as with doctors or nurses in the NICU's. Despite this, they are tasked to effect the transfer of these critically ill neonates which suggests that training providers begin to develop specialised modules to enable them to have a level of expert knowledge to manage these types of transfers. Furthermore, the data indicates that whilst there is some educational preparedness for these transfers, it is very theoretical and there remains a disconnect between what is actually taught and the very unique challenges that arise in actual practice. Practice in EMS, especially with regard to the inter-healthcare facility transfers of critically ill neonates, varies according to region and the availability of resources. Therefore, from the time a paramedic enters the system, knowledge gained from experience is dependent on these varying contexts.

A sub speciality programme, will create the opportunity for ALS paramedics wishing to join the neonatal transfer service, to receive the necessary knowledge and skills. This in conjunction with registration with the HPCSA, will ensure ethical and professional conduct in accordance with statutory requirements. Before entering the transfer programme, it is crucial that they attend orientation and complete a period of supervised practice with competent team members. Training must cover aspects of stabilization and resuscitation of the neonate, clinical skills, clinical emergency scenarios, use of specialised equipment, ambulance and aeromedical environment, safety guidelines and protocols, communication protocols with all relevant stakeholders, debriefing, ethical issues, the emotional and psychological needs of family members, filling in documentation appropriately. Once such training is completed a thorough assessment of competence with regards to the aforementioned issues is crucial before the paramedic can enter the neonatal transfer service. It is crucial that they work under a competent more senior paramedic before being allowed to manage a transfer independently.

5.3.2.6 Theme 6: Support for mothers during transfer

Perhaps one of the most significant findings within the study and the most neglected components relates to the emotional needs and psychological trauma mothers endure during a transfer. It was found that fathers rarely accompany their babies and

when they do so, follow the ambulance with their private transport, when and if possible.

a. Sub-theme 1: Fear and anxiety of the mother

A thorough literature review revealed little or outdated discourse on this topic, further reflecting the lack of attention to it within the neonatal transfer service. Several participants reported that mothers presented with high levels of fear and anxiety during the transfer. This was also reported in other studies (Steeper 2002; Wilman 1997; Affonso *et al.* 1992). These researchers highlighted that mothers or family members who accompany the sick baby, view the transfer negatively and undergo immense emotional strain. Whilst the ALS paramedic focuses on the critically ill neonate, which in itself is daunting, they also have to cope with being answerable to parents and provide reassurance and comfort to the accompanying family member. Data from the study reflected however that ALS paramedics felt totally inadequate to deal with the emotional needs of the mother.

b. Sub-theme 2: Psychological needs of the mother

Data reflected that paramedics pay little or no attention to the mothers' psychological needs during a transfer. Both mothers and other families of the neonate present with considerable stress requiring the transfer team to be able to provide some comfort and support during this process. Despite quite a high frequency of transfers little has been done to consider how accompanying members may be better supported during a transfer. Most paramedics expressed that mothers also require physical care, due to having just given birth. This is also a neglected dimension as the focus of the transfer is the neonate. These issues prompt the need for education and training to include aspects related to managing potential clinical emergencies the mothers may experience, but more importantly to be able to deal with the ensuing trauma of the transfer.

b. Sub-theme 2: Clinical incidences related to the mother

It was disconcerting to note that paramedics had indicated that there were incidences where mothers bled profusely (per vagina) during the transfer. It was Reinhard *et al.* (2013) who argued the need for basic medical attention to also be

provided to the mother by the transfer team. This requires that ALS paramedics have an appropriately qualified assistant to deal with the clinical needs of the mother.

5.3.3 Section summary

The findings made from the preliminary analysis cohered with the data obtained from this phase. It provided a more detailed understanding of neonatal transfers, through the lens of ALS paramedics. It highlighted the deficiencies in the organisational structures and transfer processes, and the clear lack of preparedness to cope with the psychological trauma family members faced. The findings also reflected the lack of preparedness by ALS paramedics, to manage the different dynamics involved in the transfer, the lack of a specialised team to strengthen the transfer service, inadequate management structures that can enable quality assurance, the dangers of poor infection control and a lack of appropriate documentation. Adverse events were noted due to these multiple challenges which prompted feelings of helplessness amongst experienced paramedics who often had no voice with regards to critical decisions within the transfer process.

Interviews with the ALS paramedics were followed by the mothers. Data related to this is resented in the following section.

5.4 Findings and discussion made: sample c

Sample c consisted of the mothers who had accompanied their babies during the transfer. They were identified during the preliminary analysis phase and were invited to participate in this study. Seven were eventually interviewed for the study.

5.4.1 Findings made

All seven participants were transferred by the public sector. The themes that emerged are reflected in Table 5.4.

Table 5.4: Themes and sub-themes: Sample c

Theme		Sub-themes
1	Mothers' readiness for transfer	
2	Mothers' experiences during the transfer	a. Lack of communication between the team and mother b. Lack of confidence in the transfer team c. Discomfort experienced in the ambulance
3	Emotional strain experienced by the mothers	
4	Attention to clinical needs	

5.4.1.1 Theme 1: Mothers' readiness for transfer

The mothers interviewed all had different experiences of the transfer. Three indicated that they were not informed by the hospital staff, that their babies were being transferred. This was only brought to their attention, once the transfer team had arrived at the referring hospital. This resulted in both shock and immense fear. They also expressed feeling overwhelmed by the busy, crowded and noisy ward whilst observing the move of the neonate from the hospital to the ambulance for transfer. Moreover they were compelled to ready themselves in a rush, in order to accompany the transfer team. The excerpts that follow reflect these issues : .

“But I didn’t even know that my baby is being transferred. I was just sitting on this stool and watching them put all these pipes on my baby. Then these paramedics arrive in the ward with a stretcher and incubator and all the equipment.”

[Mother interview 1, Page 2]

“...at the hospital I was tired and in pain, I was sleeping, then they come tell me that my baby is very sick now, but no one tell me nicely, explain what is going on. I come to my baby and see the ambulance people taking my baby. The nurse say go quick, quick, quick now your baby is going. I didn’t even pack my things nicely there. ”

[Mother interview 7, Page 1]

“They told me mommy, now your baby is going to be transferred because it’s going to a specialist, a nice hospital. ...I wait and wait. No ambulance coming.”

[Mother interview 2, Page 2]

Three participants indicated that they had to walk or run alongside the stretcher as the neonate was transferred to the ambulance. Other participants were taken to the ambulance in a wheelchair.

“.....the ambulance people were in such a rush that they took the baby and put her in the incubator and rushing her in the ambulance, I was almost running with them while they were pushing the stretcher.....”

[Mother interview 1, Page 2]

5.4.1.2 Theme 2: Mothers’ experiences during the transfer

The following three sub-themes emerged under this theme viz. a lack of communication between the transfer team and mother, lack of confidence in the transfer team and discomfort during the transfer.

a. Sub-theme 1: Lack of communication between the team and mother

Most participants expressed feelings of isolation and separation from the neonate during the transfer. This was due to a lack of communication between them and the transfer team with regards to the status of the neonate. Moreover there was no opportunity to ask questions which created further stress and anxiety with regards to whether their baby would survive. A few stated that some paramedics displayed a lack of sensitivity towards them. The following excerpts reflect these issues :

“...they didn’t say anything to me. They only say I must sit there on the chair inside the ambulance and they will be by hospital just now.”

[Mother interview 6, Page 2]

“...there was very minimal communication, they just said that they were transporting my baby, it was as though they were doing me a favour to talk to me..... Nobody was talking to me, no one was telling me what was going on, I was lost, I was left alone on the one side as they said that they were there to treat my baby and not treat me.” [Mother interview 3, Page 3]

Two mothers indicated that their families were not informed that they had been transferred to another hospital. They only discovered that they were transferred when they came to the referring hospital to visit them.

“I was alone there and they not even let me phone my family. I felt so lonely and scared with all these strangers .”

[Mother interview 7, Page 3]

Language barriers were raised by two participants who indicated that although they understood English or isiZulu, they did not understand medical terminology.

“I did not understand medical terms. Why can't the paramedic, doctors and nurses speak simple language.”

[Mother interview 7, Page 3]

b. Sub-theme 2: Lack of confidence in the transfer team

There were differing opinions of the transfer teams, with a few mothers expressing confidence in the transfer team, whilst others expressed fear and concern regarding their competencies. More importantly mothers expressed feelings of helplessness with regards to whether their child would survive. The following excerpts reflect these issues :

“There were two people working there and they looked like they didn't know what they were doing.....I feel sad...”

[Mother interview 6, Page 2]

“To me it seems like they don't know what they doing because they were asking each other what do, the machine is beep, and they were panicking. I don't know what I was feeling. I was just crying and saying please Lord, help my baby.”

[Mother interview 7, Page 4]

“...they treat my baby very well and I was happy that my baby is being treated good. They do everything like the hospital.”

[Mother interview 4, Page 3]

c. Sub-theme 3: Discomfort experienced in the ambulance

All mothers expressed a strong desire to be close to their babies during the transfer and indicated that the journey in the ambulance was uncomfortable. They said as follows :

“...they made me sit in the ambulance in the corner seat. There was nothing holding me, no seat belt. I did not feel safe. There was equipment all over moving around. I was very nervous and even more tense watching my baby bounce in the incubator. It was terrifying.”

[Mother interview 3, Page 5]

5.4.1.3 Theme 3: Emotional strain experienced by the mothers

All the mothers were found to experience acute fear, distress, anxiety, insecurity, loneliness and feelings of hopelessness during the transfer. They also experienced huge levels of discomfort having to endure watching the equipment and monitors being used on their babies, and the leads and tubes being attached to them. They said :

“I don't wish that experience on anyone. I felt very alone, very scared, very frightened. I didn't even know what those machines are attached to my baby is for. ...I was panicking seeing the pipes all over him...”

[Mother interview 3, Page 4]

“I was feeling sad for my baby. I see my baby alone in the incubator with all these strangers. I was pregnant with my baby for nine months, I feel now they taking my baby away. I just want to hold my baby I can't. I feel like my baby going to die now.”

[Mother interview 6, Page 3]

One participant experienced being rudely removed from the ambulance because the neonate needed to be re-intubated.

“They screamed at me and just said I must step outside the ambulance so that they can put the pipe properly.....I was traumatised, I could not handle it, I just remained quiet and I prayed” [Mother interview 1, Page 2]

Others experienced acute emotional strain when they became aware that the equipment being used was dysfunctional. She stated that :

“The paramedic is not telling me the truth, the machine was not working (ventilator), and the battery was died. Now my baby is not breathing. They open the incubator putting this thing on my baby’s mouth to breathe. I was panicking, crying and please save my baby...I don’t know what was happening and was so frightened.” [Mother interview 2, Page 4]

Two other mothers had endured the additional burden of being exposed to the demise of other babies in the ward, who had similar conditions to that of their own child.

“I feel so scared and I was crying and praying and praying because at that time there was a baby died. So I was so frightened what is happening with my baby, I was saying please don’t die.” [Mother interview 5, Page 3]

Other mothers expressed going through a range of tumultuous feelings which included guilt as they blamed themselves for their baby’s condition. They believed that their poor socio-economic circumstances, had resulted in them giving birth to a sick baby. They also were saddened by the fact that they could not afford better medical care.

“I live in a jondole. It not nice to stay here, it’s very bad. I have to do my work, cleaning, washing. I didn’t take care of my baby when I was pregnant. That why my baby is sick now. I made this baby sick. The father of my child say that I did that to my baby.” [Mother interview 2, Page 3]

“I know it’s my fault because I am sick too, now my baby is sick too. I don’t go clinic. I got no money. That’s why my baby is sick now.”

[Mother interview 5, Page 3]

All the participants reported that despite experiencing high levels of stress the transfer team, was oblivious to the emotional trauma they were experiencing. They said :

“...they say their job is to take care of the baby, not to look after the mother..they say me to just sit and be calm..” [Mother interview 4, Page 4]

“They could have told me calm down, your child is fine, but they just did their own thing...I had no emotional support from the paramedics”

[Mother interview 3, Page 5]

5.4.1.4 Theme 4: Attention to clinical needs

In addition the clinical needs of the mothers, were overlooked as the paramedics sole focus was on the neonate.

“..I feel sick but nobody asked me how I’m feeling or treat me in the ambulance.” [Mother interview 6, Page 2]

“...they didn’t treat me, they didn’t even give me some pain killers. Before I went into that ambulance they take out the drip in the hospital. I was bleeding heavy bleeding and they ignore me. They didn’t do anything with me, I was feeling pain in my tummy. They was ignore me, they were just busy with the baby.” [Mother interview 7, Page 5]

What was concerning was the total disregard for the mothers’ medical needs during the transfer. One mother reported collapsing in the ambulance. She also said that the paramedics and nurses were rude to her.

“...I fainted, no one treat me. I was telling them I’m scared, I feel weak. They didn’t do anything that why I fainted..... the time when I wake up, I am in the hospital. I don’t know how I get to the hospital from the ambulance.....When I wake up my baby was somewhere else. I only found out after half hour. The paramedics and the nurses was screaming me and asking why I was fainting. I said I’m fainting because I’m scared because the treatment you are doing with my child and I feel weak.” [Mother interview 5, Page 4]

5.4.2 Discussion of findings

5.4.2.1 Theme 1: Mothers' readiness for transfer

Stroud, Trautman and Meyer (2013) wrote that the hospitalization of a critically ill child creates considerable stress for their family. Woodward *et al.* (2014) and Lappälä (2010) added that this stress is often compounded by a crowded, busy and noisy NICU environment, specialised equipment, numerous and diverse healthcare providers, and exposure to unfamiliar medical terminologies. Transfers commonly occur after the neonate and family are relatively settled in the NICU environment. The routine of the NICU environment is further disrupted with a transfer to another healthcare facility which exacerbates the stress of the family members. Misund *et al.* (2013) stated that a disruption in this routine causes a great deal of emotional turmoil, and they suggested that hospital staff prepare family members for the transfer by informing them accordingly.

According to Teasdale and Hamilton (2008), when a neonate is being transferred, the mother or family must be informed and orientated about the transfer before it takes place. This information helps family members deal with the transfer by reducing the shock, abrupt separation and confusion that goes with this experience. The lack of information about the transfer reflects a lack of sensitivity and respect and leads to further anxiety as the family has little knowledge of the situation. Mosher (2013) highlighted the importance of families having the opportunity to briefly say goodbye to the neonate prior to the transfer.

Teasdale and Hamilton (2008) recommended that family members be given general information about the transfer in the form of standard flyers or pamphlets to prepare in advance. However, this written material must be supplemented by on-going communication by healthcare providers. This was non-existent, within the current study, as mothers indicated that they were not given any verbal or written communication by the hospital or paramedics.

5.4.2.2 Theme 2: Mothers' experience during the transfer

The study established that very little or no attention was given to mothers' who accompanied their babies during the transfer process. Woodward *et al.* (2014) and

Misund *et al.* (2013) stated that the experience of family members, accompanying a critically ill baby determines how they perceive the transfer. All mothers in the study found the transfer process overwhelming and experienced acute stress, fear, despair, anxiety, insecurity, loneliness, hopelessness, and a loss of control over their lives. These feelings and experiences were documented in other studies as well (Woodward *et al.* 2014; Mosher 2013; Van Manen 2012; Lappälä 2010; Fidler and McGrath 2009).

a. Sub-theme 1: Lack of communication between the team and mother

The data revealed that one of the hugest issues for mothers was the lack of communication experienced with the referring hospital and the transfer team. They reported that clear and timeous information regarding the impending transfer would have allayed their fears and enabled them to cope more effectively. International studies by Williams *et al.* (2018), Pan (2017), Mullaney (2014) and Teasdale and Hamilton (2008) also found that communication was crucial to enabling family memnbers feel more reassured about the transfer process. In addition to the lack of communication most mothers had to endure an shift to the unfamiliar, tense and fast paced pre-hospital transfer environment. The latter is associated with adverse weather conditions, excessive noise and bumps, warning alarms of the equipment, restricted lighting and limited cabin space. Aeromedical transfers are characterised by turbulence and altitude differences which bring more fear to an already stressful situation (Mullaney 2014).. The key to improving this experience was to ensure that family members were comfortable, feel reassured and that there was communication between them and the transfer team (Teasdale and Hamilton 2008).

b. Sub-theme 2: Lack of confidence in the transfer team

Writers concurred that when there is a lack of information about their baby, family members feel left out and experience anxiety and fear (Mosher 2013. Hussey and Sulpar (2009). According to Fidler and McGrath (2009) people manage their stress by looking for relevant information to clarify and understand elements of a stressful event. Whilst it is understandable that the transfer team had prioritized caring for the neonate, their lack of communication with mothers left them tense and developing a lack of confidence in the teams ability to manage their neonate safely.

It is essential that the transfer team provide the family member with clear information about the neonate's clinical condition, which is free of medical jargon, the reasons for transfer and the associated information regarding the receiving facility's location, contact telephone numbers of relevant personnel, anticipated clinical procedures and estimated time of arrival. Furthermore, the family member should have the opportunity to ask and have questions answered by the transfer team. Communication between the transfer team and the family member strengthens their relationship and helps the family member to feel more confident with the team.

c. Sub-theme 3: Discomfort experienced in the ambulance

Family members are also seldom prepared for the onslaught of the unfamiliar pre-hospital transfer environment, which encompasses watching their sick baby in an incubator.. Mothers experienced an abrupt and sometimes uncomfortable from the ward to the ambulance on a wheel chair. In some instances they were even compelled to walk to the ambulance, despite them having just given birth and having their own medical needs. Where they had undergone a caesarean section, walking quickly is dangerous. With regards to the actual transfer Hussey and Sulpar (2009) said family members accompanying their babies, should remain seated, wear a seatbelt and be as comfortable as possible and in view of their baby. Aeromedical transfers pose different problems for the accompanying mother due to the noise and vibrations of aircrafts which may cause additional stress, nausea and pain. Insurance, indemnity and other necessary regulations must be considered with regards to accompanying are adhered to.

5.4.2.3 Theme 3: Emotional strain experienced by the mothers

As discussed the transfer of ill neonates results in a mother's separation both from her child and the separation from their supportive family members, which creates huge distress. Stroud, Trautman and Meyer (2013) said that when family members find out that their baby is critically ill, they suffer acute emotional problems. Misund *et al.* (2013) added that this stress escalates with news of the baby being transferred and intensifies further during the transfer process itself (Woodward *et al.* 2014). This trauma results in despair, anxiety, insecurity, loneliness, feelings of personal blame

and guilt and a lack of control when watching the procedures being conducted on their fragile baby.

Despite the need to focus on the neonate, it is important then that the transfer team be sensitive to the trauma being experienced by family members. To be able to deal with accompanying family members ALS paramedics should receive some formal training in trauma counselling so that the emotional and psychological needs of the accompanying family member are addressed.

5.4.2.4 Theme 4: Attention to clinical needs

Whilst the immediate priority is the critically ill neonate, who requires urgent clinical attention and continuous monitoring, it is impossible to neglect the clinical needs of the mother. Teasdale and Hamilton (2008) affirmed that caring for a critically ill neonate during transfer, is a highly skilled process that places a significant amount of stress on the transfer team. Mosher (2013) however pointed out that when the mother accompanies her baby, she herself must be clinically stable. If not, alternative transportation should be arranged or the mother should remain at hospital and be stabilised, before being transferred. Although it is beneficial for the mother to accompany the neonate, the potential gain of this should be evaluated against the effects of crowding, distraction and increased stress on the transfer team especially when the mother is ill herself. If it is not possible for a mother to accompany the neonate along with transfer team in the ambulance, alternate transport to the receiving facility should be provided, particularly when the condition of the neonate is critical.

Latour et al (2010) indicated that despite the mother being potentially stable to travel on the transfer, most transfers occur within 24 hours after birth whilst the mother is recovering from her delivery. This can still result in unforeseen clinical problems arising during the event which demands further intervention for an additional person during the transfer. This can be safely accomplished only if the team consists of additional paramedics, who are able to clinically manage the mother as well. Critically ill neonatal transfers should include a minimum of two patient attendants, excluding the driver or the pilot then. The assistant should have at a minimum intermediate knowledge which will enable them to manage the mother.

5.4.3 Section summary

The data from this sample showed that mothers experienced multiple psychological and clinical challenges during the neonatal transfer. Whilst care for the neonate is paramount the transfer team should also have the appropriate knowledge and skill to empathise with the concerns of the mother and attend to their clinical needs during a transfer.

5.5 Chapter summary

This chapter provided the data and discussion of findings for phase one of this study. The analysis phase revealed that important components within the transfer system are either "non-existent" or "deficient." Deficiencies were noted both in the organisational structures and in relation to equipment, the lack of a dedicated unit to facilitate a proper transfer. ALS paramedics were also not adequately trained to deal with clinical realities, with knowledge being largely gained from experience in the field.

The study also showed that the transfer teams were not in touch with the psychological and emotional needs of the mother. This reflects a transfer service in crisis and the reality of an unsafe transfer process by virtue of defective and unavailable equipment and expertise. The following phase presents data with other samples to interrogate the specific components of an effective neonatal transfer programme.

CHAPTER 6

FINDINGS AND DISCUSSION: THE DEVELOPMENTAL PHASE

6.1 Introduction

Phase 2 addressed the third objective of this study. It explored the views of ALS paramedics, neonatologists and EMC lecturers with regard to the aspects, that need to be considered within a programme that would guide the inter-healthcare facility transfer of critically ill neonates in South Africa. The data was collected nationally using three samples . Four focus groups discussions were used to collect data from sample d, the operational ALS paramedics involved in transfers of critically ill neonates nationally. This was followed by three focus group discussions with sample e, the EMC lecturers. The final set of data was collected from sample f, the neonatologists, using individual in-depth interviews. The samples used is presented in Table 6.1 which is presented in the following sub-section.

Table 6.1: Samples used in the developmental phase

Samples used	Data collection method		Total no of Participants	Sector of the participant	Qualification of the participants	Province represented
	Focus Group	In-depth Interview				
Sample d: Operational ALS Paramedics (n= 35) FGD: Nationally	1: KZN		9	4 x Pub ground amb 2 x Pub air amb 3 x Pvt ground amb	3 x CCA 2 x ND: EMC 4 x ECP: EMC	9 x KZN
	2: GP		6	5 x Pub ground amb 1 x Pub air amb 0 x Pvt ground amb	6 x CCA 0 x ND: EMC 0 x ECP: EMC	4 x GP 2 x MP
	3: FS		11	8 x Pub ground amb 1 x Pub air amb 2 x Pvt ground amb	0 x CCA 6 x ND: EMC 5 x ECP: EMC	10 x FS 1 x NW
	4: WC		9	5 x Pub ground amb 2 x Pub air amb 2 x Pvt ground amb	2 x CCA 0 x ND: EMC 7 x ECP: EMC	9 x WC
Sample e: EMC Lecturers (n= 21) FGD: Nationally	1: GP		6	6 x COEC 0 x HEI	1 x CCA 4 x ND: EMC 1 x ECP: EMC	6 x GP
	2: WC		7	7 x COEC 0 x HEI	3 x CCA 0 x ND: EMC 4 x ECP: EMC	7 x WC
	3: KZN		8	6 x COEC 2 x HEI	1 x CCA 0 x ND: EMC 4 x ECP: EMC 2 x MTech: EMC 1 x PhD: EMC	8 x KZN
Sample f: Neonatologist (n= 7) In-dept Interviewed: Nationally		7	7	7 x Pub sector	7 x Neonatologist	4 x KZN 1 x WC 2 x GP
Pub = Public / Pvt = Private / amb = Ambulance / EMC = Emergency Medical Care / CCA = Critical Care Assistant / NDip = National Diploma / ECP = Emergency Care Practitioner (Bachelor of Technology in EMC or Professional Bachelor Degree in EMC) / KZN = KwaZulu-Natal / GP = Gauteng Province / MP = Mpumalanga Province / NW = North West Province / FS = Free State Province / WC = Western Cape Province / COEC = College of Emergency Care / HEI = Higher Education Institution						

6.2 Discussion of findings: ALS paramedics

Sample d comprised of the ALS paramedics who were actively involved in neonatal transfers across South Africa. Participants were selected from both rural and urban areas, public and private sectors and ground and air ambulances.

6.2.1 Results from Sample d

A semi-structured interview schedule (Annexure 22) was used to collect data. The findings obtained are presented within six key themes and fifteen subthemes within Table 6.2.

Table 6.2: Themes and sub-themes: sample d

THEMES		SUB-THEMES
1	A time for change	a. An integrated and standardised approach b. A move towards dedicated units and specialised teams
2	Setting up organisational structures	a. Specialised managers b. State-of-the-art equipment c. Appropriate documentation
3	A multidimensional transfer process	a. The process of requesting the transfer b. Preparation by the transfer team c. The importance of the retrieval phase d. Monitoring and evaluation during transport e. Handover at the receiving hospital
4	Paradigm shift in education and training	a. Appropriate theoretical knowledge b. Maintaining competence c. Team values
5	Quality assurance	a. Quality assurance management structure b. Evidence based research
6	The psycho-social needs of the mother	

6.2.1.1 Theme 1: A time for change

All participants agreed that there was an urgent need to improve and develop the transfer system for critically ill neonates. This emanated from the lack of direction and variations in practice during these transfers. Most participants believed that neonates were dying due to a lack of accountability and described the current system as being “a mess” (participant 9, page 1) and “disastrous” (participant 6, page 1). Most agreed on the need for a transfer programme to be developed that was informed by research.

a. Sub-theme 1: An integrated and standardised approach

Participants indicated that there was a lack of an integrated approach between hospitals and the EMS, as transfer teams worked independently from the hospitals. There was also a lack of standardisation of practice between and within Provinces.

“We are working in silos, the hospital got their own system going and we have ours...so at this stage it is about them and us, not the baby.”

[ALS, FDG 2, Participant 3, Page 2]

“...there are differences in the way things are done between provinces and the way things are done within provinces. There has to be a standardised system in South Africa.” [ALS, FDG 2, Participant 3, Page 2]

b. Sub-theme 2: A move towards dedicated units and specialised teams

All participants expressed that one of the major solutions to addressing time delays, equipment issues, safety and optimal care was having dedicated specialised units and teams.

“The answers to most of our problems will be a dedicated unit for these critical babies.” [ALS, FDG 2, Participant 6, Page 3]

“One of the biggest problems we have in the critical neonatal transfers is that we don’t have a dedicated specialised unit for these transfer. That is one of the main reasons for the transfer delayed, because when we get a transfer we have to now go around looking for equipment, looking for crews, looking for an ambulance.” [ALS, FDG 1, Participant 8, Page 3]

Participants agreed that the transfer team must be used solely for neonatal transfers. They mentioned that the team dynamics should include a minimum of two team members, excluding the driver or the pilot. The minimum qualification of the team leader should be an ALS paramedic who was qualified to undertake neonatal transfers, and an assistant who should preferably be an Emergency Care Technician or a minimum Ambulance Emergency Assistant.

“.....for the senior is an ALS paramedic who is qualified for critically ill neonatal transfers, currently it is the ECP’s, NDip’s, CCA’s but when and if the new proposed guidelines is approved then ECP’s only. For the assistant, an ECT is ideal but if not then a minimum if an AEA would do.”

[ALS, FDG 3, Participant 1, Page 6]

6.2.1.2 Theme 2: Setting up organisational structures

All participants highlighted the need to improve the current structure used for neonatal transfers by having specialised managers, state-of-the-art equipment that is functional and appropriate documentation.

a. Sub-theme 1: Specialised managers

The entire sample supported the need for specialised managers which includes a medical officer, managers, transfer coordinator and a skilled and experienced transfer team.

“Support structure at the moment is non-existent, management does not give us any support. We need a good management structure, there are enough human resources but they are not used appropriately.”

[ALS, FDG 1, Participant 2, Page 3]

Many agreed that there should be an ALS in the communication centre, who must coordinate the transfer process.

“The communication centre must have an ALS coordinator who is current with evidence base medicine. This would be appropriate because an ALS understand the transfer process involved with critically ill neonates.”

[ALS, FDG 1, Participant 3, Page 5]

b. Sub-theme 2: State-of-the-art equipment

Participants expressed that a transfer unit must have access to state-of-the-art equipment, which is functional. They reiterated the following concerns regarding equipment and logistical challenges : .

“Equipment is one of the biggest failing issues in EMS, since hospital services service their emergency equipment frequently, we don’t, there are very specific rules that our manufacturers give us regarding our equipment and the servicing and maintenance, but we don’t abide by them.”

[ALS, FDG 4, Participant 9, Page 3]

In addition the participants expressed concern regarding infection, suggesting that any transfer programme should maintain infection protocols. They said as follows :

“We clean the equipment with what disinfectant we have, it’s not always the correct disinfectant, but we do our best to clean the equipment, but we definitely need improvement in infection control.”

[ALS, FDG 3, Participant 9, Page 5]

“We have got very strict protocols when it comes to cleaning of equipment. After each case it is cleaned with as per the company policy...”

[ALS, FDG 4, Participant 8, Page 5]

c. Sub-theme 3: Appropriate documentation

Participants suggested that a new transfer programme, must be supported by new documentation which details important information regarding the neonate. It should include the neonate’s normal value parameter, blood gasses and formula and be attached to the cover of the report form, for easy reference during the transfer. This can be seen in the following excerpts .:

“We found very valuable the cover of our patient care books, have the neonate’s normal values, blood gases values and formulas if you need them they are there...”

[ALS, FDG 5, Participant 5, Page 8]

Many also indicated that the need for a checklist, assessment checklist or /rubric and patient satisfaction and complaints forms, which will assist in the transfer process and system.

“...assessment checklist will be ideal. In the prehospital environment there is a lot of stress, these babies are not easy to deal with, then the noise, the adrenaline rush, the excitement. You can miss important treatment or procedures, there the assessment rubric will ensure that all steps are covered.”

[ALS, FDG 2, Participant 1, Page 6]

There were differing views about using an electronic document system, with only a few favouring this approach. This therefore requires careful consideration before implementation.

“...having an electronic system will be good, but let’s not forget our context, these babies are critical, we are always busy with them, we have our gloves on, sometimes there is blood on the gloves, how do we use the electronic system, we have no time to take off gloves, put on gloves. Some facilities don’t have a computer, how are they going to use our system, for now paper base will work.”

[ALS, FDG 1, Participant 1, Page 11]

6.2.1.3 Theme 3: A multidimensional transfer process

Most participants mentioned that the transfer process should be a combined and integrated effort of the doctor, nurse, paramedic and support services. Participants made the following comments regarding what a newly developed programme should embrace during the five phases of transfer.

a. Sub theme 1: The process of requesting the transfer

Participants highlighted that referring personnel must provide as much information as possible, about the neonate and their requirements. This information must be recorded and should include the neonate's name, age and weight, gestational age, gender, diagnosis, vital signs equipment required, medication, infusions, arterial blood gases, ventilator settings, urgency of transfer, treatment and special conditions. The following excerpts reflect what must be captured :

"I don't know if this is an oversight or if it is omitted on purpose, when the baby has been resussed, we are never told about that. We need to know what treatment was done on the baby so we are prepared for any deterioration en-route to hospital."

[ALS, FDG 2, Participant 6, Page 7]

Most participants also stated that the details of the referring and receiving hospitals, relevant departments, and the names and contact numbers of referring and receiving personnel are important. They recommended the need for a transfer coordinator who should must screen and coordinate the overall transfer process.

"I always like to know who is referring and receiving my patient, the telephone number and names and the hospitals numbers, the numbers of the specific ward because there are always challenges, logistical, patient condition and so on, so we need contact information..."

[ALS, FDG 4, Participant 8, Page 8]

"A transfer coordinator is the most important person of the transfer process. When the call comes in it is the responsibility of the coordinator to screen the call and coordinate the entire transfer process."

[ALS, FDG 1, Participant 4, Page 13]

b. Sub theme 2: Preparation by the transfer team

All participants agreed that during this phase the transfer team must be fully prepared by way of an equipment checklist, ensure that equipment is functional and that they have a team debrief before going to the transfer.

"I think during the activation phase it is critical that the dispatcher give us the correct information about the child and the necessary equipment required because we need to prepare for the transfer..."

[ALS, FDG 4, Participant 1, Page 9]

"It will be good to call the receiving hospital and tell them that we are coming through because often they don't have neonatal ventilators; they only intubate the baby when we get there and it take time.....So by them knowing we are coming they must prepare the neonate."

[ALS, FDG 1, Participant 4, Page 15]

c. Sub theme 3: The importance of the retrieval phase

All the participants agreed that this phase of the transfer was crucial for success and that stringent attention, be paid to preparing and stabilising the critically ill neonate. Guidelines for the new programme should therefore include procedures for preparation and stabilisation. Participants said as follows : The

"the baby must be well prepared,...everything must be done at the hospital first before leaving."[ALS, FDG 4, Participant 5, Page 23]

Many participants recommended that the retrieval process begin with a comprehensive hand over by the referring doctor which includes history taking. Further guidelines should entail the team leader reading the medical notes and reviewing the charts, obtaining the latest arterial blood gas, collecting all documentation necessary for the transfer, and making sure that the baby has name tags, which must be verified, annotate and query any concerns.

".....we need the transferring doctor or the treating doctor to be there because he is the one that treated the baby and this is an intensive care patient, we need a formal hand over, we need all information, what was done,

what was given, a full history so if anything is going wrong en-route we have an understanding of why and what is happening.”

[ALS, FDG 2, Participant 4, Page 9]

“...before you leave make sure you collect all the documents, referral letters, the notes, buy-out letters from public to private hospitals, consent forms, x-rays, CT scans, bloods and any specimens. Very important, make sure that the baby has a name tag, check if it is the right baby, write down everything, your findings, what you are taking.” [ALS, FDG 1, Participant 7, Page 16]

Participants further recommended that the baby be clinically assessed following an ABCDE approach, with all necessary interventions being undertaken to stabilise and prepare it for transfer. Other protocols to be followed should include a verification that all tubes be secured to ensure free drainage, all lines properly inserted and secured and the necessary transfer equipment attached and functioning appropriately, that the incubator has the appropriate temperature. In addition the neonate should be sedated and settled on the transport ventilator, before the transfer. Participants also added that saturation and end tidal carbon di-oxide monitoring must be attached to the neonate, who must be properly assessed to ensure that they are coping with the ventilator before transport.

“Do a head to toe examination, follow an ABCDE approach, check the airway, check breathing, check the circulation, and check the circulation, the drips, the medication, is the incubator warm.”

[ALS, FDG 1, Participant 1, Page 17]

“All monitoring equipment must be on the baby, the baby must be comfortable on the portable ventilator, incubator must be warm to the right temperature, all the infusions must be running, try to have two sats monitor if you can.” [ALS, FDG 4, Participant 1, Page 10]

Many participants suggested that the new programme should include an assessment checklist which would be useful to ensure that nothing was missed during this phase.

“It is very important to call the receiving doctor before you leave and let him know the condition of the patient coming through, the ETA and so forth. Often the transferring hospital does not relay the right information.”

[ALS, FDG 1, Participant 4, Page 17]

Some participants felt that some guidelines should be in place regarding aeromedical transfers. Firstly the flight team should be comfortable with and familiar with this environment and the constraints of the cabin. In addition accompanying persons, should also be orientated to aviation requirements and be given prophylactic medication for motion sickness.

d. Sub-theme 4: Monitoring and evaluation during transport

Most participants mentioned that guidelines embedded within a new programme should include continuous monitoring and evaluation of the neonate using the following monitoring equipment, such as an electrocardiogram (ECG), non-invasive blood pressure (NIBP) devices , non-invasive arterial saturation (SpO2), non-invasive end tidal carbon dioxide (EtCO2) and non-invasive temperature, which should be attached to the neonate. The monitoring equipment should be positioned facing the paramedic and be within hands-reach of the transfer team members. Participants said as follows :

“Put all monitoring on the patient, don’t rely on just one form of monitoring, attach everything, because with the noise, vibration, lighting and so on, it’s easy to get a false reading, so attach everything.”

[ALS, FDG 4, Participant 5, Page 11]

A few participants suggested that in the event of a clinical emergency during transfer it was optimal to stop the vehicle at an appropriate safe place, than attempt to carry out interventions in a moving vehicle. They also indicated that the driver or the pilot should understand the nature of the transfer and make the ride as comfortable as possible. There were suggestions that a backup power source was vital for the transportation process, which must be fixed to the ambulance and be portable so that it can be taken with them from the ambulance to the hospital ward.

“.....the bumps and movement tubes and lines can get dislodged.”

[ALS, FDG 2, Participant 2, Page 10]

Several participants indicated that all equipment should be safely secured including the neonate in the incubator.

“Often we all strap the incubator to the stretcher, but what about the baby in the incubator, if the baby is not strapped in the incubator, the baby can be a projectile in the incubator which can cause serious injuries to the baby.”

[ALS, FDG 3, Participant 3, Page 16]

e. Sub-theme 5: Handover at the receiving hospital

Participants also suggested that there should be a formal handover from the team leader of the transport team to the receiving personnel, who would assume responsibility for the neonate's care. Documents for the handover should include the neonate's history, vital signs, interventions, significant clinical events during transport, documentation and specimens.

“.....it is pretty frustrating when the receiving doctors, nurses or facilities are inadequately prepared for us, occasionally the ward where we were to be going to don't even know that we are coming, so again I think it comes back to the communication.”

[ALS, FDG 1, Participant 7, Page 21]

Participants also suggested the need for a physical examination by the receiving personnel, in the presence of the transport team leader, so that this can be documented and signed off as part of the handover. The newly developed programme should be guided by this protocol and those which keep clear records of all phases of transfer in the neonates report form. As one participant said :

“The doctor must take over in front of you so that there is no blame shifting which always happen and you can clarify any concerns.”

[ALS, FDG 2, Participant 5, Page 12]

Participants suggested that further protocols that should guide a new programme should include debriefing procedures of the team members and opportunities to

discuss issues of concern. This should be followed by the immediate cleaning and sterilisation of all equipment.

6.2.1.4 Theme 4: Paradigm shift in education and training

As detailed previously almost all participants expressed an unpreparedness for neonatal transfers due to the absence of this within their undergraduate training programme. They noted as follows :

“Definitely we are not adequate prepared, we need more education. Education is one of the biggest problems, no doubt. What we are taught and what is going on in reality, big difference, and big gap. If I put it frankly, no we are not prepared, not at all. One’s career can start and end on his first day on the job if he gets a neonatal transfer. I assure you that paramedic will not know what to do, that a guarantee.” [ALS, FDG 1, Participant 6, Page 21]

a. Sub-theme 1: Appropriate theoretical knowledge

Most participants believed that the knowledge derived to deal with the transfer was gained more from their experience rather than their formal education. Whilst they supported the inclusion of greater theory related to the clinical emergencies of neonates and the transfer process, in undergraduate training, many supported the notion that an internship programme or ongoing educational programme be part of a holistic programme that guides neonatal transfers.

“All the components of the critical neonate is covered in the curriculum, anatomy, physiology, pathophysiology and so forth, but it’s just theory. The practical aspects of the transfer needs lots of attention, there seem to be a misalignment there.” [ALS, FDG 3, Participant 5, Page 17]

Many participants agreed that whilst EMC education and training developed high end paramedics with advanced life-support experience, it did not address the clinical emergencies of neonates and the transfer process adequately. They indicated that this theory-practice gap suggests the need for sub-speciality qualifications and internship programmes. Participants made the following recommendations that

training covers new aspects of clinical intervention and use of more sophisticated equipment as it becomes available :

“Practice gaps can only be addressed by in-service training, inter-disciplinary training, M and E’s (mortality and morbidity), workshops, updates and refreshers. This will definitely deal with the gaps.”

[ALS, FDG 4, Participant 6, Page 14]

A few participants recommended that paramedics be empowered with specialist knowledge about the aeromedical environment as follows :

“paramedic must have specialised knowledge about the aeromedical environment and they must be certified to work in air ambulances.”

[ALS, FDG 3, Participant 3, Page 18]

b. Sub-theme 2: Maintaining competence

Most of the sample agreed on the need for protocols to maintain competence and confidence, saying that this field of work required specialised knowledge and skill so as not to jeopardise the neonate. One participant said :

“The ALS covers the skills needed for a critical neonate, but it’s the competence and confidence that is the issue here. We deal with all emergencies, medical, trauma, child, adult, deliveries, and transfers. When there is a neonate transfer we go, so there are times when we didn’t do an intubation or put up a line in a long while, so sometimes we lose that confidence and when we have to do that technique we need multiple attempts.”

[ALS, FDG 2, Participant 3, Page 14]

Participants specifically suggested regular emergency and ventilator drills and scenario based simulations with regards to oral and nasal intubation, umbilical and peripheral vein cannulation, ventilator setting and neonatal resuscitation.

“...skills like airway management, intubation, we normally intubate orally but we need more training in nasal intubation, ventilation we need continuous

practice, even IVI (intravenous infusions) and umbilical line because those are common skills and we must be totally competent.”

[ALS, FDG 3, Participant 4, Page 19]

Almost all participants believed that a newly developed programme which harnesses multi disciplinary expertise should embed opportunities for doctors and nurses who work with neonates to spend time in neonatal ambulances, so that they are familiar with the pre-hospital environment and can contribute meaningfully to improving it.

c. Sub-theme 3: Team values

Several participants believed that a programme which includes aspects of education and training, should also focus on buiding the correct values for this type of work.

“The newer paramedics have a very bad attitude. They believe in evidence based only and have very little insight to reality and therefore sometime they come across as arrogant.”

[ALS, FDG 2, Participant 1, Page 14]

Some participants believed that the negative attitudes of paramedics stemmed from EMS staff being overworked, demotivated and exhausted. This calls for the new programme to embed workshops for stress management and create opportunities for trauma debriefing due to the highly intense nature of this type of work. Participants recognised the damaging effects of being overworked, saying that :

“EMS staff are being overworked. This is because of a poor system, poor management. People are demotivated, they are tired and fatigued.”

[ALS, FDG 1, Participant 6, Page 26]

6.2.1.5 Theme 5: Quality assurance

Participants also reported that a newly programme should build in mechanisms for quality assurance. The following sub-themes speak to this aspect.

a. Sub-theme 1: Quality assurance management structure

Participants voiced the need for a quality assurance management structure to be in place and be responsible for clinical governance. This calls for a dedicated person,

preferably the transfer co-ordinator to be responsible for the transfer function, whilst the manager oversees the entire unit. This was reflected as follows :

“.....quality assurance is everyone responsibility, but to ensure that it is happening, there should be a transfer coordinator to quality assure the transfer while it is happening.... Then for the system as a whole there must be a QA manager....”

[ALS, FDG 1, Participant 7, Page 27]

b. Sub-theme 2: Evidence based research

A few participants mentioned the need for research to ensure a better understanding of neonatal transfers and how to improve the system. This too should then become part of the newly developed programme.

“Research and quality assurance should work hand in hand, research will guide the quality assurance because through research you can see where we need improvement, our weaknesses, strengths, and benchmark.”

[ALS, FDG 1, Participant 4, Page 28]

6.2.1.6 Theme 6: The psycho-social needs of the mother

All participants mentioned the need for a newly developed programme to include ALS preparedness to deal with the psychological distress mothers present with and any potential clinical emergencies that may arise during the transfer.

“There is a need for psychosocial support for the mother or the family members who are travelling with us, as far back as I remember, there has been issues with the mothers. I don't think there is any policy or procedure that talks to how we need to deal with the mother. This needs urgent attention because it is not easy for a mother to go through that experience.”

[ALS, FDG 3, Participant 2, Page 21]

“...we need development in that specific area, especially how to deal with the psycho-social needs of the mother or family who is travelling with us so that we can explain to them in a better and simpler way what is happening....”

[ALS, FDG 1, Participant 2, Page 29]

Participants provided valuable guidelines on what must be followed in relation to the family and or mother as follows :

“Preparation toward the psycho-social needs of the accompanying person, especially the mother, because the mother normally goes with the baby, must start at the hospital. The mother must be aware of the transfer and why it is happening when it is happening, the family also must be aware of the transfer so they can support the mother. Many times when we fetch the baby, the mother is not ready, sometimes the mother is surprised that that baby is being transferred.”

[ALS, FDG 4, Participant 2, Page 22]

“On aeromedical cases we have challenges, apart from space, mothers do not want to fly because they fear the helicopter or the aeroplane, that’s why they must be well informed by the hospital staff that they are going to fly, and if they are scared of flying then this is going affect them even more, or if they panic on the flight it can compromise the mission.”

[ALS, FDG 1, Participant 1, Page 29]

In addition procedures must be put in place for information to be relayed to extended family members. This should also become part of the protocol within the newly programme. Participants recommended the following .:

“I believe that the mother should be given time to call her home and tell her family about the transfer, because the family can meet her at the new hospital. I think that will make her feel more comfortable knowing that her family is meeting her there.”

[ALS, FDG 4, Participant 9, Page 22]

6.2.2 Discussion of findings

6.2.2.1 Theme 1: A time for change

Whyte and Jefferies (2015) wrote that in developed countries, the inter-healthcare facility transfer of a critically ill neonate forms a single component that is embedded within a larger system of neonatal intensive care. More sophisticated transfer systems are associated with delivering state-of-the-art critical care during the transfer and serves as an extension of the neonatal intensive care units that bring an advanced level of care to the bedside of the referring facility. These systems have

improved neonatal outcomes and significantly reduced neonatal mortality rates. Messner (2011) described a good neonatal transfer service as including an appropriate management structure, a well configured specialised and dedicated transfer team with relevant knowledge and skills, standardised practice with policies and procedures, and clear articulated steps for the transfer processes. This is underpinned by good communication and coordination, specialized transfer equipment, a quality improvement programme, appropriate documentation and family support. These findings concurred with presentation from the national consensus conference in paediatric and neonatal inter-facility transport, which was held in the United States (Stroud, Trautman and Meyer 2013; Stroud *et al.* 2011). These are all issues that were evident in the participants excerpts in the preceding phase.

Although SA is a developing country with its own socio economic and political challenges and a higher burden of disease, some lessons can be learnt from more developed countries. Moreover the data presented in the preceding sub-sections provide significant support for systems that are in place in developed countries, particularly for a dedicated specialised unit, ongoing training and also highlight the various protocols that must be followed in terms of family members. More importantly the data supports the need for an urgent platform to bring together all role-players in neonatal transfers to consider appropriate alternatives to the current system and to embed the various recommendations from the data to create a new neonatal transfer programme that also takes cognisance of the human aspects family members face. It calls for a strengthening of the undergraduate training programme, but more importantly for neonatal transfer paramedics to receive ongoing education and training to manage all aspects of neonatal emergencies.

Sub-theme 1: An integrated and standardised approach

Kage and Akuma (2012) argued that the neonatal transfer systems in developed countries was successful because of the consolidation of various elements of the transfer service into one unified, and standardised harmonious whole programme. The decision to transfer a critically ill neonate cannot be taken lightly, due to the stresses associated with the transfer (Miller *et al.* 2008; Barfield *et al.* 2011), thereby demanding that it be approached in a systematic, integrated and

standardised way by the referring hospital, the transportation team, and the receiving hospital. This is in stark contrast to the somewhat fragmented and chaotic process that unfolded within the data in the current study. The data also revealed the inefficiencies within the transfer and the huge risks being taken either with equipment that is not easily accessible or malfunctioning.

b. Sub-theme 2: A move towards dedicated units and specialised teams

A move toward dedicated units and teams was another theme that emerged in the current phase and in the first phase. According to Whyte and Jefferies (2015) neonatal transfer services in well resourced world countries have evolved significantly over the past 25 years. This is largely in response to needs, of these countries and the efforts of certain individuals. It has been documented, that these dedicated units and specialised teams, have prevented a large number of life threatening adverse events during transfers, and has also reduced time delays (McEvoy *et al.* 2017; Droogh *et al.* 2015; Gonzalez 2014; Parmentier-Decrucq *et al.* 2013; Blakeman and Branson 2013; Baird and Ravindranath 2012; Messner 2011; Lee *et al.* 2010; Orr, Felmet and Han 2009; Lim and Ratnavel 2008; Berry and Sivasangari 2008).

It has been argued that although each country needs to adapt practice to what works for their unique context, what was clear was that a separate unit, dedicated solely to transfers, with specialised teams has huge advantages and underpins the success of the entire network. It is therefore no longer safe or efficient, for paramedics without expertise or the required equipment to undertake a transfer. A further issue emerging from the literature on the state of the art in transfers, reflects that in developed countries, specialised retrieval teams of physicians, anaesthetists, respiratory therapists, paramedics, neonatal intensive care nurses, or a combination of experts from these disciplines from individual healthcare facilities, constituted the team behind successful neonatal transfers (Whyte and Jefferies 2015; Wieggersma *et al.* 2011;) However, there was no evidence that indicated that any specific professional, contributed to improved outcomes on a transfer. This resonated with the Cochrane Database Systemic Review, which indicated that there was no evidence from randomised trials to support or refute the efforts of any given professionals within specialist retrieval neonatal transport teams. Woodward, Insoft

and Kleinman (2007) however argued that a successful transfer team requires good leadership and all team members should be able to demonstrate flexibility, critical thinking, independence, timely judgment, problem solving skills, interpersonal and communication skills and appropriate crisis resource management. Hence whilst due consideration should be given to operationalising a specialist team, it is crucial that team members have the aforementioned skills.

As the ALS providers are the pre-hospital care specialists in South Africa, they are responsible for undertaking inter-healthcare facility transfers of critically ill neonates. The transfer team should consist of a minimum of two team members, excluding the driver or the pilot. This should include the team leader, and an assistant, with the appropriate qualifications and expertise. A study by Karlsen *et al.* (2011) who looked at the composition of neonatal transport teams in the USA, found that successful transportation of a neonate was best accomplished by a team of two or three health care professionals. In addition to the competency of all team members in neonatal intensive care, it is crucial to have a delegated team leader who manages the entire transfer and can manage any potential crises that may arise (McEvoy *et al.* 2017).

6.2.2.2 Theme 2: Setting up organisational structures

The inter-healthcare facility transfer of neonates requires a sound organisational system with essential structural components. Wieggersma *et al.* (2011) and Barfield *et al.* (2011) argued that regardless of the high level of knowledge and expertise of the transfer team in developed countries, organisational structures are a crucial component of maintaining or improving the continuum and overall neonatal care. Resource limitations within such systems, include a lack of essential equipment, trained professionals, structural restrictions, and appropriate systems to manage patients. Within most of African emergency care settings, resource limitations involving one or more of these are common and impact upon the success of a safe transfer.

a. Sub-theme 2: Specialised managers

Specialised managers form the core of the transfer system in developed countries and include physicians and doctors within their management structures. Although South Africa and other developing countries do not have such specialist managers,

the data reflected that an appropriate management structure should include: (i) a medical officer, with specialty training in neonatology or equivalent expertise, to oversee the appropriate departments and ensure quality assurance; (ii) a manager for neonatal transfers, with an ECP qualification and experience in neonatal transfers, to oversee its day to day management and quality assurance; and (iii) a transfer co-ordinator, with an ECP qualification and experience in neonatal transfers who is responsible for the clinical supervision, screening and co-ordination of the entire transport process while in progress. In order to realise these suggestions data, it is critical then that those within the specialized are of neonatal transfers be empowered with relevant knowledge to manage the transfer process and transfer itself.

b. Sub-theme 2: State-of-the-art equipment

As a mobile intensive care unit, the ambulance, its equipment and supplies should reflect the needs of the patient population. Equipment was highlighted as an important factor that warranted serious attention in the South African context. A multitude of issues related to equipment that was malfunctioning, incompatible or received poor infection control emerged within the current study. More seriously however were instances when appropriate equipment, was not even available. As critically ill neonates require intensive care during a transfer, the equipment used must be technologically sound, reflect the state-of-the-art and be totally functional. Moreover it should have the capacity to deal with any any emergency that might arise during the transfer process.

Transfer environments are dynamic and may become unpredictable during road or air travel. Neonatal transfer equipment in both air and ground ambulances should be functional for longer periods of time and (i) should have AC power capability; (ii) be easily maintained and cleaned; (iii) be self-contained, lightweight and portable; (iv) provide capabilities for neonatal intensive care in the transport setting; (v) not interfere electromagnetically with navigation and communication systems; (vi) be durable enough to withstand severe mechanical, thermal and electrical stress and repeat use; and (vii) be packaged to enable continuous neonatal intensive care while entering and exiting a ground or air ambulance.

Moreover the ambulance should be fitted with a fixed backup power source, and a portable power source must be available for transition to and from the ambulance. Power supply extensions must be carried, to be used as external supplies when necessary and oxygen and medical gas requirements should be determined and estimated before commencing the transfer. Equipment must be lightweight, compact, durable, well secured for safety reasons, and motion and g-force tolerant.

Singh *et al.* (2010) argued that although the incubator was designed to provide warmth, stillness, humidity and security for the neonate, it should be mandatory that the baby is secured in the incubator while still allowing easy access to intravenous lines and the airway. Ambient noise and vibration are concerns in both land and air transport (Bouchut *et al.* 2011, Romano and Kaufmann 2012, and Karlsson, Lindkvist and Lindkvist 2012) Therefore, neonatal ear muffs should be used routinely to reduce noise effects. Similarly, Gajendragadkar *et al.* (2000) showed that an air-foam mattress and gel pillow can reduce potentially harmful vibrations that may lead to morbidity. Carreras-Gonzalez and Brió-Sanagustin (2014) added that in aeromedical transfers, equipment should be certified, specific to the aircraft, and any change to the equipment, should necessitate recertification. Equipment related faults, no matter how minor, should be referred immediately to the designated technologist for investigation or repair, with a prompt return. It is essential then that a transfer programme makes provision, for these equipment related dynamics, keep a well-structured maintenance plan for equipment, regular testing protocols and procurement and replacement plans.

c. Sub-theme 3: Appropriate documentation

Fendya *et al.* (2011) wrote that appropriate documentation with accurate information was an essential component of a neonatal transfer programme, not only for clinical management, audit and research purposes, but also as a defence against possible litigation. Bigham *et al.* (2014) added that the transfer service is a link between healthcare facilities, which results in overlapping accountabilities, which can leave opportunity for blame when determining legal responsibility in the event of problems. The transfer team should therefore have appropriate documents which captures communication, decision making, clinical management and other salient issues related to the transfer process in its entirety (Woodward *et al.* 2002;).

The transfer request form in the emergency management communication centre must include as much details of the transfer as possible. This must include the neonatal details (name, age and weight, gestational age, gender, diagnosis, history and vital signs), timeframes, equipment required, medication, infusions, special conditions, clinical management, blood gases, ventilator settings, mode of transfer, the details of the transfer team, the referring and receiving hospitals and the relevant departments, as well as names and contact numbers of referring and receiving personnel. Once the details of the transfer are completed, it should be screened and verified by a transfer coordinator.

Craig *et al.* (2012) argued that the neonatal transfer form should be specifically designed to reflect information from the time the transfer was dispatched to the transfer team, to the time of completion of the transfer. This includes time frames, neonatal details, history, evaluation and treatment (all entries should be timed), medication given (dosage and time) vital signs (ongoing basis), blood gasses and bio chemical values, neonates' condition pre, during and post transfer, any changes in the neonatal condition, adverse events, and the take over and hand over personnel, and proof of documents from the referring and receiving facilities.

In England, Sharma and Peters (2013) evaluated the introduction of a ward round checklist on a PICU. Participants indicated that it provided structure and the mnemonic helped easier learning. Similarly, Zavalkoff *et al.* (2011) and Craig *et al.* (2012) concluded that checklists were associated with improved communication and patient safety. Therefore, a standard pre-departure checklist of equipment and supplies should be mandatory as an aide memoire to ensure that all equipment was in good working order and the medical supplies required during the transportation phases were present. Furthermore, the assessment checklist is a useful tool to guide the transfer team, especially during emergency situations, to ensure that specific activities are undertaken, as they are developed with an explicit set of criteria used for ensuring nothing is missed. When the neonate is handed over, the receiving personnel should complete a satisfaction or compliant form for feedback and clinical governance. In the current context, consent forms for neonatal transfer are the responsibility of the healthcare facility. However, the transfer team must ensure that the consent form is completed and signed before the transfer.

Bigham *et al.* (2014) concluded that all documentation should become part of the neonate's permanent medical record and must be forwarded to the clinical governance group to evaluate the overall performance of the transfer process. These documents should include transfer request forms, checklists, assessment rubrics, patient report forms, satisfaction or compliant forms and consent forms (Fendya *et al.* 2011) and should be properly maintained as they have important clinical, resource and medico-legal implications (Goel *et al.* 2017).

6.2.2.3 Theme 3: A multidimensional transfer process

The data reflected that a newly developed transfer programme should embrace the actions within the following five sub themes :

a. Sub-theme 1: The process of requesting the transfer

From the outset of the transfer there should be good communication and co-ordination between the referring facility, the receiving facility and the transfer team to ensure a safe and timely transfer (Kage and Akuma 2012). This study reflected numerous shortfalls in obtaining the relevant important information, pertaining to the transfers which negatively affected the rest of the transfer process. This demands that the telephone operator have a thorough understanding of neonatal transfers. (Similarly, Horowitz and Rozenfeld 2007). A newly developed programme should ensure that when the telephone operator receives the call from the referring doctor/nurse, that all necessary information be recorded. Thereafter, the request should immediately be relayed, to a transfer co-ordinator who would be the clinical supervisor for screening and co-ordination.

b. Sub-theme 2: Preparation by the transfer team

The preparation phase should be guided by the transfer team prior for the transfer, before proceeding to the referring facility. In South Africa, the most senior medically qualified person on the team, should be automatically designated to be the team leader, and should be responsible for the team and the transfer operations. Although the team leader is ultimately responsible for the transfer, all team members should work collaboratively and understand their respective responsibilities. Ashokcoomar and Naidoo (2016) and Mgcini (2011) found that preparation for the transfer of

neonates in South Africa is poor. Hence once the dispatch is received by the team leader, it should be clearly understood, and where there are ambiguities the team leader should seek immediately clarity regarding the circumstances. Most importantly the team leader should be familiarised with the neonate's condition, treatment already undertaken, equipment required and any other information vital for the transfer.

Other guidelines which should be embedded within the programme should include that the team leader do a transfer pre-briefing to inform team members of the neonate's condition, equipment required and other transfer issues. A pre-departure checklist should be completed to ensure that all necessary equipment is available. This can be facilitated by a pre-departure equipment test to ensure same and that all equipment is sterile, fully charged and in working order. Moreover, the team should ensure that all equipment is well secured in the ambulance before it departs for the referring hospital. In addition the EMCC of the receiving hospital should be informed of the estimated time of arrival at the referring facility so that they when to expect the transfer team and be ready to receive the neonate.

c. Sub-theme 3: The importance of the retrieval phase

According to Grosek (2007) a whole spectrum of things can go wrong during the transfer with a minor physiological change in the condition of the neonate, that can cascade into a life-threatening complication. Gunz, Dhanani and Whyte (2014) described the retrieval phase as being the most important one of the transfer process. The data reflected several important points to guide the transfer. These include : whilst it is possible to undertake invasive procedures during the actual transfer, it is not ideal and the neonate should be stabilised and properly packaged, with meticulous attention to pre-transport stabilisation, to minimize clinical instability and complications that might arise during the transfer in order to ensure a good neonatal outcome. According to the American Heart Association, European Resuscitation Council and International Liaison Committee on Resuscitation (2010), subsequent evaluations should adopt the ABCDE approach and seek advice on stabilisation from the receiving facility, if necessary. The airway should be assessed and confirmed, and if necessary secured and protected, and the tube position, size and depth annotated. Intubation and ventilation prior to transport is mandatory if

there are any concerns about the integrity of the airway or the adequacy of ventilation. Droogh *et al.* (2012) argued that the neonate should be assessed for respiratory efforts, and inspired oxygen may be guided by SpO₂ (estimate of arterial oxygen saturation) and EtCO₂ (end-tidal carbon dioxide). Intubated neonates should normally be sedated and ventilated before transferring them onto the transport stretcher, and attaching the ventilator and monitoring equipment. Karlsen *et al.* (2011) stated that the neonate may take a while to stabilise on the portable transport ventilator, after which, if possible, an arterial blood gas (ABG) should be performed prior to departure. A bag valve mask (BVM) should always be readily available, and if a pneumothorax is present, a chest drain should be inserted prior to departure.

Other guidelines are that arterial blood gas monitoring are routinely used at neonatal intensive care units. The ability to assess neonatal arterial blood gasses by modern, easily used blood gas analysers should be available in neonatal units. The routine measurement of arterial blood gasses monitoring in ventilated neonates, is essential to determine ventilator status. The neonate needs time to settle on the ventilator and once stabilised, at least one arterial blood gas (ABG) should be performed prior to departure to ensure that the neonate is being ventilated appropriately. However, if a blood gasses analyser is unavailable at the referring ward, or if the arterial intravenous line on the neonate is not available, then the transfer team must not delay the transfer by insisting for an arterial blood gas reading and proceed to the designated hospital, using other methods of monitoring. Hypothermia, hypoglycaemia and metabolic acidosis are reversible courses, and have a significant negative impact on the transfer and the eventual patient outcome. Therefore it must be corrected before the transfer.

The status of circulation by pulse volume and capillary refill time needs to be assessed, and if the circulation is compromised, it should be corrected according to the latest resuscitation guidelines. Karlsen *et al.* (2011) asserted that venous access is mandatory, with all intravenous (IV) lines needing to be secured, and redundant IV lines and infusion not vital to the neonate's treatment removed, the line flushed and capped. All infusions should be running, and if there is doubt about the infusion, the doctor consulted and a new infusion drawn up. Nasogastric/orogastric tube, urine catheter or any other drains necessary for the transfer should be secured in place,

and free drainage allowed into collection bags, which should be emptied prior to the transfer. McEvoy *et al.* (2017) indicated that adequate sedation and/or analgesia should be provided, and if inotropes or other vasoactive agents are required to optimise haemodynamic status, the neonate should be stabilised, before leaving the referral unit. The administration of all medication should be documented to avoid inadvertent repeat dosing and toxicity.

Singh *et al.* (2010) discussed the need for the neonate to be well secured and protected from the environment. Bouchut *et al.* (2011) added that maintaining a thermal neutral environment for the neonate during transportation is essential to avoiding thermal stress, which may create a metabolic effect. The transport incubator should be set at the appropriate temperature and the neonate secured in the incubator to protect them from sudden acceleration or deceleration of the vehicle or the G force or turbulence of the aircraft. Before departure from the referring facility, the transfer coordinator or the receiving doctor should be contacted and given an update of the neonate's condition, the estimated time of arrival and any clinical advice, if necessary.

Carreras-Gonzalez and Brió-Sanagustin (2014) expressed that clinical management of a neonate in aeromedical transfer is slightly different from ground transport, mainly because of the change in altitude and limited cabin space. Aeromedical personnel should therefore have a higher level of expertise, specialist knowledge and practical training, and must meet minimum aviation requirements. Jackson and Skeoch (2009) added that the issues of isolation, unfamiliar environment, ambient pressure and altitude, temperature control, acceleration, deceleration, excessive ambient noise and vibration are all aeromedical problems that might impact the transfer of the critically ill neonate. Therefore, the aeromedical team and medical doctors must be familiar with these challenges. An increase in altitude affects the neonate's physiology in a number of ways, including: (i) a decrease in barometric pressure results in reduced alveolar pressure of oxygen (decrease in the partial pressure of gases) and may lead to hypoxaemia, making increased inspired oxygen concentration mandatory for all aeromedical transfers; (ii) decreased barometric pressure, which leads to an increase (expansion) in the volume of gas filled cavities in the neonate, such as the pneumothorax, therefore the pneumothorax must be

drained, and (iii) a change in altitude lowers environmental temperature, resulting in hypothermia.

d. Sub-theme 4: Monitoring and evaluation during transport

The transportation phase begins at the time of departure from the referring facility to the time of handover at the receiving facility (including loading the neonate into the ambulance, the ambulance journey and unloading the neonate from the ambulance). To maintain a continuum of care the standards of monitoring and clinical management should be equivalent to a neonatal intensive care unit environment (Parmentier-Decrucq *et al.* 2013). Monitoring and evaluation is crucial throughout the transfer. Any changes or interventions in the neonate's condition should be documented and handed over to the referring personnel and the emergency management communication centre should also be kept updated. The minimum standards require that neonatal monitoring by appropriate trained personnel occur as follows : (i) electrocardiogram (ECG) monitoring (ii) non-invasive blood pressure (NIBP); (iii) non-invasive arterial saturation (SpO₂); (iv) non-invasive end tidal carbon dioxide (EtCO₂); and (v) non-invasive temperature monitoring (American Heart Association, European Resuscitation Council and International Liaison Committee on Resuscitation 2010). These are the protocols that should become embedded within a newly developed intervention.

Taljard (2008) highlighted that safety is paramount for the transfer team, the neonate and the accompanying family member. All equipment should be secured to prevent loose items from becoming missiles, during sudden acceleration or deceleration of the vehicle or because of G force or turbulence of the aircraft. Whyte and Jefferies (2015) added that no equipment be left on top of a neonate or the incubator and that guidelines should allow easy access for the airway and intravenous lines. In addition gas cylinders should be securely housed other equipment within easy reach of the attendants. Other protocols to be included in the programme should stipulate that transfer team members and the accompanying family members remain seated in the ambulance and wear the seatbelts. In aeromedical transport, if a crew member needed to unbuckle a seatbelt for whatever reason, the pilot should be informed immediately. If, despite stringent pre-transfer stabilisation, an unforeseen clinical emergency should arise and the neonate requires intervention in a ground

ambulance, it is better to stop the vehicle at a safe place, rather than carry out an intervention in a moving ambulance.

e. Sub-theme 5: Handover at the receiving hospital

The final phase viz. the reception phase, entails handing over the neonate to personnel at the receiving facility. This requires that they prepare in advance to accept the neonate, and that a formal handover from the team leader to the receiving personnel occurs. In the United States, Foronda, VanGraafeiland and Davidson (2016) reviewed the handovers of the critically ill children at the John Hopkins Hospital. They noted that handover procedures be both verbal and written, and include all events preceding the reception phase and the neonate's history, vital signs, significant clinical events during transport, interventions conducted specimens obtained and other relevant documentation. Acosta *et al.* (2010) advised that a physical examination be undertaken by the receiving personnel in the presence of the transfer team leader and that vital signs and findings on handover should be documented on the neonatal transfer report form. This must be duly signed by the receiving personnel, and a copy of same forwarded to the receiving facility, together with a satisfaction or compliant form for feedback and clinical governance.

Hence the newly designed programme must have in place these procedures for a handover. Reeves *et al.* (2008) noted that the handover of critically ill patients requires the sharing of vital information amongst all disciplinary experts. Without knowledge of the clinical condition of the neonate before and during a transfer, can be catastrophic as the requisite interventions will not be put in place.. Heinrichs, Bauman and Dev (2012) highlighted the human factors, such as role ambiguity, differences in values, professional hierarchies and lack of teamwork, as those which can impact a handover. These factors were also common in this study which suggests the need for organisational infrastructure and a manager who can ensure that the role of each individual is clear, in conjunction with protocols to be followed. These are some of the practical issues deserving of consideration within the newly developed programme. What also requires consideration is a team brief following completion of a transfer to ensure that stress is adequately managed and that challenges are noted and dealt with as part of a rigorous quality assurance programme.

6.2.2.4 Theme 4: Paradigm shift in education and training

The transfer of a critically ill neonatal transfers, demands a highly competent team leader, who must have a combination of appropriate knowledge, skills and values to be able to diagnose and clinical manage the critically ill neonate. This study revealed that ALS paramedics did not feel adequately prepared to deal with the transfer and lacked intensive care expertise, which evolves through the experience of undertaking such transfers.

A newly developed programme should therefore ensure that ALS paramedics who are part of the team are adequately capacitated to deal specifically with neonatal transfers. This level of knowledge is crucial to dealing with the challenges that the transfer environment brings. Whyte and Jefferies (2015) asserted that neonatal transfers generally require more interventions and involve more complications as compared to other populations groups. Where paramedics have not received the appropriate education and training, it is crucial then that those identified for a team undergo further training to be prepared (Hancock and Harrison 2018, Meberg and Hansen 2011) and Snijders *et al.* 2007).

a. Sub-theme 1: Appropriate theoretical knowledge

Most paramedics expressed that their education covered basic information for neonatal transfers which left them sorely unprepared for the real world realities. Once qualified, they enter the pre-hospital environment with broad theoretical knowledge and skills that they have to apply to neonates. Given that there is no internship programme, suggests that knowledge and skills are developed from practice experience which reflects that at any point in time a relatively inexperienced paramedic with no proper educational preparedness, may be involved in a transfer. Those at the apex of neonatal transfers therefore need to call on higher education institutions and colleges involved in training ALS paramedics to include a specialised module related to this aspect in their training and should guide these institutions on what aspects are important within such a module.

b. Sub-theme 2: Maintaining competence

Dealing with a critically ill neonate during a transfer requires a very high level of expertise, as clinical interventions are often needed during the transfer process. Paramedics should be competent to ensure critical care and monitoring during the transfer to avoid neonatal adverse events (Dalal *et al.* 2013; Gilpin and Hancock 2016).

Given the relative unpreparedness of paramedics currently, demands that training be provided to those who will become part of dedicated neonatal transfer teams. In the absence of such dedicated units, training should still be provided to all ALS paramedics who within the current context, may be called to effect a transfer. Continuous education, related to neonatal clinical interventions and competency to use equipment and understand the protocols related to a transfer is therefore essential within a newly developed programme. The latter can be effected through regular continued professional development (CPD) forums, mortality and morbidity workshops, lectures and group discussions, refresher workshops, multi-disciplinary training with other crucial role players involved in the transportation of neonates (doctors, nurses and support staff).

LeFlore and Anderson (2008) and McBride *et al.* (2011) suggested that procedural skills can be taught in a safe, simulated environment, will enable competence. Most participants indicated that the skills requiring attention as part of ongoing training were oral and nasal intubation, umbilical and peripheral vein cannulation, ventilator setting and neonatal resuscitation.

c. Sub-theme 3: Team values

The efficacy of the transfer team is the result of a complex combination of knowledge, skills and values. Knowledge is the theory that underpins practice and can be taught formally (in the classroom) and informally (in the workplace). Skills are practical tasks that can be taught by demonstration followed by practice and then observation. While these are important Cooper (2007) affirmed that the values and attitudes of healthcare providers were equally important. Gilpin and Hancock (2016) added that attitude is a product of individual unique beliefs, professional and personal life experiences which cannot be taught, but can be encouraged.

The most critical values include responsibility, empathy, care and respect. It is therefore important that those identified for newly dedicated specialist units have such values. These are essential to a well balanced practitioner, who can empathise with family, communicate positively with other team members, and respect the diversity of all including the team and accompanying family members.

6.2.2.5 Theme 5: Quality assurance

A clear need for quality assurance protocols to support a programme for neonatal transfers. All transfers should be reviewed to identify their strengths and weakness, and opportunities to reflect on team performances, system issues and the feasibility of its documents and policies. In addition to neonatal care, quality assurance programmes, within a newly developed programme to guide transfers, should also include the performance of the EMCC, required registrations, certifications and licensing of EMS personnel, maintenance of equipment and ambulances, and safety issues.

a. Sub-theme 1: Quality assurance management structure

The data supported the need for an an appropriate management structure that incorporates quality assurance. Although quality assurance is the responsibility of everyone involved in the transfer, managers should ultimately be involved in quality assurance through a thorough review of all structures and processes, ensuring sufficient resources, replacing obsolete equipment and ensuring new organizational developments. Incident-reporting mechanisms and critical incident monitoring should also be in place, allowing for the overall transfer system to be improved.

b. Sub-theme 2: Evidence based research

For several years developed countries have used evidence-based research to support efforts to improve the quality of health care programmes for all disciplines of care and categories of patients. In South Africa little research exists to guide the improvement of inter-healthcare facility transfer programmes of critically ill neonates. Data from the current study supports the need for research to be a component of a new programme. This will eventually facilitate tracking the various aspects related to neonatal transfer and can be used to improve practice standards. More importantly

universities should be encouraged to devote attention to and partner with a newly developed specialised unit to explore research topics that may eventually improve and strengthen neonatal transfers in South Africa.

6.2.2.6 Theme 6: The psycho-social needs of the mother

A newly developed programme must create an enabling and supporting environment for the accompanying mother or other family members. The data highlighted the distress endured by mothers who in most instances are still recovering from delivery, who may be affected by general anaesthetic and the downsurge of hormones post delivery. These combined factors lead to her being physiologically weak and emotionally sensitive, which is exacerbated by the transfer of her baby. The transfer team should therefore be sensitive to her psychological needs, make her safe and comfortable and provide reassurance that her baby is being given the best possible care. In South Africa, literature related to this aspect is non-existent and the data reflects that this aspect of care is also invisible within current EMC education. A newly developed programme should therefore take cognisance of this aspect and create separate opportunities for empowering paramedics to deal with the psychological distress experienced by mothers and other family members.

6.2.3 Section summary

ALS paramedics appear to be largely unprepared for the realities of neonatal transfers and have to grapple with issues of a lack of infrastructure and equipment when faced with same. The study highlights the need for higher education institutions and colleges to capacitate paramedics but moreover for newly dedicated units to capacitate those who will be involved in transfers to be prepared for the multidimensional challenges ensuing from a transfer. More importantly a newly designed programme, will have to give earnest consideration to overhauling the system to ensure that a dedicated unit and team has the appropriate infrastructure, appropriate training and preparation, equipment, documents and policies in place and availability of resources to serve as as the bedrock from which EMC practitioners can operate.

6.3 Results and discussion of findings: sample e

Sample e consisted of EMC lecturers who educate and train the ALS paramedics to undertake neonatal transfers. They lectured at Higher Education Institutions (HEI) (n=1), and public Colleges of Emergency Care (COEC) (n=3), in SA

6.3.1 Results of the findings:

Findings derived from this sample were grouped into six key themes and sub-themes which are presented in Table 6.3.

Table 6.3: Themes and sub-themes: sample e

THEMES		SUB-THEMES
1	Knowledge gap	a. A demand for internship programmes b. Inexperienced lecturers
2	Awareness of SA practice realities	a. Continuous educational and vocational programmes b. Algorithms, clinical care pathways and checklists
3	Maintaining skill competency	
4	Improving values and attitudes	
5	A holistic programme	a. Psycho-social support training b. Safety during transfer
6	Supportive structures for the transfer	

6.3.1.1 Theme 1: Knowledge gap

Most participants agreed that there was a distinct theory-practice gap in terms of preparedness for the transfer of critically ill neonates.. Almost all lecturers indicated that current education related to critically ill neonates is much shorter than instruction for adults and the other paediatric teachings.This is reflected in the following excerpts :

“...you can teach as much theory and practical as you what in the classroom, it is still not going to help. You need to physically do these transfers, therefore there must be a dedicated unit, with a dedicated teams, specialised programmes and continued practice. This is where the proper teaching and

experience will come from, subspecialty and vocational training is the way forward.” [Lec, FDG 3, Participant 7, Page 1]

“...our formal programmes are so cramped that we give a lot of attention to adults and older paediatrics but not as much to the critically ill neonate, we provide as much theory as possible.....to meet the minimum standards of the programme.” [Lec, FDG 1, Participant 4, Page 2]

a. Sub-theme 1: A demand for internship programmes

Almost all the lecturers supported the need for internship programmes, before a paramedic is certified for operational duties, due to the gap in their training experience.

“A paramedic can practice immediately once he/she qualifies. Although they had work integrated learning and their skills are signed off in skills labs, it does not make them ready for operational duties. Neonatal transfers are very different from other cases, a paramedic can begin with your first case being a neonatal transfer, but it can also be the end because if you don't know what you doing, the baby can die. Internship programmes are needed, I would say for at least 6 months before paramedics are allowed to practice.”

[Lec, FDG 3, Participant 6, Page 19]

“I do not understand why there is no internship programmes. There is a lot of thing we don't understand after we qualify, an internship will help clarify those uncertainties and help the paramedic gain experience.”

[Lec, FDG 2, Participant 3, Page 2]

b. Sub-theme 2: Inexperienced lecturers

Some lecturers expressed that that they themselves little or no knowledge related to neonatal transfers. Most indicated having little operational experience with which to base their teaching on therefore suggesting the need for subject specialists to be assigned to teach content related to neonatal transfers.

“...so going forward it would be great if neonatologists or paediatricians teach this module, or even a paramedic who has vast experience in this area, bring them in as specialist lecturers.” [Lec, FDG 1, Participant 1, Page 2]

“Our education system must also take blame for problems in transfers, because lecturers are not doing a good job. Lecturers who never worked operational are now teaching people. How can you teach something you don’t understand?” [Lec, FDG 2, Participant 2, Page 8]

6.3.1.2 Theme 2: Awareness of SA practice realities

Participants mentioned that whatever material they taught, has been deemed adequate for preparation for neonatal transfers. Earlier data from paramedics however suggest the inadequacy of this in terms of being able to deal with the realities of a transfer, particularly in the face of no or dysfunctional equipment and other relevant support. Academics also indicated that the content taught is very theoretical, and embedded in first world literature. The lack of locally relevant knowledge led a few lecturers to suggest that paramedics being trained at universities require further training.

“...best practice is specific to the geographical, economic background of the country therefore the theory needs to be linked to that and the categories of best practice, not what is happening right now, it’s all evidence based practice from first world countries, it’s not working.”

[Lec, FDG 3, Participant 1, Page 6]

a. Sub-theme 1: Continuous educational and vocational programmes

Continuous education and vocational programmes were identified as crucial to empowering the current cadre of ALS paramedics and to addressing the theory-practice gap. It reinforces earlier discussions for a newly developed programme to have as a sub component, continuous professional development (CPD) workshops, mortality and morbidity workshops, case studies, reflections, and group discussions, debriefing sessions and multi-disciplinary training with all role players involved in the transportation of neonates (doctors, nurses and support staff).

“Once a qualification is obtained, education must be continuous with workshops, updates and refreshers. Having all the formal education with all the theory will not address contextualised problem.”

[Lec, FDG 2, Participant 5, Page 10]

b. Sub-theme 2: Algorithms, clinical care pathways and checklists

This sample also supported the use of algorithms, clinical care pathways and checklists to simplify and make the transfer process more efficient. .

“The use of algorithms, clinical care pathways are useful tools to simplify processes and practices, it makes quick referencing when a paramedic wants to know something in a hurry. Checklists as well can also ensure that everything is there and in order and everything is done the way it should. These tools make good practice and they must be user friendly.”

[Lec, FDG 1, Participant 5, Page 6]

6.3.1.3 Theme 3: Maintaining skill competency

Almost all the lecturers expressed that EMC education fails to recognise the importance of mastering skills for neonatal emergency clinical issues.

“.....critical neonatal transfers requires a paramedic to be competent and updated with his/her skill because if not the baby will die. There must be continuous development, continuous assessment and no room for mistakes. If you don't use it you loose it, if a paramedic does not practice this skill regularly then that skill can be lost.” [Lec, FDG 3, Participant 2, Page 14]

Participants suggested that constant interactive skills sessions, outlining vital components for the transfer of neonates and their clinical requirements is beneficial. They indicated that these skills can be acquired using a simulated manikin and scenario based role play, in-service training, practice in skills laboratories, and regular emergency drills and skill competency assessments combining theory and practice.

“To acquire professional competence as far as skills are concerned, there must be regular practice and evaluations, regular simulations and OSCE's

(objective structured clinical examination), continuous practice to keep skills refined.” [Lec, FDG 1, Participant 4, Page 7]

Many lecturers mentioned that more time should be devoted to experiential learning and once qualified, the transfer team should be involved with training with discipline specific experts to enhance their skills and expertise, and to familiarise themselves with the NICU and its requirements.

“A lot of teaching and learning happens during cross training and paramedics can enhance their skills and expertise when spending time in NICU’s”

[Lec, FDG 3, Participant 5, Page 15]

“Professionals also needs to understand each other’s field, cross training should be a part of the transfer programme when NICU staff spends time in ambulance and transfer team spend time in NICU.” [Lec, FDG 2, Participant 5, Page 12]

6.3.1.4 Theme 4: Improving values and attitudes

A few participants expressed that the poor attitudes and values of paramedics was as a result of the under resourced and over burdened health care system. They indicated that an improved system will address many factors contributing to poor attitudes.

“Our setting are very different from first world settings, our paramedics are overworked, sometimes they undertake multiple transfer a day with, inadequate and substandard equipment, then they have to respond to operation duties, they deal with continuous intimidation, poor management and working conditions. At the end of the day the paramedic is exhausted, overworked, and demotivated, these are issues that relate to bad attitude. They system needs attention first then before we can focus on professionalism and good attitude.” [Lec, FDG 3, Participant 1, Page 18]

Most participants indicated then that education should include values. A few also indicated that appropriate knowledge and skills can build confidence, which will ultimately reduce intimidation in the clinical environment.

“Through appropriate knowledge and skills, confidence is boosted and that changes a paramedic’s attitude, he/she will have a positive attitude knowing that he/she is confident to treat any critically ill neonate at ease, without doubting their abilities” [Lec, FDG 1, Participant 2, Page 9]

“Paramedics are intimidated to undertake critical neonatal transfer, but if they become specialists in this field, have the correct knowledge and skills then they will be positive and confident about their abilities and will not feel intimidated or be intimidated.” [Lec, FDG 2, Participant 6, Page 14]

6.3.1.5 Theme 5: A holistic programme

Lecturers also supported the need for a more holistic programme that took into account the psychological needs of accompanying family members.

a. Sub-theme 1: Psycho-social support training

Most participants agreed that paramedics should have knowledge to deal with the psychological and emotional needs of the accompanying family member. They suggested that to enable this a checklist highlighting important points to address relevant issues be created.

Psycho-social support for the accompanying family member is compulsory; I have no idea why this is non-existent. Paramedic and the transfer team should have basic psycho-social skills because of the nature of the case, it’s a highly traumatising situation for the accompanying person.

[Lec, FDG 3, Participant 4, Page 20]

“.....the baby is a critical patient, the paramedics attention is on that baby, so with the adrenaline rush he can forget to communicate or say thing that he should not have said, so having a checklist with a tick box will help relay information, like have you introduced yourself, did you explain the following and so on.” [Lec, FDG 2, Participant 5, Page 18]

b. Sub-theme 2: Safety during transfer

Almost all the lecturers argued for the newly developed programme to create mechanisms to address safety during transfers.

“Firstly the team must abide by the rules and regulation of road and air modes of transport...use seat belts and so on, but there should be safety programmes and regular safety drills should there be an emergency. Even when there is an escort, they should be orientated or quick safety update, where is the exit points, where is the fire extinguisher, what to do in the event of an emergency and so on.” [Lec, FDG 3, Participant 2, Page 21]

“Safety during transfer, understand the aircraft in air transfers, what to do in flight emergency situations, do safety drills and touch tests before flying, know the danger point and basic aircraft operations.”

[Lec, FDG 2, Participant 2, Page 16]

6.3.1.6 Theme 6: Supportive structures for the transfer

Almost the entire sample stated the need for a newly developed programme to create appropriate structures and human and material resources.

“But irrespective of the appropriate knowledge and skills, we can educate this high end ALS paramedic, if there is no structures in place to support this highly qualified and skill personnel to do his/her job then it’s a fruitless exercise.” [Lec, FDG 3, Participant 1, Page 22]

All lecturers argued for the inclusion of a clinical governance programme, with regular audits to improve the transfer process, with communication, documentation and educational programmes as part of clinical governance.

“Clinical governance is always an issue, its lacking and we all know the importance of it, there must be a well organised and structured clinical governance programme with audits and feedbacks.”

[Lec, FDG 2, Participant 5, Page 19]

6.3.2 Discussion: Sample e

6.3.2.1 Theme 1: Knowledge gap

The EMC education and training environment is changing with the implementation of the NECET Policy. Under this policy, the short course training will be closed and replaced by only three formal EMC qualifications, namely: the Emergency Care Assistant (ECA), Emergency Care Technician (ECT) and Bachelor of Health Science in Emergency Medical Care (BHSc: EMC). Although the intention of this policy is to professionalise EMS and allows for vertical articulation in education, this study provided evidence that formal education has thus far not adequately addressed neonatal transfers. It suggests the need for a deeper understanding between the government and higher education institutions to provide contextually relevant education, based on local neonatal transfers so that those emerging with these qualifications have adequate educational preparedness to deal with this specialised field. This sample supported calls made from other samples to address the relevant unpreparedness of the current cadre of paramedics by ensuring that ongoing training becomes embedded within the core of a newly developed programme for neonatal transfers.

a. Sub-theme 1: A demand for internship programmes

In South Africa, doctors and nurses working in ICU's, undergo internship programmes, as part of additional specialised education and training (de Beer, Brysiewicz and Bhengu 2011). This is not true for ALS paramedics, who have the the same level of responsibility during transfers. This reinforces earlier arguments for knowledge and skills, to be taught post qualification. Milburn and Colyer (2008) emphasised that internship provides opportunities for experienced healthcare providers to guide fledgling paramedics. Once internship period is completed, a formal evaluation of competence can be undertaken and only when the intern is successful, can they be fully licensed to clinically manage critical ill neonates without supervision. Again given that the current cadre of paramedics have not undergone an internship programme, a specific component of transfer programmes should specify internship programmes alongside continuous education.

b. Sub-theme 2: Inexperienced lecturers

Mundy and Denham (2008) wrote that educators are critical in developing academic knowledge and skills, and therefore must have in-depth knowledge of and experience with regards to the subject matter they teach. Stroud *et al.* (2013) and Kue *et al.* (2011) added that experienced lecturers are essential to improved student outcomes and developing professionals who can meet the demands of their profession. A potential lack of knowledge amongst educators with regards to teaching content, constitutes the hugest barrier to professional preparedness (LeFlore and Anderson 2008), as was evident in this study. This supports earlier arguments for them to be in touch with neonatal practice realities and keep abreast of contemporary neonatal clinical and transfer related issues to ensure that ALS graduates are fully prepared for the intense level of this type of emergency care.

6.3.2.2 Theme 2: Awareness of SA practice realities

The academic sample further acknowledged the lack of attention to the practical realities, within the EMC neonatal transfer system in SA. They argued that much of the course focuses on Eurocentric approaches and are theoretical and bear little relevance to preparedness for the SA context. Moreover as Giardino *et al.* (2012) added the transformation of theoretical knowledge reinforce opportunities for clinical skills that can only be acquired by experience. Hence any form of professional preparedness prior to qualifying and in preparation to enter the neonatal transfer field demands immersion within such a context as part of training and opportunities to practice in simulated practice contexts to ensure complete readiness for this field.

a. Sub-theme 1: Continuous educational and vocational programmes

Achieving an appropriate knowledge base begins during formal education and must be maintained throughout an individual's career (Michael 2013). Karlsen *et al.* (2011) reiterated the need for continuous education as voiced by the academic sample and should include the elements already discussed. As argued it should be done be with all role players involved in neonate transportation (doctors, nurses and support staff).

Moreover continuous educational workshops ensures that professional standards are maintained , helps to build confidence, competence, career progression and advancement (Karlsen *et al.* 2011). In addition as McPherson *et al.* (2014) asserted continuous educational and vocational programmes promotes greater engagement with the workforce, general commitment to the job and the sharing of best practice ideas.

b. Sub-theme 2: Algorithms, clinical care pathways and checklists

Giardino *et al.* (2012) described clinical algorithm and care pathways as a text format, which is especially designed for presenting a sequence of clinical decisions making for guiding patient care. Kline-Krammes *et al.* (2012) agreed that that these tools can be used to standardise care processes, and reduce the variability in clinical practice and improve outcomes. However, they act as a guide and are not intended to replace the independent medical or professional judgment of health care providers. Checklists then should be developed and incorporated into the new programme being developed and should serve as aide memoires, and to ensure that no equipment is left behind. They will be particularly useful within the newly designed programme as they will guide paramedics and others on what specific activities and criteria should be undertaken to ensure that nothing is missed in an emergency situation. In addition, it is essential that the transfer team leader has a detailed understanding of the common problems that may present within neonatal I transfers. These common challenges should be part of continuous education. Moreover a pocketbook defining the most common life threatening emergencies and their clinical management can be developed to act as a quick reference guide (McEvoy *et al.* 2017; Gilpin and Hancock 2016; Sethi and Subramanian 2014; Stroud *et al.* 2013; Messner 2011; Singh and MacDonald 2009).

6.3.2.3 Theme 3: Maintaining skills competency

Most of the sample agreed on the need for regular interactive skills building, in-service programmes. In-service training contributes to developing and maintaining prerequisite skills (Nsemo *et al.* (2013; Ni *et al.* 2014; Sajjadnia *et al.* 2015) post qualification. The purpose of interactive skill sessions, reinforces and embeds learning, enhances clinical skills while combining theory and practice in a non-

threatening manner (Cioffi 2001). The skills supported by participants, that must be included in the newly developed programme, should include those mentioned such as practice on simulated mannequins and scenario based role plays. Learning occurs within contexts that provides a foundation to construct knowledge in practice (Argyris and Schon 1996) which suggests the need to strengthen experiential learning during formal education and post qualification. This may be enabled by ensuring that ALS paramedics spend time in NICU's, and that staff at NICU's work within transfer teams to understand and learn from the context, as suggested by participants.

6.3.2.4 Theme 4: Improving values and attitudes

The data reflected the need to change the values and attitudes of health practitioners which can be effected through correct training (Strang *et al.* 2007). The efficacy of the transfer team hinges on a complex combination of knowledge, skills and attitudes thereby necessitating that values remain pivotal in terms of team relationships and commitment to a successful transfer (Cooper 2007). A newly developed programme should therefore be underpinned by sound values which can be embedded within its mission statement. A lack of professional preparedness acts as a significant barrier to successful diagnosis and clinical management (Peltzer *et al.* 2009), thereby decreasing competence which may result in poor attitudes. Proper training which is guided by sound values may ultimately lead to better attitudes within EMC. Despite this it is crucial however that paramedics selected not only for neonatal transfers, but EMC in general have a solid value given the fragility and vulnerability of humankind they encounter during practice.

This study showed the lack of dedicated specialised transfer units and variations in the team dynamics. Having a dedicated inter-healthcare facility transfer unit and teams for critically ill neonates that are informed on empirical research, with the appropriate knowledge, skills for ALS practitioners and organisational structures, will empower paramedics to offer a specialised service. This will also make it more likely that paramedics who are part of the transfer team will have the right attitude and passion for this field of practice. Furthermore, paramedics who are overworked with operational duties and transfers, often work with limited staffing and equipment. An increase in workload may result in fatigue and stress, and can lead to low morale.

6.3.2.5 Theme 5: A holistic programme

This sample reiterated the views of other samples regarding a more holistic neonatal transfer programme..

a. Sub-theme 1: Psycho-social support training

The need for paramedics to have professional preparedness to deal with the psychological distress and trauma of the transfer experienced by accompanying family members, was supported strongly by this sample as well. This calls for higher education institutions and colleges to include this component in the training of paramedics. In addition it is crucial that this void be filled within the current qualified cadre of paramedics who clearly cannot deal with crisis intervention and support related to family members. The newly developed transfer programme and unit should then have a separate facility for family members at all hospitals, where they can receive help and information. Components of a training module should include trauma debriefing, providing empathy and support, basic counselling skills and the ability to refer appropriately to a psychologist or hospital chaplain or other spiritual support systems where appropriate.

b. Sub-theme 2: Safety during transfer

In the United Kingdom, Fenton and Leslie (2009) noted the potential hazards when an ambulance, transferring a critically ill neonate was involved in an accident. Investigations showed inadequate equipment securing devices, unreasonable equipment weight, and that the baby was not secured in the incubator, all of which breached existing Health and Safety legislation. It was discovered that staff training related to these issues was patchy. American Academy of Pediatrics (2007) indicated that the increasing numbers of ambulance accidents either by ground or air, worldwide has heightened awareness among EMS and regulatory bodies about the dangers encountered during transport. The newly developed programme therefore needs to give due consideration to the regulations governing road and air transfer and should ensure that they are enforced and abided by, to ensure safety during transfer. Ambulance safety cannot be neglected, and efforts are needed to guarantee that vehicles and aircraft, patient care areas, and operational procedures meet safety standards. Safety training should begin during orientation, and be

emphasised throughout all levels of operational and educational forums. This should include safety drills before transfers, and in the event of having an escort during transfer, they should be orientated about safety requirements before the transfer. Transfer teams need to adopt a culture of safety that ensures that policies that are adhered to to protect staff, the neonate and accompanying family member's safety.

6.3.2.6 Theme 6: Supportive structures for the transfer

This sample also supported the need for proper structures to support the work of those undertaking neonatal transfers. The lack of a dedicated organisational structure, to facilitate transfers and huge deficits in the actual infrastructure were also raised by other samples thereby strengthening the need for both organisational and other resources to be firmly in place within the context of a newly developed programme.

Clinical governance which is a systematic way of maintaining and improving patient care features was a central thread within the data. The academic sample expressed that whilst clinical governance was a critical aspect of their education and training it did not necessarily lead to daily practice. Health care organisations are duty bound to uphold quality and safety in the provision of care, and to create the necessary organisational structures and provide the necessary resources for this. Although the South African health care system is under resourced and plagued by a burden of disease, it is critical that clinical governance characterise not all aspects of healthcare but underpin the neonatal transfer process.

Those managing the neonatal transfer system need to engage in continuous conversations and empirical research to be aware of the challenges facing those effecting transfers so that the emergency medical service within this sector functions optimally. Whilst this is obviously not occurring due to a lack of human resources and time it is crucial that specific cases be reviewed to understand the unique issues associated with neonates and to develop mechanisms that enhance a successful transfer based on different issues related to these transfers. Only through a more deeper understanding of the diverse clinical issues facing neonates and an interrogation of what may potentially compromise a transfer can the South African emergency medical service learn about how to develop a transfer service that is

grounded in evidence based practice. This in turn can catalyse the development of policies that are sorely lacking within the South African context related to neonatal transfers.

6.3.3 Section summary

These findings highlighted the multifaceted issues that the South African Department of Health will need to address in order to recreate a more efficient and safe neonatal transfer system. The academic sample reiterated the views of the other samples with regards to specialised organisational structures, state-of-the-art equipment, paramedics who can be sensitive and professionally prepared to deal with the trauma accompanying family members face. These are the dynamics that deserve consideration within the proposed new programme to guide neonatal transfers in South Africa.

6.4 Results and discussion of findings: sample f

Sample f consisted of seven neonatologists from the public health sector nationally.

6.4.1 Results of the findings

The themes and sub-themes derived from this study is reflected Table 6.4.

Table 6.4: Themes and sub-themes of sample f

Themes		Sub-themes
1	Toward safer neonatal transfers	a. Lack of adequate communication and coordination b. Technical and logistical issues c. Prolonged delays in the transfer
2	Strategies for risk reduction	a. Assessing the need to transfer unstable neonates c. Regular audits and feedback
3	Attributes for preparedness	
4	A contextualised standardised transfer system	
5	A family centered approach	

6.4.1.1 Theme 1: Towards safer neonatal transfers

Almost all the neonatologists supported the views of the other samples, that drastic steps were needed to reinvigorate and improve the neonatal transfer system. They also acknowledged that neonatal transfers in the South African context, differed from that of developed countries, warranting the need for a more careful consideration of how these transfers can be operationalised in under resourced and poor socio-economic areas. Participants for example raised important issues such as lengthy delays that occur when transferring neonates from a rural hospital to more resourced one. They said as follows :

“There is much need for improvement in the intensive care neonatal transfers especially in the public sector, there are too many variations, unplanned and unorganised transfers with no proper structures in place, and as a result there are long delays, logistical and technical issues. These add further

complications to a baby that already has critical complications”.

[Neonatologist interview 5 Page 2]

“Let do things that suits us, what is beneficial and realistic in our setting. Best practice in first world countries does not necessarily mean best practice in resource poor countries, like ours.”

[Neonatologist interview 7 Page 2]

a. Sub-theme 1: Lack of adequate communication and coordination

The neonatologists agreed that there was a lack of a properly co-ordinated effort from the beginning to the end of the transfer, as well as post transfer follow-ups. Moreover poor communication posed a huge problem in terms of ensuring a smooth transfer. Participants expressed the following sentiments :

“Communication and coordination is poor, and this is one of the key importance of a transfer system for the best interest of the patient and service delivery.”

[Neonatologist interview 6 Page 2]

“...there is a lack of communication and sometimes miscommunication, so communication needs a lot of attention as it is the core of transfer. Everyone dealing with the patient needs to know what is going on.”

[Neonatologist interview 1 Page1]

b. Sub-theme 2: Technical and logistical issues

Technical and logistical challenges, especially the lack of critical life-saving equipment for critically ill neonates, were the most significant issues raised in the data. This cohered with the views of other samples who highlighted the damaging consequences of defective or a lack of incubators, ventilators and syringe drivers.

“...technical and logistics issues with equipment are a huge concern that we are currently facing. There are always problems with equipment, its either they don't work or it's not available. I know that equipment was procured but it comes down to poor management of theses equipment because they are not serviced and well-kept especially the incubators, ventilators and syringe drivers..”

[Neonatologist interview 1 Page 2]

“...they are borrowing equipment for the transfer which is the incorrect thing to do. Sometimes the paramedics come without dated equipment, faulty equipment, cold incubators, and battery failures. So the problems with EMS equipment are endless.

[Neonatologist interview 3 Page 2]

c. Sub theme 3: Prolonged delays in the transfer

Prolonged delays in the transfer was also identified, leaving the neonate without appropriate care at the referring facility. Participants said as follows :

“Having a critical neonate in an ambulance on a portable ventilator for long period is not advisable simple because of the potential dangers of a portable ventilator, mainly barotrauma and all the risk of the ambulance environment. Therefore, long distance transfer must be airlifted to speed up the process”.

[Neonatologist interview 7 Page 3]

“Waiting for long periods for a baby to arrive is problematic, not only for the baby but it has a ripple effect on the whole system. Doctors and nurses have to wait for the baby, we are very busy, and we cannot just sit around and wait. Delays must be prevented, it is the responsibility of the EMS.”

[Neonatologist interview 5 Page 5]

6.4.1.2 Theme 2: Strategies for risk reduction

Neonatologists also expressed the need to reduce potential risks in multiple ways. Most participants stated that the transfer team should understand the transfer process, in its entirety and need to have appropriate skills and knowledge to effect the transfer of the neonate. More importantly they argued that it was the responsibility of the referring and receiving doctors to understand the pre-hospital environment and the processes involved in the transfer, and provide as much information as necessary about the history of the neonate and clinical support required during the transfer. Finally they said that preparation and stabilisation of the neonate was crucial before the transfer to reduce risks.

a. Sub-theme 1: Assessing the need to transfer unstable neonates

Some neonatologists pointed out that paramedics are at times intimidated by referring doctors to transfer unstable neonates, which results in their being handed over at the receiving doctor despite their poor clinical condition. They suggested that when this occurs paramedics who are being intimidated to transfer an unstable neonate, should have the opportunity to consult with the receiving doctor. In addition other relevant stakeholders involved in the transfer should be consulted before a final decision is made to effect transfer of an unstable neonate. This then should be incorporated into procedural guidelines for transfers within a newly developed programme.

“Do not transfer an unstable baby because you are just going to make a bad situation worse, I do understand that at times there is a degree of intimidation to transfer an unstable neonate, in that case the paramedic must phone the receiving doctor and or the consultant and discuss the matter, let them get involved in this decision”. [Neonatologist interview 3 Page 5]

“...we also need to keep in mind the context we are in, there is always resource issues, and if you leave the baby at a low level hospital the baby will die, for example is unstable and the referring hospital do not have a ventilator, you cannot leave the baby there, the baby will die, so in that case speak to the relevant people, the doctors involve and the transfer team and take an informed decision, but it must be clear that the baby is unstable, however there no choice but to do the transfer..”. [Neonatologist interview 6 Page 4]

b. Sub-theme 2: Regular audits and feedback

The need for regular audits and feedback to assess the transfer team and the referring and receiving facilities performance was also identified by neonatologists.

“There have to be a good system in place for regular audits and feedbacks. In my view this does not exist, only when there is a service complaint then we go and look for the problem. Neonatal transfers are teams work between the hospitals and ambulance service, therefore there need to be feedback, audits

to see what is going on, what should happen, why it's not happening. It's an improvement mechanism". [Neonatologist interview 3 Page 3]

"I definitely feel that there should be some clinical governance. We must professionally appraise our system by quality assuring it through audits, compare our system with others. There must always be room for improvement". [Neonatologist interview 3 Page 3]

6.4.1.3 Theme 3: Attributes for preparedness

The entire sample agreed with earlier samples views regarding paramedics clinical preparedness to effect transfers.

"For a paramedic to be prepared to manage an intensive care neonate they have to have the current and continuous correct education and training, with the right attitude". [Neonatologist interview 7 Page 6]

Participants also supported the need for ongoing education and training so that paramedics could keep abreast of contemporary transfer related skills. This is reflected as follows :

"Preparedness will have to be the correct education. Paramedics have education in critical care, they have a qualification but it needs to be continuously refreshed, they need to know what does the latest evidence say, keep their skills sharp, continuous practice, so it's not just about getting a qualification, it also about maintaining the knowledge and skills, that how they can be prepared". [Neonatologist interview 3 Page 7]

6.4.1.4 Theme 4: A more contextualised transfer system

Several participants mentioned the need for paramedics to learn more from other disciplines whilst at the same time for NICU staff to work in the ambulance environment to enhance their understanding of the paramedics role and understand the dynamics and challenges of the transfer process.

"...I think that cross training could be beneficial, paramedics will learn a lot from this process and if the NICU doctors spent time on the ambulances, it

would certainly give us insight into the challenges. So from that point of view I think it could be beneficial because NICU doctors will understand what a transfer is all about and what is going on, and then I definitely think that there's benefit in terms of the paramedic spending time in NICU because they will understand what's going on in the hospital". [Neonatologist interview 1 Page 7]

Participants also highlighted that there was variation in practice as follows :

"What's needed is a standardised transfer programme, because right now everyone is doing their own thing, there are different policies and procedures between provinces, even within provinces there is a lack of standardisation, there is also difference in policies and even lack thereof between hospitals and EMS. So there need to be standardised policies and procedure in place to have an effective programme". [Neonatologist Interview 5 Page 12]

6.4.1.5 Theme 5: A family centered approach

Neonatologists also asserted that transfer team members should be sensitive towards and support accompanying family members, a view reinforced by the other samples. They suggested that paramedics be trained as counsellors.

".....when it comes to neonatal transfer, most often you have an anxious mom or they might even be other family members that goes along with the baby, they are scared, their baby is critical, just understanding that and empathising with them, will help them deal with the traumatic situation.....so, it must be compulsory that the paramedic and the team goes for some form of training in terms of counselling". [Neonatologist Interview 1 Page 9]

Most neonatologists also said that accompanying family members needed information before and after the transfer and that there should be agreement between the referring doctor and paramedic on what to tell parents. Moreover reassuring the parents was seen as an important role that paramedics should play during the transfer. This reinforces earlier arguments for education to address this as

a separate component and that a newly developed programme give due consideration to this aspect of the transfer. Participants indicated the following which provides important guidelines to guide interaction with accompanying family members. They said as follows :

“...I don’t think the mother is prepared, that poor mother is actually clueless, even the family don’t know what is going on. So we definitely have a gap here. Psycho-social needs for the mother or whoever is going on the transfer must start from the hospital, especially the mother because she is all the time with her baby in the hospital. She needs to be well briefed before she leaves the hospital and when she arrives at the receiving hospital, psycho-social treatment must continue.....do not give false hope”.

[Neonatologist Interview 3 Page 9]

“.....the transfer team should constantly communicate with the escort, this will add to the mother or family members trust, they can gain confidence in the team this way because they won’t feel left out, they will feel as if they are part of the team. Besides it will keep their minds occupied instead of having sitting in the ambulance and having panic attacks. From the outset the paramedic must communicate with the escort, introduce himself or herself and the team. This way the mother will be reassured and will be comfortable with the team, instead of just jump in an ambulance with strangers, whose baby’s life in their hands...”.

[Neonatologist Interview 6 Page 6]

“It will also be good to have some sort of checklist for communication and counselling because you can get so caught up treating the critical baby that you forget about the mother and sometime social skills because it’s a stressful transfer”.

[Neonatologist Interview 4 Page 10]

6.4.2 Discussion of findings

6.4.2.1 Theme 1: Toward safer neonatal transfers

The need for an improved and safer transfer system resonated throughout all the samples in this study. Services for neonatal transfers in South Africa have evolved in a largely unplanned manner with little or no formal structure, resulting in variations of practice, depending on different geographical regions and the availability of resources. Whilst it is not possible to have unified guidelines that may always be applicable in every transfer, certain protocols should be in place regardless of the geographical context in South Africa. A definite organisational structure and a dedicated specialised team that manages and oversees the transfer should be the core of all prehospital contexts. The following sub-sections reflect some of the salient issues that need consideration to improve the transfer process and will be included within the newly developed programme.

a. Sub-theme 1: Lack of adequate communication and coordination

The lack of adequate communication and coordination between the referring facility, receiving facility, communication centre and transportation team appeared to create multiple issues to the detriment of the neonate during transfers. Other writers supported this notion saying that ineffective communication and co-ordination can increase morbidity and mortality of these neonates (Fenton and Leslie 2012; Ratnavel 2013). Horowitz and Rozenfeld (2007) expressed that at any time during a transfer, the transfer team should be able to communicate directly with the transfer coordinator, and the referring or receiving personnel for clinical advice or any matter relevant to the transfer process. An interactive emergency medical communications system is therefore a compulsory component of EMS. Neonatal transfers are specialised types of transfers which demand a transfer co-ordinator who can assist with clinical issues and provide support in relation to the actual transfer and with regards to any intervention required.

b. Sub-theme 2: Technical and logistical issues

Technical and logistical issues in particular equipment such as transport incubators, mechanical ventilation and syringe drivers and other lifesaving equipment were

identified by this sample as being crucial to ensuring the survival of the neonate. The lack of equipment, as voiced by other samples will undoubtedly escalate mortality rates. Whilst there are no figures available related to transfer related deaths greater prioritisation in terms of funding and policies are required to ensure that the neonatal transfer system gets the attention it deserves in terms of equipment.

c. Sub-theme 3: Prolonged delays in the transfer

The data reflected a somewhat chaotic transfer process. This seems to stem from the lack of a dedicated unit to prioritise transfers as they arise. Instead transfers appeared to be couched within other emergencies, which results in a transfer only being effected once an ALS paramedic and ambulance staff were available. This caused delays which may result in mortality. Gilpin and Hancock (2016) wrote that a longer duration of transfer was considered to be an independent risk factor associated with adverse events. It was Mori *et al.* (2007) who highlighted the plight of critically ill neonates in their study, by finding that those transported for more than 90 minutes were found to have a high risk of experiencing life threatening adverse events. Kumar *et al.* (2010) supported this and recommended that any transfer of more than 90 minutes must be undertaken by air ambulance. This calls for an earnest inquiry into the current transfer system in South Africa which seems to effect longer transfers due to the delays, as a result of a lack of staff and equipment. More importantly is the need for consideration at the government level to have air emergency services available particularly near rural hospitals who remain at a distance from more specialised neonatal hospital services.

6.4.2.2 Theme 2: Strategies for risk reduction

Given an already diminished transfer system characterised by the ready availability of paramedics and equipment it is crucial then that a co-ordinator be in place to manage the transfer in terms of communication from the referring to receiving hospital. Moreover it is crucial that the neonate be prepared and stabilised properly to tolerate what sometimes might be a hazardous journey, in order to improve survival. Much of the issues raised within the data collected from the neonatologists cohered with that from the other samples in the study and illuminate the aspects

warranting attention during the design and development of the programme. They will be discussed in further detail below :

a. Sub-theme 1: Assessing the need to transfer unstable neonates

A study by Miller *et al.* (2008) confirmed that the transfer of a critically ill neonate is associated with a high level of life threatening adverse events, requiring that they are adequately prepared and stabilized before a transfer, in order to improve their chances of survival. Part of this requires competence on the part of the referring neonatologist and ALS paramedic to assess the need to effect a transfer. Where it is not indicated, then the transfer should not occur. Given the lack of a proper system and guidelines for same it would appear then that assessments are not being undertaken prior to transfer.

More importantly is the need to carefully consider whether the transferring ambulance is free of stresses associated with excessive noise, vibration, poor lighting and limited space (Lorch *et al.* 2012). Stroud *et al.* (2013) asserted that these stresses can directly or indirectly influence the physiological condition of the neonate which can cascade into a life threatening situation, during the transfer journey. Adequate preparation and stabilization of the neonate is then crucial prior to the transfer journey.

More important is assessing the risks associated with the transfer which calls for sound clinical competence in making such decisions. An informed undertaken by the referring, transporting and receiving personnel is critical to ensuring that no one can be held accountable for any adverse events encountered during transportation (Kage and Akuma 2012). More importantly paramedics should not be intimidated by the real or perceived power of other healthcare providers, and should adhere to policies in the best interest of the neonate.

b. Sub-theme 2: Regular audits and feedback

The cornerstone of good clinical governance for neonatal transfers is regular audits and feedback to analyse the efficiency of the process, share and ensure best practice. Orr, Felmet and Han (2009) suggested that data be collected for the entire transfer process, from the time of the initial request for the transfer, until the transfer

team returns to their base, and should include technical, logistical, and clinical data. Given that transfers involve a multidisciplinary team it is crucial that feedback be obtained from stakeholders to ensure that their expertise and knowledge is harnessed in terms of the transfer process.

6.4.2.3 Theme 3: Attributes for preparedness

Paramedics undertaking neonatal transfers should receive the requisite educational knowledge and opportunities for clinical practice, related specifically to critically ill neonates before they are placed within the neonatal transfer process. This was transparent in the data from other samples and demands multifaceted knowledge, skills and ability to deal sensitively with the accompanying family members. It is dangerous to assume that once a paramedic qualifies, they are immediately empowered to effect a transfer. Specialised education and training is required prior to qualifying coupled with ongoing professional development that enhances the ability to use more sophisticated equipment and adapt to changing transfer systems.

6.4.2.4 Theme 4: A more contextualised transfer system

Forneris (2004: 5) defined context as ‘the nature of the world in a given moment, encompassing culture, values, facts, ideals and assumptions.’ Understanding the South African context is crucial to developing a neonatal transfer system that has relevance to the local situation. It is crucial that the South African landscape in conjunction with the health care system be interrogated, to deepen an understanding of how the neonatal system may be developed and optimised within the context of a limited budget and within the context of the diverse socio-economic profile of South Africa. Whilst this study highlights the broader issues that must underpin the newly developed programme, the government must give due consideration to how this must be realised.

Testa and Gang (2009) highlighted that standardised policies and procedures are translated through the decision-making processes of relevant role-players into their daily practices. This study however has shown significant variation in practice in the context of the neonatal transfer system. Standardised policies and procedures are beneficial for the growth and development of the health system, with a definite need for the activities within the transfer system to be co-ordinated and regulated. More

importantly however is the need for these policies and procedures to be continuously reviewed in terms of efficacy (Fortune *et al.* 2017)..

6.4.2.5 Theme 5: A family centered approach

The transfer of a neonate for specialised care often involves a family member, mainly the mother. Mosher (2013), described the transfer process as one of the most frightening, confusing and difficult experiences for an accompany family member, due to the nature of the intensive care and pre-hospital environment. Monbaliu *et al.* (2017) said that during the last thirty years, developed countries have evolved considerably using research evidence promoting a family centered service for a child who is being transferred. Tortora *et al.* (2017) also showed that attention given to the accompanying family member is crucial to improving satisfaction with the transfer services. However all the samples hihighlighted the lack of support being provided to accompanying family member.

In an effort to provide a family centered approach, to ease the trauma of the transfer process, the transfer team should provide psychological care as discussed. In addition a standardized communication tool in the form of a separate checklist for the accompany person during the transfer process may help facilitate communication regarding aspects of the transfer.

6.4.3 Section summary

The data derived from the neonatologists reinforced much of the other findings regarding what requires attention when developing the programme. This included implementing strategies for risk reduction, a more contextualised transfer service and a family centered approach.

6.5 Chapter summary

The quality, safety and efficiency of neonatal transfers are dependent on a team, who can intervene proactively within the context of different neonatal emergencies and complications. Moreover appropriate structures and processes to undertake this is reliant on a properly functioning transfer vehicle that mirrors a NICU. The huge deficits in educational preparedness coupled with a diminished infrastructure reflects

a transfer system that places the neonate at huge risk. Within the context of strengthening South Africa's ability to achieve its SDG's both government and higher education institutions and colleges will need to remap the transfer system. The newly developed programme emanating from this study will highlight the critical issues that will require immediate attention.

The following chapter reflects predetermined set of operational steps, with data being harnessed to develop the new innovation within this study.

CHAPTER 7

DEVELOPING THE PROGRAMME

7.1 Introduction

This chapter presents the programme that was developed for this study, and its various components. It was developed through from a series of operational steps, with data being used to guide this process (Thomas, 1981). This chapter discusses the process undertaken in developing the programme and reflects its various components.

7.2 The processes of assembling the design components

A draft programme to guide neonatal transfers was designed through the form of a series of operational steps. The main source of data for the programme was from the interviews and focus group discussions, with those most involved in the transfer process viz. ALS paramedics, EMC lecturers and neonatologists and the accompanying mothers. The design and content of the programme was also shaped by the state-of-the-art reviews. Holistically this was triangulated to design the programme.

The process undertaken to assemble the design components included identifying the core aspects for the programme and then building relevant material into each component. The programme was divided into four sections and reflects the following : an introduction to neonatal transfer, organisational structures, transfer processes, and accompanying family member support. Each of these provides guidance on specific components of the five transfer phases: activation, preparation, retrieval, transportation and reception. It also deals with the needs of the family member who accompanies the neonate during the transfer (Annexure 27). Accordingly, each section includes algorithms, clinical care pathways with a brief list of references, and appendices (checklists, report forms and a consent form). The development of the programme is reflected in Figure 7.1 and the framework of the programme is reflected in Table 7.1.

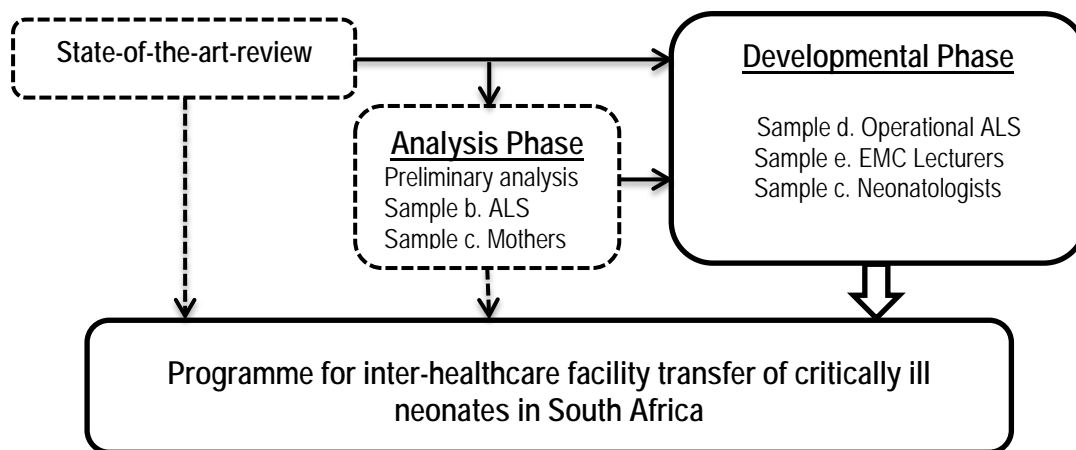


Figure 7.1: Developing the programme

7.2.1 Algorithms, clinical care pathways

The use of algorithms and clinical care pathways in the programme rendered it user friendly and acceptable to the educators, the ALS paramedics and the transfer team. It is also a familiar part of clinical practice in EMC, will assist in the visualisation of the structures and processes, and may be used as a quick reference guide by lecturers and transfer team members.

7.2.2 Appendices

Seven appendices are attached to the programme (Annexure 27). These provide the tools required for operational use throughout the entire transfer process. These tools were designed and developed based mainly on the study data and the state-of-the-art reviews, with the intention of providing best practice that is suitable for local conditions. The appendices are listed below:

- *Appendix 1:* Neonatal transfer request form
- *Appendix 2:* Consent form
- *Appendix 3:* Equipment checklists
- *Appendix 4:* Neonatal report form
- *Appendix 5:* Pre-departure assessment checklists
- *Appendix 6:* Accompanying family member checklist
- *Appendix 7:* Satisfaction or complaint form

7.2.2.1 Checklists

Three checklists are attached to the programme (Annexure 27); these include checklists for equipment (Appendix 3), pre-departure assessment (Appendix 5) and the accompanying family member (Appendix 6). All checklists are designed in a stepwise fashion with a simplified tick-box layout to save time.

- The **equipment checklist** (Appendix 3) is completed during the preparation phase to ensure that all equipment is in good working order and nothing is left behind before proceeding to the referring hospital.
- The **pre-departure assessment checklist** (Appendix 5) is completed to guide the transfer team to ensure that specific activities are undertaken before the neonate leaves the referring facility.
- The **accompanying family member checklist** (Appendix 6) is intended to ensure that communication with the accompanying family member is provided and facilitated throughout the transfer process.

7.2.2.2 Neonatal forms

Two neonatal report forms are attached to the programme, the neonatal transfer request form (Appendix 1) and neonatal report form (Appendix 4). These forms have been specifically designed based on the data and state-of-the-art reviews for neonatal transfers, to ensure that all essential information is included. They follow a sequential, easy-to-read, tick-box design to save time and decrease errors.

- The **neonatal transfer request form** (Appendix 1) is completed by the EMCC staff when the transfer is initially requested by the referring personnel. This form includes detailed information relevant to the transfer.
- The **neonatal report form** (Appendix 4) is completed by the transfer team leader, and includes information on the entire transfer process.

7.2.2.3 Consent and satisfaction/complaints form

The final two forms that have to be completed before the transfer are the consent form (Appendix 2) and a feedback form (indicating satisfaction and/or complaints)

(Appendix 7). These forms were developed from the data, local practice and sections of the state-of-the-art-reviews.

- The **consent form** (Appendix 2) is to be completed and signed by the accompanying family member before the transfer is undertaken in line with legal requirements.
- The feedback form (Appendix 7) is completed by the receiving personnel as a form of quality assurance and for the purposes of ongoing improvement.

7.3 Conclusion

The draft programme (innovation) presented in this study was developed for application in the South African context and other similar settings. It sets out the operational tools required for the transfer of a critically ill neonate. Included in this programme are the knowledge and skills required by ALS paramedics, as well as the appropriate structures and processes for the transfer of a critically ill neonate.

PHASES	ORGANISATIONAL STRUCTURE	TRANSFER PROCESS	ACCOMPANYING FAMILY MEMBER
1. ACTIVATION	<ul style="list-style-type: none"> Fully operational Emergency Management Communication Centre Trained & experienced communication staff Transfer coordinator Neonatal transfer request form (Appendix 1) Ground & air ambulances 	<ul style="list-style-type: none"> Request for transfer from the referring doctor/nurse Obtain appropriate & correct transfer details Screen & verify the transfer Select the appropriate mode of transfer Ensure good communication & coordination Dispatch the transfer details to team leader 	<i>Referring facility</i> <ul style="list-style-type: none"> Psycho-social screening & support family member Family member informed of the need to transfer
2. PREPARATION	<ul style="list-style-type: none"> Dedicated transfer ambulance & teams Adequate & reliable neonatal equipment Pre-departure checklist (Appendix 1) Consent form (Appendix 2) 	<ul style="list-style-type: none"> Dispatch details must be clear & complete Transfer pre-brief by team leader Review team tasks, roles & responsibilities Team leader pre-departure equipment test Provide referring facility with estimated time of arrival 	<i>Referring facility</i> <ul style="list-style-type: none"> Family member prepared for the transfer & signs consent form Mothers must be clinically stable for transfer
3. RETRIEVAL	<ul style="list-style-type: none"> Neonatal report form (Appendix 4) Pre-departure assessment checklists (Appendix 5) 	<ul style="list-style-type: none"> Team leader introduces him/herself & the team Take a clinical history Collect all documents & specimens Clinical assessment, interventions & preparation of the neonate (adapt an ABCDE approach) Aeromedical considerations for air transfers Provide receiving facility with estimated time of arrival 	<i>Transfer team</i> <ul style="list-style-type: none"> Introduction by team leader Interact with & support family members Provide adequate & accurate information Transfer the mother in a wheelchair Prophylactic treatment for air transfers if necessary
4. TRANSPORTATION	<ul style="list-style-type: none"> Neonatal report form (Appendix 4) Accompanying family member checklist (Appendix 6) Communication infrastructure 	<ul style="list-style-type: none"> Continuous monitoring & evaluation Preserve/charge batteries Maintain thermally neutral environment Ensure safety & secure equipment 	<i>Transfer team</i> <ul style="list-style-type: none"> Safety debrief & compliance Ensure continuous communication Attend to mother's basic clinical needs
5. RECEPTION	<ul style="list-style-type: none"> Satisfaction/complaints form (Appendix 7) 	<ul style="list-style-type: none"> Formal clinical & documentation handover Conduct a physical examination of the neonate Debrief team Clean & sterilise equipment 	<i>Receiving facility</i> <ul style="list-style-type: none"> Introduction by receiving personal Orientated to ward, procedures & processes Psycho-social support by receiving facility

PRE- AND POST-TRANSFER		
Management structures <ul style="list-style-type: none"> Medical officer Transfer managers 	Planning and Implementation <ul style="list-style-type: none"> Quality assurance and improvement Policies, procedures and guidelines 	Joint responsibility <ul style="list-style-type: none"> Research programmes Education and training Comply with the legislative prescripts Consultation and integrated approach

Table 7.2: Programme framework

CHAPTER 8

FINDINGS AND DISCUSSIONS OF EVALUATION PHASE

8.1 Introduction

Phase 3 of this study addressed the fifth objective, which was to evaluate the newly developed programme for the inter-healthcare facility transfer of critically ill neonates. According to the Development Research and Utilisation model, the purpose of this phase is to appraise the programme (Thomas 1981); that is, to evaluate the innovation (programme) for its relevance, strengths and weaknesses pertaining to the material contained in the programme itself. A group of experts were identified for this purpose. Consequently, relevant professionals directly involved and experienced in the transfer of critically ill neonates were identified for participation, including public and private ambulance paramedics, as well as a lecturer and neonatologist (Table 8.1).

Table 8.1: Samples used for the group of experts

Samples Used	No. of Participants	Participant's Sector	Participants' Qualification
Sample g: Group of experts 1 Focus group discussion	5	1 x Public ground ambulance 1 x Public air ambulance 1 x Private ground ambulance 1 x College of Emergency Care lecturer 1 x Neonatologist	1 x CCA 3 x ECP: EMC 1 x FC Paed / Cert Neonatology

8.2 Evaluation of the programme

The experts were presented with a hard copy of the draft programme for evaluation two weeks prior to the evaluation focus group meeting. At this meeting, a programme evaluation focus group schedule was used to guide the discussion on the effectiveness and relevance of the programme (Annexure 28), and whether it was suitable for distribution. The focus group schedule comprised of questions evaluate the programme and explore any further items for inclusion and exclusion, layout changes, and, finally, whether the programme could be accepted.

8.2.1 Overall evaluation

Issues pertaining to the evaluation of the programme is presented in the following sub-sections :

8.2.1.1 Programme strengths

Participants expressed that content was clear, concise and comprehensive, and contained excellent principles to guide neonatal transfers. They were happy regarding its development and referred to it as a much-needed quality programme to improve service delivery. They were generally impressed with the holistic, multidisciplinary, integrated approach it embraces, from the beginning to the end of the transfer, and pre- and post-transfer considerations. The inclusion of aspects related to support for the accompanying family member was considered essential and its inclusion in this programme was described as very commendable. They also mentioned that the programme reflected the importance of multidisciplinary teamwork required during transfers and brought together the various disciplinary and other relevant stakeholders, and illustrated in detail their respective roles and responsibilities in a synergistic manner. They affirmed the inclusion of educational, operational and structural aspects for the transfer programme, saying it can be used as an instruction manual for as an implementation guideline. The experts concluded that the programme was “practical and absolutely necessary” and “long overdue”.

“It was a pleasure to read, a well-designed document, and I am excited with what it offers. This is a huge step in the right direction in intensive care neonatal transfers.” [Expert 4]

“This is a realistic one-size-fits-all programme that clearly stipulates, from the beginning to the end, what needs to be done, who does it, when it must be done and how it must be done.” [Expert 1]

8.2.1.2 Programme weaknesses

A few weaknesses regarding the programme were pointed out. One expert mentioned that due to its comprehensiveness, educators and transfer team members may become accustomed to the programme and rely heavily on it without

doing additional educational work or staying abreast of evidence-based practice. Other experts mentioned that, to address this additional learning material, such as tutorials and case studies of latest evidence, could be added to the programme on an ongoing basis to ensure that it remains current and relevant.

The second weakness highlighted by two of the experts was the failure to indicate a duration for the programme. Other participants noted that that this could only be finalised once the programme was piloted. One participant also mentioned that the programme excluded doctors and intensive care nurses as part of the transfer team. Others disagreed on this point, however indicating that the availability of doctors and intensive care nurses was limited, and they were needed by their hospitals. Moreover this programme was developed to guide EMC. All the experts eventually agreed that the transfer team should remain unchanged, but that there was no reason why other professionals could not be included should the need arise.

8.2.1.3 Programme implementation challenges

Participants expressed that adoption of the programme by EMS senior managers at various provincial health sectors, both public and private, may arise as a result of possible resistance to change and scepticism. Another challenge was that due to the high daily workloads of EMS, there was a potential for the dedicated neonatal unit to be abused as it might be used instead for other cases. Another expert indicated that the intensive care transfers of neonates should be the only cases relegated to this specialised unit. They added that policies and procedures should in place to avoid unwarranted use and authorisation for same be managed by the overall manager of the unit.

“... in light of our challenges and territorial issues within our context, my concern is, will this programme be supported by everyone and will it be used appropriately?” [Expert 2]

“Although this is evidence based, it will take convincing at higher levels to ensure that this programme is a national imperative.” [Expert 3]

8.2.2 Inclusion and exclusion

There were no suggestions to exclude anything from the newly developed programme. Minor amendments suggested included contextual terminology and the reorganising of sections. The amended terminology related to changing “medical officer” to “doctor”, “control room” to “emergency management communication centre”, “cross discipline” to “multidiscipline”, “sisters” to “nurses”, “packaging” to “preparation” and “drugs” to “medication”. A few sentences were moved between sections to improve understanding of the programme and to ensure that it could be used for teaching purposes.

8.2.3 Layout of the programme

The experts mentioned that the programme was well organised and followed a logical sequence, making the content easy to find. They added that the use of algorithms and/or clinical care pathways for each section made the programme user friendly. The experts were very satisfied with all the programme attachments (Appendices 1-7), and stated that it could be operationalised and used for clinical teaching. They indicated that the checklists followed a logical well-ordered sequence, contained relevant information and addressed the required actions and “to-do” steps. The neonatal report and transfer request forms were similarly appraised and were found to be simple and understandable.

“I liked the use of bullets in the document, as it makes it easy to read. Each section is simplified by a flow diagram; its user friendly yet detailed and has the necessary tools attached to support the transfers.” [Expert 2]

“The layout and the content of this programme are so simplified that anyone can use it. There is no medical jargon, the sentences are short and simple and it’s not ambiguous. Most importantly, it identifies its audience.” [Expert 1]

8.2.4 Recommendation

The sample unanimously agreed that the programme was acceptable and applicable because it took into consideration the current organisational structures and the cultural EMC context. They agreed that it was applicable to other similar settings and

with minor adjustments, could guide transfers for other critically ill patients. The following excerpts reflects their views

“It is already known that communication failure and human errors are common stumbling blocks in the system. This programme has the potential of mitigating these stumbling blocks and can be standard practice.” [Expert 5]

The programme was “recommended” for dissemination in South Africa. .”

8.3 Chapter summary

The evaluation process discussed in this chapter was the last operational step in the Developmental Research Model, which concluded the developmental effort of the study. This programme was seen to be satisfactory by relevant experts, and the innovation found to be worthy of dissemination and use. The evaluative data highlighted a few amendments, which were corrected accordingly This final step in the Developmental Research Model brought the research process to its conclusion.

The following chapter discusses the final conclusions of the study and makes a number of recommendations.

CONCLUSION AND RECOMMENDATIONS

9.1 Introduction

Inter-facility transfer of critically ill neonates continues to expand and in most developed countries has evolved, with mobile intensive care units capable of delivering state-of-the-art critical care during the transfer. However the situation in developed countries, may not necessarily be appropriate for South Africa and cannot be unilaterally transferred without careful consideration of differences.. The study found that ALS paramedics were inadequately prepared to deal with transfers of neonates and the accompanying family members. Organisational structures and the transfer processes were found to be inadequate, Moreover there appeared to be a void in EMC education with regards to neonatal clinical emergencies and transfers.

For healthcare service delivery activities to be relevant, they should be linked to the needs of the context, practice and morbidities and mortalities that most often occur. Therefore, a well-developed programme with contextual relevance will benefit neonatal survival and address the challenges related to a safe transfer. This newly programme is relevant to the South African context and is essential to achieving effective and efficient quality healthcare, reducing adverse events during the transfer, responding proactively to potential challenges that may arise and in turn achieving the relevant SDGs.

The development of such a programme was important as it has the potential to enhance the EMC profession and enabling appropriate emergency medical care to neonates More importantly, it will potentially enable the survival of the already fragile neonate and potentially reduce the stress for accompanying family members by giving them due support during the transfer process. This study was timely and addresses a huge gap in terms of an integrated multidimensional approach to neonatal transfers.

9.2 Significance of the study

The study has significance for a number of areas relevant to critically ill neonate transfers both in South Africa and in other resource-limited countries:

- **Policy development.** The programme could be used as a starting point to inform an EMC policy, for South Africa and similar resource poor settings that makes provision for intensive care of critically ill neonates during transfers.
- **System improvements.** The study provides valuable evidence to create the systems that need to be in place for safe and effective transfers to occur. It may also be applicable to other transfer programmes in developing countries.
- **Planning and implementation.** The results may be used to guide the planning and implementing of organisational systems and transfer processes necessary for critically ill neonates. Sound planning is the key to ensuring that the resources, structures and processes are in place .
- **Management issues.** The programme highlights the importance of having appropriate managers and management systems in place for transfers in a resource limited setting.
- **Clinical management.** Critically ill neonates are transferred when their lives are at risk, at which time they need intensive care to ensure their survival. The programme reflects those aspects which affect proper clinical management during transfers.
- **Curriculum development.** The various issues within the programme can serve as a resource for curriculum development in EMC education in South Africa. It also has the potential to be applied to training in other countries.
- **Monitoring, evaluation and research.** The results indicate the need for ongoing monitoring and evaluation to be conducted, and the data that results from such endeavours could be used to make an important contribution to improving EMS services in the country. The data may also be used to catalyse various research studies in an under-researched field, which would not only benefit local services but also those in other under-resourced settings. Standardised monitoring and evaluation tools would enable a comparison of services across the country, and would set the benchmark for

minimum required standards. The programme itself could possibly contribute to ongoing monitoring, evaluation and research.

- **Service delivery improvement.** Collectively, all the above components are required to ensure that patients are provided with optimal services, that all staff are competent to undertake transfers and the required infrastructure in place for same.

9.3 Recommendations

The following recommendations should be considered for future research..

9.3.1 Recommendations for future research in EMS

In South Africa, future research in neonatal transfers is particularly important to contextualise healthcare needs in terms of what works from evidence-based practice, and is essential in terms of providing literature on a limited body of knowledge.

- Developmental research methodology should be applied in designing and developing innovative EMS interventions that are relevant for solving problems within their context instead of the traditional research approach of investigations.
- National and international studies, especially in resource-limited settings, should be conducted to enable healthcare services policy makers to decide on the measures to be taken to modernise EMS systems and stay abreast of state-of-the-art-practice on neonatal transfers.
- More family-centred research should be conducted to ensure that appropriate pre-hospital care is provided to families.

9.3.2 Recommendations for educational programmes

The following recommendations are made for educational programmes:

- Educational programmes should be piloted by EMS nationally and in developing countries for possible future use and standardisation, and should guide the transfer process of critically ill neonates.

- Curriculum development within the EMS must focus on better empowering ALS paramedics to deal with neonatal clinical emergencies, transfer issues and multi disciplinary teamwork. .
- Programmes could act as a possible guide or starting point for specialised critically ill neonatal transfer training, including sub-specialisation and/or internship programmes.
- Papers should be presented at local and international EMC and paediatric conferences, workshops and seminars to raise awareness improve quality. .

9.3.3 Recommendations for the clinical practice in EMC

The following recommendations are made for clinical practice in EMC:

- The operational tools provided in the programme should be piloted by EMS nationally and in developing countries for possible future use and standardisation, and to guide the transfer process of critically ill neonates.
- There should be engagement with EMS providers and the relevant stakeholders on a regular basis to ensure that the programme is continuously improved within the South African context as well as in similar settings.
- The programme could possibly be used as an internship or apprenticeship for ALS paramedics before being certified for independent practice in neonatal transfers.
- Infection prevention and control policies should be strictly adhered to.

9.4 The uniqueness of this study

As there was no holistic multi-dimensional programme designed for inter-healthcare facility transfers of critically ill neonates in South Africa and other similar settings globally, this study was unique in the following ways.

9.4.1 Transfers versus retrievals

In South Africa, Africa and similar settings globally, critically ill neonates are transferred from one facility, to a specialised intensive care unit by ad hoc teams of ALS paramedics within a context characterised by a lack of structures, processes and preparedness. This system takes the neonate from the bedside of a referring

facility to the intensive care environment of the receiving facility. This differs from the retrieval system that is used in most developed countries, where specialised dedicated teams (physicians, anaesthetists, respiratory therapists, paramedics, neonatal intensive care nurses) or a combination of experts, take the resources of the intensive care environment from the receiving facility to the bedside of the referral facility to retrieve the neonate. The retrieval system is facilitated by a number of factors – the geography of developed countries, with relatively short distances between hospitals, and the availability of adequate resources that makes retrievals feasible. The specialist, who will care for the neonate at the receiving facility, is likely to be involved in the transfer, thereby improving patient care during the transfer. This also occurs without too much disruption to the daily work of the specialist.

However, in resource-limited settings, practitioners need to do things differently from developed countries owing to constraints related to the availability of resources, including human resources. The two transfer systems are very different, and require differing structures and processes to ensure that an optimal service is provided. The uniqueness of this study is that a holistic programme was developed, taking into consideration the organisational structures and transfer processes that are practical and feasible in a developing or resource-limited environment. It was developed to assist with EMC education as well as enhancing the execution of such transfers by providing the transfer teams with operational tools.

9.4.2 Holistic multidisciplinary approach

While critically ill neonatal transfer programmes are available in developed countries, they are not available in most developing countries, especially programmes that follow a holistic multidisciplinary approach. This study included the perspectives of ALS paramedics, EMC lecturers and neonatologists to understand the issues surrounding neonatal transfers, and identified solutions that do not depend on isolated variables. In addition, the programme included the voices of the mothers who accompanied their babies during the transfer, which are under-represented and often overlooked in EMS in South Africa, Africa, and many other developing countries. The combined opinions of all illuminated the multiple challenges within the transfer process and assisted in developing the programme. No prior study has

been done in South Africa or other similar settings that provides a holistic multidisciplinary perspective related to neonatal transfers in an EMC context.

This programme therefore provides a comprehensive overview of what needs to be considered in EMC education and what is essential for safe neonatal transfers.

9.5 Study limitations

This study had the following limitations:

- Data for the accompanying family members was only obtained from mothers who accompanied their babies during the transfer. Cases where the neonate is accompanied by a father or other relative although rare, required attention as well.
- For the final evaluation phase, the group of experts was selected only from KwaZulu-Natal province. Although this was used due to logistical and financial challenges the voices of others nationally could have shed light on other shortcomings of the programme.
- Senior EMS managers were not included in the study as this was intended to be an operational programme. However, it will be presented to senior levels of healthcare professionals with the intention that it be adopted for practice.

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11 ANNEXURES

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