

**Preparedness of Western Cape ALS providers to provide clinical
stabilisation and intensive care for neonates during the patient journey**

By

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A dissertation submitted in fulfilment of the requirements for the degree of Master of Health
Sciences: Emergency Medical Care in the Faculty of Health Sciences

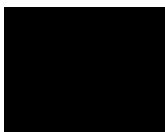
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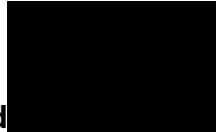
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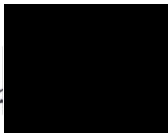
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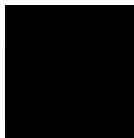


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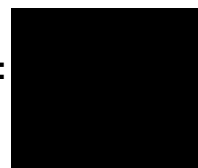
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Ethical Clearance Certification

Ethical clearance for this dissertation was obtained from the Institutional Research Ethics Committee (IREC) of the Durban University of Technology.

Allocated Ethic's Clearance number is: **REC 69/15**

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Abstract

The management and intensive care of neonates is inherently prone to adverse events, particularly as such management often involves pre-term neonates in distress – this means they have been born too early and their frail bodies require external support in order to survive. In the Western Cape high-risk neonates who are being referred from one neonatal intensive care unit (NICU) to another such unit or from primary and secondary hospitals to NICU are transported by ALS providers. However, there is a paucity of evidence relating to the preparedness of these ALS providers for the management and continuum care of these critically ill neonates.

This study showed the general lack of neonatal exposure as the clinical management of critically ill neonates ranged from once in six months ($n = 17$, 11.7%) to a group of 6.9% ($n = 6$) who indicated that they had never managed critically ill neonates. The lack of frequency of employing the critical ALS skills of neonatal intubation ($n = 62$, 42.8%) and neonatal CPR ($n = 49$, 33.8%) cited, reflected the lack of opportunity to use such skills frequently in the pre-hospital environment. Only 9.7% ($n = 14$) of the respondents indicated they had the necessary specialised monitoring equipment to safely transfer neonates and only 14.5% ($n = 21$) of the respondents felt “well-prepared” to manage critically ill neonates.

There is an urgent need to standardise both the theory and the practicum components for all ALS provider neonatal training programmes. The ideal would be the establishment of a mentorship programme, supervised by neonatologists. Additional neonatal short course/refresher training is also needed which includes the design of Continued Professional Development (CPD) accredited activities. In order to improve patient safety, the procurement of sufficient specialised neonatal intensive care equipment and disposables, especially for the rural ALS providers, should be prioritised.

Elements before, during and after the inter-facility transfer of a critically ill neonate by ALS providers were explored. This study suggests that these factors may impact on the emotional and mental preparedness of the ALS providers, possibly hampering their ability to provide optimum care.

Dedication

This dissertation is dedicated to:

My wife, Fatima, who supported me with positive encouragement, as well as to my parents who are pillars of strength upon whom I could always call when work, study and family responsibilities became too much. I will forever be thankful for all your love and support.

Shukran (Thank you)

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Glossary of terms: Operational definitions and abbreviations

- **Advanced Life Support (ALS) provider:** Refers to a level of care provided within the paramedic, emergency care technician or emergency care practitioner scope of practice as determined by the Health Professions Council of South Africa in terms of the Health Professions Act.
- **Adverse patient incident:** Refers to an event or circumstance that leads to unintended harm or injury to, suffering or illness of, a patient.
- **Basic Life Support (BLS):** Refers to a level of emergency care provided primarily by emergency care providers that practise within the Basic Ambulance Assistant scope of practice as determined by the Health Professions Council of South Africa in terms of the Health Professions Act.
- **Clinical experience:** Refers to the actual observation and treatment of patients as opposed to theoretical or basic sciences.
- **Clinical practical phase:** This is a compulsory prescribed period of work that provides the student with the opportunity for clinical experience as opposed to the simulated class environment.
- **Critical adverse event:** Refers to any unintended event that occurs when a patient receives treatment or medication which result in death, serious disability, injury or harm to the patient.
- **Critically ill neonate:** This refers to a feeble neonate who is either born prematurely (under-developed), born with life-threatening defects or afflicted with an infection/disease.
- **Dispatch centre:** Centralised control room to receive and dispatch emergency calls, including inter-hospital transfers.
- **Emergency care:** Refers to the evaluation, treatment and care of an ill or injured person in a situation in which such emergency evaluation, treatment and care are required and the continuation of treatment and care during the transportation of such person to or between health establishments.
- **Emergency Medical Service or EMS:** Refers to an organisation or body that is dedicated, staffed and equipped to operate an ambulance, medical rescue vehicle or medical response vehicle in order to offer emergency care.
- **Emergency rescue technician:** EMS personnel specialise in rescue, for example using, the “jaws of life”.
- **HPCSA:** The Health Professions Council of South Africa (HPCSA) is the regulatory body governing all prehospital care and intensive care in South Africa.
- **Intensive care:** This refers to the instituting of Advanced Life Support skills/procedures, either by ALS providers in the prehospital environment or in ICU/resuscitation rooms to maintain the ventilatory/haemo-dynamic status of a patient and the continuation of this care.
- **Inter-facility (hospital) transfer:** Refers to the patient journey from one medical facility to another medical facility.

- **Intermediate Life Support (ILS):** Refers to a level of emergency care provided within the Ambulance Emergency Assistant scope of practice as determined by the Health Professions Council of South Africa in terms of the Health Professions Act.
- **Knowledge:** Refers to familiarity, awareness or understanding gained through experience or study.
- **Maternity out-patient units (MOU):** The primary health care centres in communities which provide maternity services and make provision for the delivery of neonates.
- **Neonate** refers to a new-born baby, less than 28 days old.
- **Neonatal intensive care unit (NICU):** Either a mobile (ambulance), aero-medical aircraft (rotor or fixed wing) or an in-hospital unit dedicated to the specialist critical care of neonates.
- **Neonatal inter-facility transfer:** The transfer of a neonate from one NICU to another NICU, either by road (ambulance) or by air (rotor wing or fixed wing).
- **Operational experience:** Refers to hands-on training acquired after becoming qualified.
- **Operational preparedness:** The state of being able to deal with the challenges of the work environment. These challenges may be different to those encountered during the academic and clinical cases experienced during training.
- **Operational readiness:** The in-service training provided by the employer to prepare newly qualified paramedics for neonatal ICU care.
- **Paramedic:** A person registered as such with the Health Professions Council of South Africa in terms of the Health Professions Act.
- **Paediatrics** refers to the branch of medicine concerned with treatment from birth to adolescence.
- **Emergency care personnel:** Providers of prehospital emergency patient care.
- **Patient safety** refers to reducing the risk of unnecessary harm associated with healthcare to an acceptable minimum.
- **Pre-term neonates** are neonates born at less than 37 weeks' gestation. Premature neonates (newborns) may have to face many physiological challenges when adapting to the extra-uterine environment as their tiny bodies may not be fully developed.
- **Response time:** The time measured from when an Emergency Medical Service receives an emergency call to the time the first medical responder arrives at the scene
- **Technical adverse events:** Refers to harm resulting to a patient either from a medical intervention from or incorrect use of medical equipment

Chapter 1 – Overview of the Study

1.1. Introduction

The clinical management and transportation of high-risk, critically ill neonates requires emergency care providers who are competently skilled to perform clinical interventions safely, as well as their having specialised biomedical instrumentation for continuous monitoring at their disposal. In the Western Cape, the intensive care and management of neonates are provided by a two-person team, comprising an ALS provider and an ambulance emergency assistant or basic ambulance assistant. Their role is to provide an extensive spectrum of care to all patients of all ages. These teams possess specialised skills in narrow areas of treatment and care, such as neonatology, although they may be called upon to manage neonates on an infrequent basis only (Siren Newsletter, 2012).

ALS providers responding to callouts involving the intensive care of neonates are recruited from normal operational duties and may not have undergone additional certified neonatal training. The implications of this practice have not yet been documented although the limited data available indicates a high number of technical, clinical and critical adverse events associated with the managing and caring of neonates (Hatherill, Waggie, Reynolds & Argent, 2003; Lloyd & De Witt, 2013). In view of the limited available research in the South African context, Ashokcoomar (2012) suggests that this may be one of the factors contributing to the increasing neonatal mortality. In addition, the influence of the preparedness of ALS providers to provide intensive care for neonates, which is a major determinant of prognosis, has not yet been determined.

1.2. Background of the study

The Millennium Development Goals, adopted by the United Nations in 2000, aimed to decrease child deaths worldwide by 2015. Globally, 8.8 million children a year die before reaching their fifth birthday (Figure 1.1). It is clear that the first four weeks of life are the most challenging, as nearly 40% of deaths occur during this period.

The under-five mortality rate is generally used as a measurement tool with which to gauge the health of a nation. The main causes of these deaths recorded and indicated below were preventable. Although there has been much progress made in reducing child mortality, reducing neonatal deaths (deaths during the first 28 days of life), remains a challenge and accounts for almost 41% (about 3.3 million) of the total deaths (Oestergaard et al., 2011).

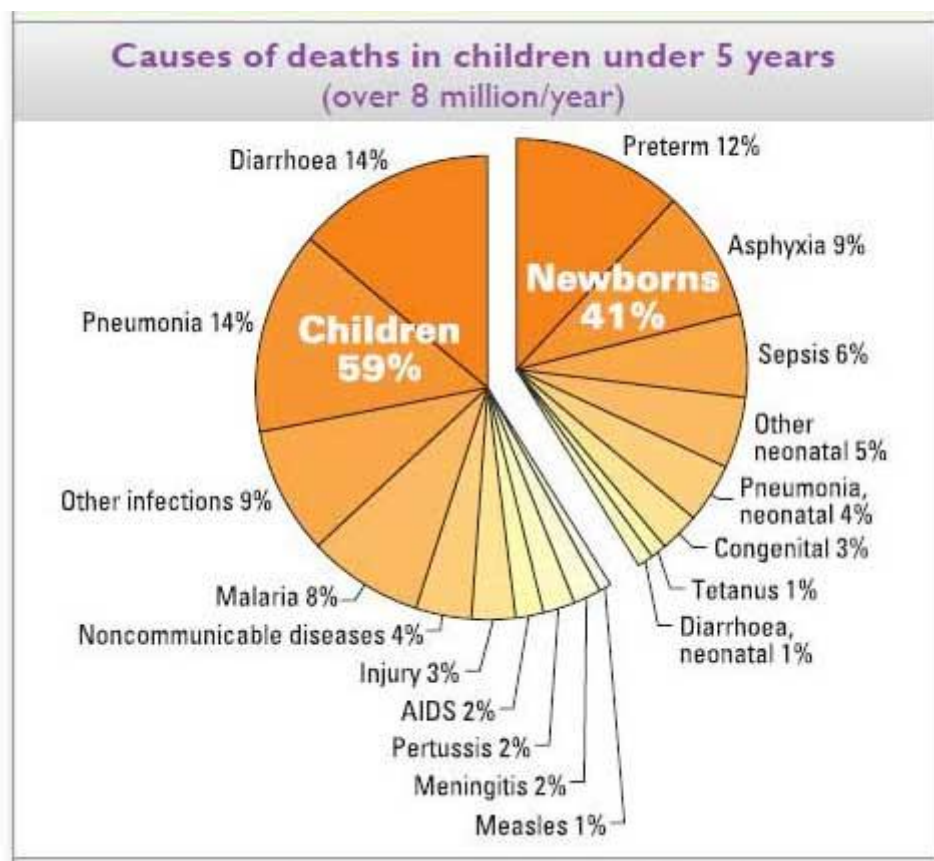


Figure1.1: WHO countdown to 2015 decade report (2010)

According to Swingler et al. (2012), South African child health statistics have worsened, as the under-five mortality has risen from 56 per 1000 live births in 1990 to 67 in 2008 (Figure 1.2). On the other hand, other middle-income countries, such as Brazil and Mexico, managed to decrease their under-five mortality rate by more than 60% for the same period.

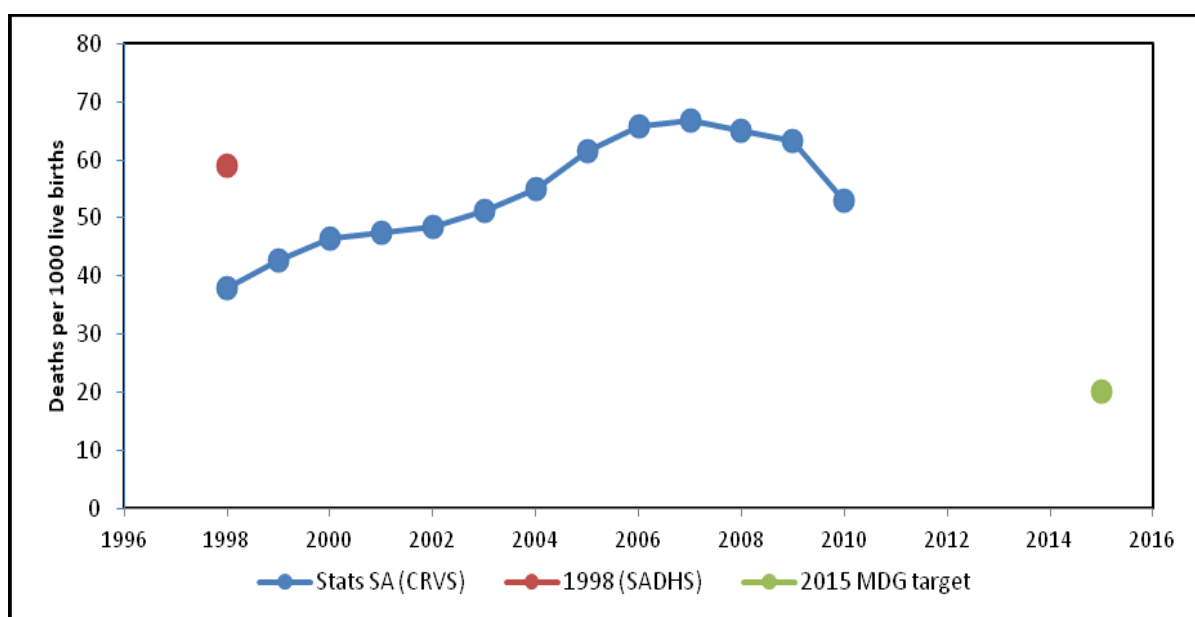


Figure 1.2: Trends in under-five mortality rates in South Africa since 1998 and the 2015 MDG (4) target decline in the infant mortality rate (IMR) in South Africa after 2010

Source: Statistics South Africa (2013b)

However, recent data does indicate a decline in the mortality rate (Figure 1.2) and in fact it would appear that South Africa is likely to achieve the target set of 20 under-five child deaths per 1000 live births.

South Africa was one of the countries that participated in the Fourth Session of the African Union (AU) Conference of Ministers of Health held in Addis Ababa, Ethiopia in 2009. Here a new strategy to combat child mortality was adopted, namely, the Campaign on Accelerated Reduction of Maternal and Child Mortality in Africa (CARMMA). A survey conducted in South Africa on the disease burden for under-five children revealed the following as the most common causes of deaths during the neonatal period (18%):

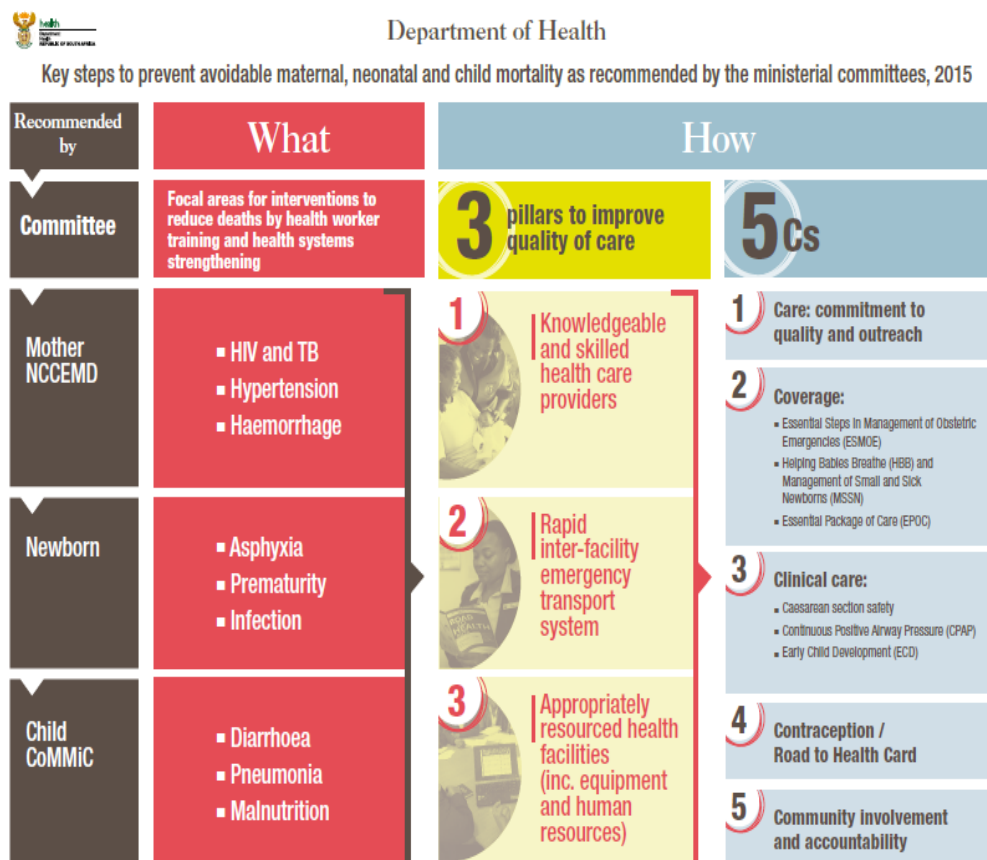
- Low birth weight (12%)
- Infections (3%)
- Birth asphyxia (3%)

The CARMMA strategy has been incorporated into the Strategic Plan for Maternal, Neonatal, Child and Women's Health (MNCWH) and Nutrition in South Africa, 2012–2016. This strategy

has been designed to respond to the major causes of morbidity and mortality as they relate to mothers, neonates and children under five (South African Government, 2012: 8).

Subsequently, the *Integrated Plan for reducing mortality in mothers, newborns and under-fives in South Africa* (Department of Health, 2016) was developed. The plan aims to decrease the number of deaths in South African hospitals by focusing on maternal, neonatal and child health. It also calls for action to address “adverse events, near misses and associated morbidity” (Department of Health, 2016: 4) by concentrating on the diseases/factors which contribute to high mortality in institutions (Figure 1.3). Ultimately, the goal is to ensure the country meets the United Nation’s (UN) Sustainable Development Goals (SDGs) 2030. As indicated in Figure 1.3, the focal areas for intervention affecting neonates include asphyxia, prematurity and infection. The “pillars”, which are highlighted as the interventions “How”, and which need to be addressed, include knowledgeable/skilled and well-equipped EMS personnel to provide a “rapid, inter-facility, emergency transport system” (Department of Health, 2016:7).

Figure 1.3: Integrated plan for reducing mortality in mothers, newborns and under-fives in South Africa (2016:7)



In the Western Cape, the Department of Health aims to reduce the neonatal mortality rate from 14 per 1 000 live births (2012) to six per 1 000 live births by 2019 (Department of Health. 2014. Strategic Plan, 2014/15–2018/19. Research conducted by McKerrow and Mulaudzi (2010), using 2007 data, revealed that the majority of neonatal deaths were caused by respiratory, cardiovascular and prematurity disorders. The following areas were identified as the main reasons for the deaths, namely, failure to recognise the severity of the illness, delays in seeking medical assistance and delays in transfers to specialised care. These will be briefly investigated later.

A study by De Vries et al. (2011) retrospectively evaluated the impact of a dedicated obstetric and neonatal ambulance service in the Western Cape in addressing the “delays in transfer to specialised care”. They found a significant improvement in dispatch and response times. However, neither the impact on neonatal mortality and morbidity nor the preparedness of ALS providers to manage these cases were investigated.

Throughout the world, patient safety strategies have been developed to identify and reduce the risks associated with the increased mortality and morbidity of patients. The World Health Organization’s (WHO, 2009) *Conceptual framework for the International Classification for Patient Safety* algorithm labels contributing factors/hazards on the part of medical personnel as the main threat to patient safety. These include cognitive factors (e.g. perception/understanding), performance factors (e.g. technical error in execution – skill based) and behavioural factors (e.g. fatigue and non-compliance). It may be that these factors are in fact those which lead to the ill-preparedness on the part of the ALS providers and the subsequent compromising of patient safety, thus contributing to increased mortality.

1.3. Purpose of the study

The purpose of the study was, therefore, to determine the preparedness of ALS providers for the intensive care of neonates in order to ensure safe patient care during journeys of the neonates.

1.4. Objectives of the study

The following objectives were identified for this study:

- Assess the ALS providers' knowledge and understanding of the management and intensive care of neonates
- Determine the type of technical, neonatal skills/procedures undertaken by ALS providers in their management of these neonates
- Assess whether the training curriculum equips ALS providers adequately to enable them to deal with critical neonates
- Determine whether qualifications and operational experience play a role in the preparedness of ALS providers to clinically stabilise and provide intensive care to neonates.

1.5. Rationale for the study

The desire to save lives is a common motivation behind becoming an ALS provider. However, a study by Gaffney and Johnson (2001) highlighted that paramedic training tends to focus primarily on the emergency rescue and stabilisation of adult patients. Gaffney and Johnson (2001) found that paramedics were often ill-prepared to deal with paediatric emergencies. This finding was substantiated by a study by Seid, Ramaiah and Grabinsky (2012), which found that a gap existed between the pre-hospital management of adults versus that of paediatric patients. They surmised that greater numbers of emergency care providers needed to be trained to address the specific care and management of paediatric patients.

The management and intensive care of neonates is inherently prone to the occurrence of adverse events, particularly as a result of the fact that management often involves pre-term neonates in distress. This means they have been born too early and their frail bodies need external support in order to survive. High-risk neonates who are referred from one intensive care unit (ICU) to another, or from primary and secondary hospitals to ICU, require skilled personnel and specialised monitoring equipment. Globally, these teams are composed of various specialised medical professionals, including doctors, nurses, respiratory therapists and ALS providers (Ohning, 2012).

The pre-hospital neonatal management and intensive care crew in the Western Cape, South Africa, at the time of the study consisted of an Ambulance Emergency Assistant (AEA) or Basic Ambulance Assistant (BAA) and an ALS provider, who is the more highly qualified emergency care provider. While they provide prehospital care or intensive care to a neonate, any pre-existing medical condition present prior to the arrival of the emergency care providers, may lead to the neonate's death. Such conditions may include the under-development of the respiratory/cardiovascular system, congenital birth defects or prolonged hypothermia. If a neonate dies during the patient journey, the diagnoses and prognosis of the neonate may be subsequently investigated. Nevertheless, there is a paucity of evidence relating to the ALS provider's preparedness for the actual management and intensive care of the neonate while in transit (Senthilkumar, Corpuz, Ratnavel, Sinha & Mohinuddin, 2011).

In the face of the high infant mortality rates prevalent in South Africa (Baleta, 2011), it is anticipated that this study has the potential to contribute valuable information regarding the current state of neonatal management and critical care by ALS providers in the Western Cape, as well as to make profound recommendations regarding improved training and ultimately superior clinical practice.

1.6. The researcher's interest in the study

The researcher is both a diagnostic radiographer and an ALS provider. Throughout my academic training years as well as my years as an operational ALS provider, I have been exposed to neonatal intensive care units. These fragile neonates require special care and management, particularly in view of the fact that even a decrease in ambient temperature alone may have disastrous consequences. Currently, as an ALS provider and lecturer employed at the College of Emergency Care in Cape Town, I have experience of the frustration ALS provider students face in practising their neonatal ALS skills, as they are competing with nursing and medical students who practise the same skills. In addition, neonatologists are often not aware of the scope of practice of ALS providers and students are often only allowed to "cup-feed" breast milk to neonates!

1.7. Assumptions and delimitations of the study

Assumptions:

Assumptions are factors which are beyond the control of the researcher although they are important if the study is to be relevant. According to Leedy and Ormrod (2010: 62), “[a]ssumptions are so basic that, without them, the research problem itself could not exist”. The main assumption made in this study was the participants would answer honestly. It was explained to the participants that their confidentiality would be preserved and also that their participation was voluntary. In other words, they were free to withdraw from the study at any time, with no consequences.

Delimitations:

According to Simon (2011), delimitations in the context of a study refer to characteristics which limit the scope and define the boundaries of the study. Delimiting factors include the researcher’s choice of objectives, the research questions and the population under investigation. For the purposes of this study, the population was limited to the public and private prehospital care ALS providers in the Western Cape only. Thus, ALS providers working in hospitals/clinics and as sales representatives were excluded from the study.

1.8. Structure of the dissertation

The remaining chapters of this dissertation are structured as follows:

Chapter 2 presents a comprehensive literature review on the existing literature on the prehospital care of neonates. The discussions are linked to the objectives of the study.

Chapter 3 describes the methodology used in the research study, including the study design, the data collection and data analysis methods, sampling, inclusion/exclusion criteria, reliability/validity, limitations and ethical considerations.

Chapter 4 presents a comprehensive descriptive and inferential analysis of the results compiled from the data collected. This data is presented in the form of tables and figures.

Chapter 5 presents a comprehensive, in-depth discussion of the findings of the study.

Chapter 6 contains the conclusions to and recommendations of the study.

Chapter 2 – Literature Review

2.1. Introduction

The purpose of this study was to determine the preparedness of ALS providers regarding the intensive care of neonates in order to ensure safe patient care during the patient journey. The literature search highlighted certain factors which influence this level of “preparedness”. The following factors related to the research topic were reviewed:

- Patient safety
- ALS provider training
- ALS provider skills and procedures
- Resources available to ALS providers
- ALS provider team dynamics
- ALS provider adverse events

The literature search was an ongoing process throughout this research study, thus allowing for the inclusion of current developments related to the research topic. Numerous searches were conducted on multiple electronic data resources, including PubMed, Ebscohost, Cochrane Reviews, Springerlink, Science Direct, Medline, ProQuest Nursing, Allied Health Source, as well as Google Scholar. Key phrases used in the literature search included “ALS provider (paramedic) neonatal ICU transfers and neonatal prehospital care”. A significant number of results were found. For example, for “ALS provider (paramedic) neonatal ICU transfers”, 173 results were found in Science Direct and 2 316 results in Ebscohost. In addition, library (books) and published journals (hardcopy and online) were also reviewed. However, very few studies could be directly linked to the proposed research area. Nevertheless, the relevant articles/studies were downloaded, saved on hard-drive and then printed. The printed literature was placed in various groupings according to its specific content. After critically reviewing the available articles for relevance and significance, the following themes (Figure 2.1) related to the research topic emerged and were elaborated on:

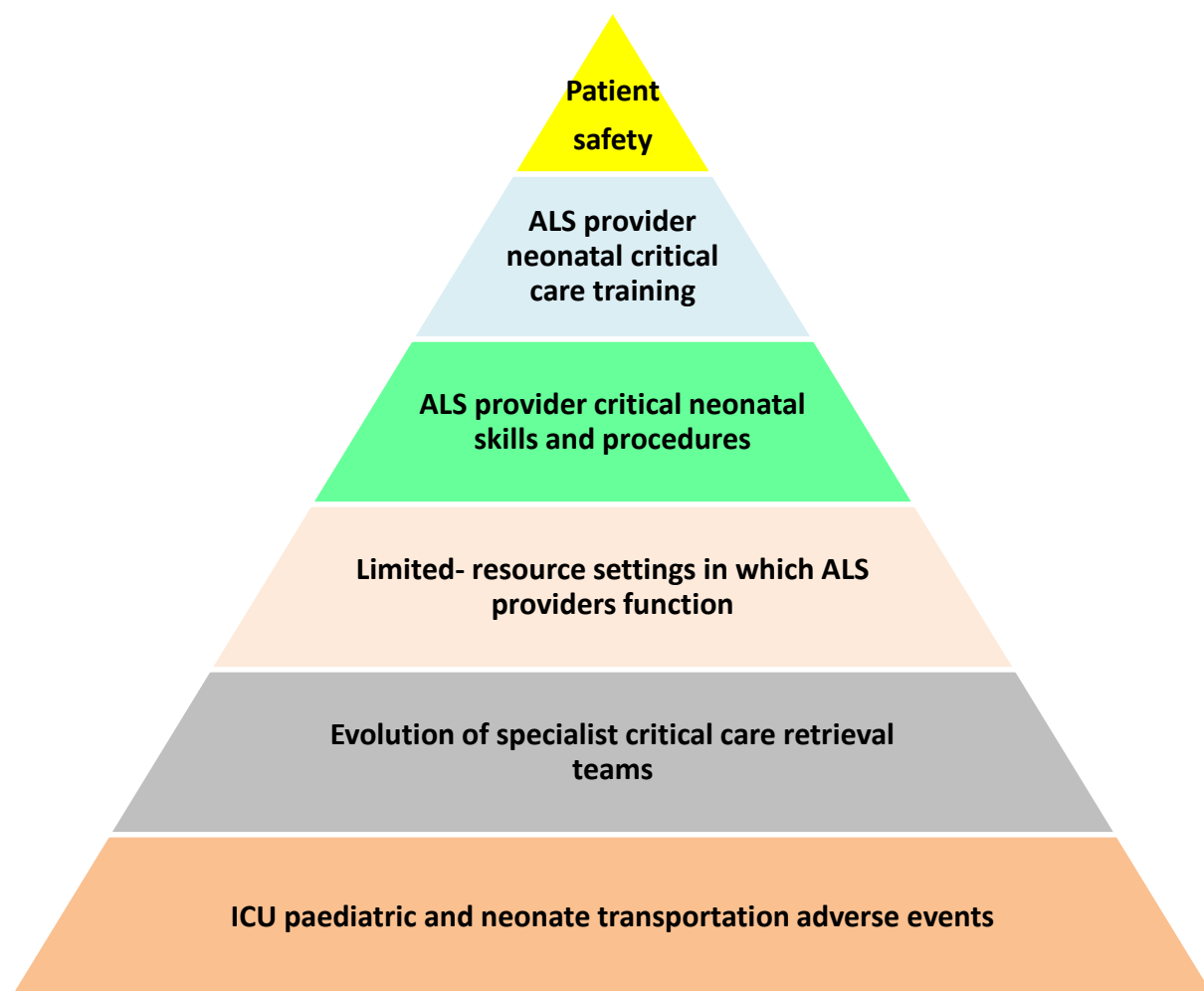


Figure 2.1: Themes which emerged from the literature review

2.2. Patient safety

Patient safety has become a key element in improving the quality of patient care. Increasing attention is being paid to patient safety internationally in response to the increasing number of negative reports indicating that a substantial proportion of patients have been exposed to preventable adverse events caused by health care providers. As highlighted in Figure 2.2, the World Health Organization's (WHO, 2009) *Conceptual framework for the International Classification for Patient Safety* algorithm identifies "Contributing factors/Hazards" as the key "Influence" where "Action" can be advocated to "reduce risk" (improve patient safety). During the developmental phase of this algorithm, health care providers were identified "as the main threat to patient safety". This study was undertaken to assess if ALS providers are

unintentionally increasing this “threat”, due to a lack of “preparedness” with regards to neonatal critical care and negatively impacting “Patient Outcomes”.

Recently in London, at the Patient Safety Global Action Summit (2016), experts agreed to “galvanize international policy and governmental actors to prioritise patient safety at all levels. The aim was to review past experience, inspire new strategies and coordinate action on patient safety globally”.

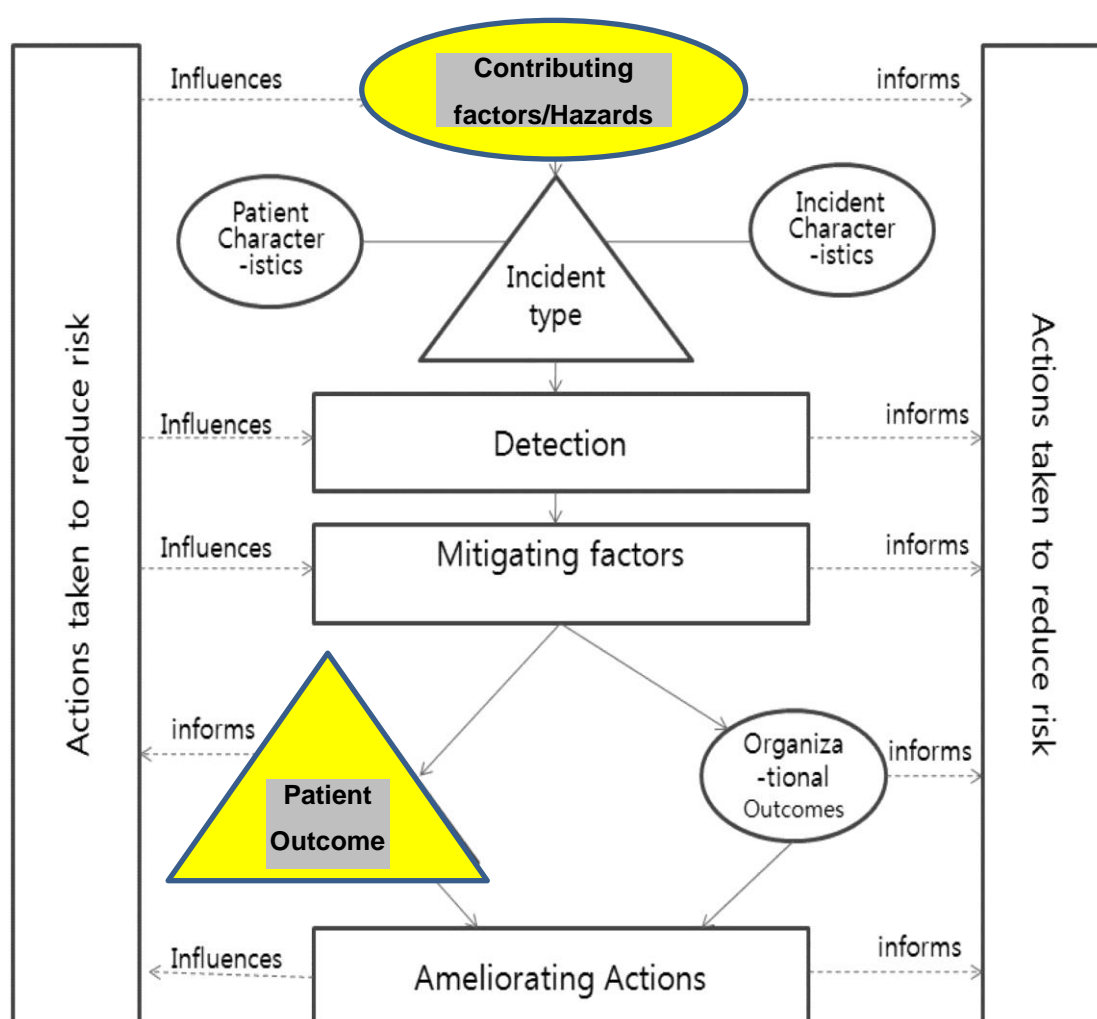


Figure 2.2: World Health Organization. 2009. Conceptual framework for the International Classification for Patient Safety.

Jha A., et al. (2013:809-815) reviewed available literature pertaining to patient safety and found the following group of adverse events:

- “adverse drug events

- catheter-related urinary tract infections
- catheter-related blood stream infections
- nosocomial pneumonia
- venous thrombo-embolisms
- falls
- decubitus (pressure) ulcers”

They calculated that there are approximately 421 million hospitalisations globally on an annual basis, with patients experiencing approximately 42.7 million adverse events. Low and middle income countries account for almost two-thirds of all adverse events. In addition, “unsafe medical care” may cause patients to move away from the formal healthcare system as they may choose to seek healthcare in the informal sector. This may add to the burden of disease as the healthcare provided in this sector (traditional healers, herbalists, etc.) often raises questions on the “appropriateness and quality of care” provided.

A study by Nolan et al. (2001:106–110) reported that paediatric patients received better care at teaching hospitals. However, at other health facilities they reported that “inadequacies were observed in triage, patient assessment, emergency treatment, availability of essential supplies and case management (inappropriate treatment and monitoring)”.

The Western Cape Government, Department of Health (2011) has also become aware of a deficiency in patient safety and thus developed the strategy known as *The future of health care in the Western Cape 2020*. The vision is to ensure improved quality of patient care by assessing the level of compliance of all health care providers with the national core standards. The strategy states that EMS communication centres “have been modernised, a significant number of the ambulance fleet has been replaced, the staff complement was expanded and strengthened and ‘one man ambulances’ was done away with” (Department of Health, 2011:7). However, the strategy does not mention ensuring that EMS personnel are developed and trained to adapt their practice to international best practice standards as a way in which to “improve quality of care” (Department of Health, 2011:17). The main focus is on improving EMS resources, thus overlooking the WHO (2009) report, which labels “health care providers as the main threat to patient safety”.

2.3. ALS provider's neonatal critical care training

It was decided that a review of ALS training in First World countries, where neonate mortality is significantly lower than in other countries, would enable a useful comparison to be made with current practices in South Africa. In First World countries, neonatal transport team members are required to continuously update their skills if they are to be allowed to keep practising. Karlson, Trautman, Price-Douglas and Smith (2011) found that in the United States of America, for example, transport team members are required to have passed the national certification courses and have completed a didactic patient care orientation curriculum to enable them to work as neonate and paediatric transport team members. National certification courses include:

- Neonatal Resuscitation Program
- Basic Life Support
- Paediatric Advanced Life Support
- STABLE Program (Sugar, Temperature, Airway, Blood pressure, Laboratory work and Emotional support)
- Advanced Cardiovascular Life Support

The above-mentioned courses are mostly accredited by the American Heart Association (AHA). These courses use simulation and interactive clinical intervention activities to teach the management principles of "life-threatening medical emergencies". It serves to refresh certain critical skills of ALS providers and update their knowledge by incorporating the latest practice guidelines (AHA, 2015).

In addition, they also found that certain transport teams were required to revise their critical intervention skills on an annual basis. These intervention skills are highly technical procedures which may easily lead to critical adverse events for the patient or even death if not executed correctly.

In British Columbia, the majority of transport programmes require continuing education for the transport teams, including updating neonatal knowledge, maintaining skills, reviewing practices and introducing new patient care management (Lupton & Pendray, 2004). Evidence has shown that they have significantly lower neonate mortality rates compared to those in South

Africa (WHO, 2006). This is related to ongoing medical education as well as the acquisition of more experience in the profession.

The International Association of Flight Paramedics (IAFP, 2009), the largest independent paramedic association in the world advocates for a consistent level of high quality and safe patient care is delivery, which is underpinned by critical care ALS providers meeting national core standards. In the South African context, it is the HPCSA's responsibility to ensure that training institutions comply with the Board's examination criteria/standards, in terms of "registration, education and training, professional conduct and ethical behaviour, ensuring continuing professional development, and fostering compliance with healthcare standards" (HPCSA, 2017). The IAFP recommends that the following pathway to becoming critical care ALS providers be followed:

1. "Experience: Minimum three years of full time employment as an ALS provider in a busy advanced life support EMS system

2. Education:

- Primary: Successful completion of the ALS Provider National Standard Curriculum or equivalent
- Secondary: Successful completion of a Critical Care education program which includes didactic sessions, practical sessions, skill proficiency demonstrations and clinical rotations
- Tertiary: Continuing mentored didactic education, skill maintenance and clinical opportunities in ICU

3. Certifications:

- Advanced Cardiac Life Support
- Adult and Pediatric International Trauma Life Support/Pre-hospital Trauma
- Life Support/Advanced Trauma Life Support
- Pediatric Advanced Life Support/ Advanced Pediatric Life Support
- Neonatal Resuscitation Program" (IAFP, 2009)

The IAFP Certification recommendation does not specifically include a neonatal critical transfer course, possibly as such a course did not exist at the time. Currently, in the Western Cape province, the Neonatal Life Support Course, a one - day course is the only option for ALS providers to gain additional certification (Cardiocare, 2017). There is no specific neonatal critical transfer environment course available at present. The IAFP (2009) does however advocate “Continuing mentored didactic education, skill maintenance and clinical opportunities in ICU” which unfortunately, is also not part of the current training landscape for ALS providers. It would be prudent to adopt this approach for continued education in this field considering the complexity of the competencies required to undertake such tasks.

The second National Paediatric and Neonatal Transport Leadership Conference held in Chicago (2000) highlighted the need to develop educational and clinical standards of care for all practitioners involved in paediatric and neonatal care. It was recommended that additional intensive neonate and paediatric training was required to ensure clinical competence (Woodward et al., 2000).

In contrast to what is found in First World countries, in South Africa the only requirement to practise as an ALS provider is registration with the HPCSA. No additional training or certification is required in neonatology to equip ALS providers to manage and provide intensive care to neonates.

In order for an ALS provider to qualify, he/she is required to achieve a level of “applied competence”. According to the South African Qualifications Authority (SAQA, 2000), applied competence is defined as the amalgamation of the following three factors:

1. Practical competence – the demonstrated ability to do a particular thing.
2. Foundational competence - the understanding of what is being done and why.
3. Reflexive competence – the ability to integrate or connect performance with the understanding of that performance so as to learn from the actions and adapt to change/unforeseen circumstances.

The South Africa Qualifications Authority (SAQA, 2000:4) further defines a qualification as “a planned combination of learning outcomes which has a defined purpose or purposes and which is intended to provide qualifying learners with applied competence and a basis for

further learning". This implies that learners have achieved "applied competence" if successful in their final exit exams. However, "further learning" should follow to augment their knowledge and understanding.

Gibbons et al. (1994) state that the concept of applied competence incorporates the view that there are different kinds of knowledge. They recognise two modes of knowledge, namely:

1. "Mode 1 – knowledge tends to be homogenous, rooted in disciplines, hierarchically structured and coded according to the canonical rules of specific disciplines. It is usually transmitted from disciplinary expert to novice and problems are usually set and solved within the academic community.
2. Mode 2 – knowledge on the other hand is non-hierarchical, inter- or trans-disciplinary, fast changing, contextualised and socially responsive. Problems arise in society and are solved in the context of application."

Current ALS training is associated with "Mode 1 knowledge" and there is limited scope for the "inter- or trans-disciplinary, fast changing, contextualised and socially responsive" application of such knowledge.

Furthermore, in the Western Cape EMS, there is no structured mentorship programme with defined objectives in place. In-service induction/orientation periods vary across the province. Based on the researcher's own EMS exposure (almost 20 years), it would appear that "new" (recently qualified) ALS providers may work with an experienced ALS partner for one, three or six months. However, in the rural areas especially, there is a severe shortage of experienced ALS providers to offer guidance and "further learning". The prevailing workload may thus necessitate that the unfortunate recently qualified ALS providers may be "thrown into the deep end and told to sink or swim".

In addition, it would appear that the possibility of "further learning" from experienced ALS providers is negatively affected by the ongoing migration of existing ALS staff. Govender, Grainger, Naidoo and MacDonald (2012) found that, in 2008, there were 1 631 registered ALS providers in South Africa (SA) with these providers having to deliver prehospital care to a population of approximately 50 million. Compared to internationally accepted ratios, the number of ALS providers in South Africa is dismally inadequate. Govender et al. (2012) also found that ALS providers were emigrating as a result of poor working conditions, a lack of physical security and economic considerations. The prevailing crime rate and the working

conditions which ALS providers endure on a daily basis will probably result in even more ALS providers considering the emigration option. EMS crews are often seen as “soft”, unarmed targets by criminals. This has led to a spate of attacks on and robberies of EMS crews and even their ambulances being vandalised (ENCA, 2016). This then implies that more experienced ALS “mentors” will be lost, placing the “new” ALS staff at an even greater disadvantage.

Furthermore, there is no legislation in place to ensure that ALS providers receive either regular updates or ongoing training in neonatology. An example of the implementation of a new technology is the implementation of continuous positive airway pressure (CPAP) systems in the prehospital environment. A systematic review and meta-analysis study conducted by Williams, Finn, Perkins and Jacobs (2013) showed that CPAP decreases the need for mechanical ventilation by delivering positive end expiratory pressure (PEEP), while decreasing the incidence of

- barotrauma – injury of a body part or organ as a result of changes in barometric pressure, in this case the lungs
- volutrauma – damage to the lung caused by over-distension by a mechanical ventilator set for an excessively high tidal volume.

Williams et al. (2013) found that the use of CPAP led to fewer endotracheal intubations (ETs) and a decrease in mortality. CPAP enables ALS providers to avoid complications arising from intubation-related sedation or paralysis, including limiting unexpected difficulties such as hypoxia, lethal dysrhythmia, tissue trauma, aspiration and undetected oesophageal intubation.

The placement of ETs to secure a patient’s airway, although often life-saving, increases the risk of respiratory infections, in particular ventilator-associated pneumonia. Decelle, Thys, Zech and Verschuren (2013) found a 20% occurrence of ventilator-associated pneumonia after intubation in the prehospital environment or in emergency units. Thus, older ALS providers who have not remained abreast of the evolving innovation and technologies in neonatal critical care may do more harm than good if they are not taught and trained to utilise new technologies.

According to Benner (2013), experience is a prerequisite for becoming an expert. She describes a “novice” as a newly qualified practitioner with no experience. She labels the next

level of development as that of the “advanced beginner”, namely, a practitioner who demonstrates an acceptable level of performance. The third level of development is that of “competent” practitioner, namely, a practitioner with two to three years of on-the-job experience. “Proficient” refers to the fourth level of development and it is at this level that the practitioners have learnt from their experiences, they know what to expect in certain situations and they are able to adapt their management in order to improve the situation. The final level of development, which she terms the “expert” level is the level at which a practitioner has achieved an intuitive grasp of the clinical situation and performs at a highly proficient level.

In the Western Cape province, newly qualified ALS providers are expected to be “competent” according to Benner (2013), thus implying that they have “2–3 years of on-the-job experience”. However, the problem is that, during their study years, their clinical practical exposure is often limited as they compete with other learners (i.e. nursing and medical students) to acquire the same ALS skills. In addition, rescue training and other theoretical subjects (e.g. Physics and Pharmacology) take up a significant amount of the student ALS providers’ training semesters. Therefore, their final year of studies is often extremely stressful as this is their exit level, leaving them with limited time to assimilate both the theory and practicum components. Thus, to become a “proficient” and an “expert” ALS provider requires many years, as well as considerable exposure to treating and managing critically ill patients. Sadly, this does not inspire much confidence in the newly qualified ALS provider’s capabilities and may cast a shadow of doubt in the initial period of employment of ALS providers.

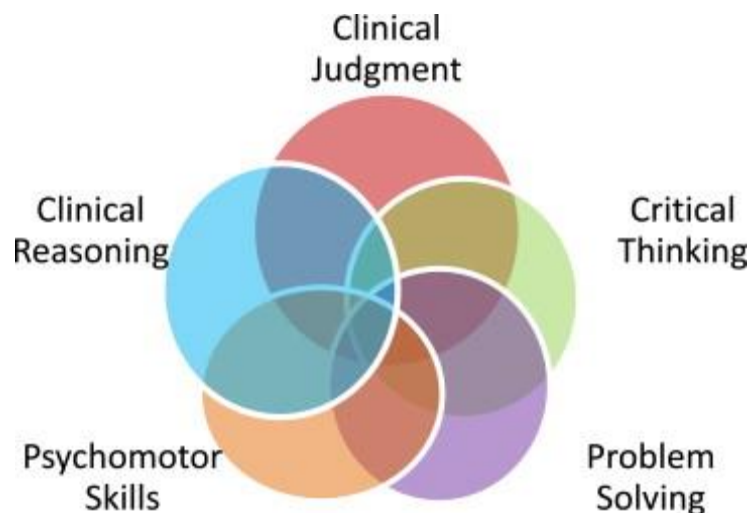


Figure 2.3: A nursing skill development and clinical judgement model (Meakim C, Boese T, et al, 2013)

In addition, the nursing skill model depicted in Figure 2.3 describes various levels of development which are dependent on each other. For example, a lack in psychomotor skills may lead to a lack of sound clinical judgement and vice versa. The learner needs to develop in all these areas in order to become “proficient”. A lack of clinical exposure managing critically ill neonates, may diminish their ability to enhance their “skill development and clinical judgement” as ALS providers. As newly qualified ALS providers, their level of clinical judgement can only improve with adequate learning experiences to prepare them to deal with the complexities of critical care. According to Lindsey and Jenkins (2013) clinical judgement has become a vital skill needed “to determine the appropriate interventions when planning patient care, especially the ability to manage rapidly deteriorating patients.”

The standardisation and homogenisation of a curriculum leads to the enhancement of the quality of learning, as well as providing established indicators for proficiency. This is sadly lacking in South Africa in the context of the training for ALS providers, as the current ALS providers’ training landscape of short courses (CCA) and tertiary courses (NDip EMC, BTech EMC and BEMC) is extremely varied with regard to neonatal prehospital care. The wide range of curricula means that the entire academic time spent on the preparation of ALS providers to manage ICU neonates can vary from two weeks to twelve months (CPUT, 2014). Even though “only one University” is stated as reference, all Higher Education Institutions should be offering similar ALS provider training, as they all fall under the ambit of the authority of South African Qualifications Authority (SAQA) and the National Qualifications Framework (NQF) main

objective: “To create a single integrated national framework for learning achievements” (SAQA, 2017).

To further highlight the problem at hand, the Durban University of Technology’s current four-year Bachelor of Emergency Medical Care degree aims to prepare ALS providers to deliver emergency care to patients in any environment (including aquatic and mountain rescue). During the second year of study, the ALS provider students complete a two-semester subject known as Primary Health Care 2. This subject deals with neonatal, paediatric and gynaecological emergencies. In addition, the ALS provider students undergo a neonatal practicum phase (in-hospital training). Many ALS students find this extremely challenging as they work alongside nursing and medical students to acquire critical neonatal skills, since there is fierce competition amongst these allied health workers for the limited number of cases available during the allotted training period. Students from other disciplines also need to perform a certain number of skills, for example intra-venous access (IV). During their clinical shift, if there is only one opportunity to place an IV on a patient, “competition” exists between the ALS student, nursing and /or medical students (working in the same ward) as to who will place the IV. The one performing the skill will be credited in their practical workbook.

Furthermore, children (including neonates) represent a small percentage only of prehospital emergencies (Babl, Vinci, Bauchner & Mottley, 2001). Accordingly, a newly qualified ALS provider may face many challenges in the progression from novice to expert, particularly if there is a lack of opportunity to practise advanced neonatal care. This often translates to a lack of proficiency in this particular aspect and may lead to a cascade of unfavourable effects, ultimately contributing adversely to the performance of the ALS provider.

The Health Professions Act, 1974 (Act No. 56 of 1974, as amended) states that CPD is a means of “maintaining and updating professional competence, to ensure that the public interest will always be promoted and protected, as well as ensuring the best possible service to the community”. The purpose of CPD is to assist health care professionals to remain abreast of new technologies and clinical procedures as “there is always more to learn”. The fostering of an attitude of eagerness to acquire new knowledge, skills and ethical attitudes will “enhance and promote professional integrity”. It is therefore a requirement that all registered health care professionals participate in accredited CPD activities each year. However, health care professionals “may select activities at any level of learning that meet their particular needs and the demands of their practice environments” (HPCSA, 2011). CPD activities have

an important role to play with regards to critical neonatal care, as any short-comings highlighted previously in terms of the ALS provider's training arising from limitations in the curriculum or clinical exposure, could be remedied by the creation of the appropriate neonatal critical care CPD programmes/workshops, especially designed for the prehospital transport environment.

Currently, CPD accredited courses for ALS providers include Paediatric Advanced Life Support (PALS) and Neonatal Advanced life Support (NALS). However, these courses may be extremely costly compared to other CPD activities which are offered online (often only a small registration fee). In addition, participating in online CPD activities may have numerous benefits. The ALS practitioner requires only a computer with an internet connection. It is cost-effective (no travelling to a venue) and may be done at leisure anywhere. However, is it possible that sitting in front of a computer can replace a hands-on practical clinical session?

2.4. ALS provider critical neonatal skills and procedures

Proficiency declines when advanced paediatric skills are not practised and this leads not only to an increase in practitioner anxiety but may also result in harm to the patient. This was reported in a study by Su, Schmidt, Mann and Zechnich (2000) in which the ALS provider paediatric resuscitation skills were found to decrease within six months after they had attended a paediatric resuscitation course. In addition, a study by Foltin (1995) found that ALS providers regarded critical paediatric calls as their most stressful cases. This anxiety was due to their low exposure to these types of cases.

A literature review conducted by Al-Anazi (2012) highlighted four key areas in which ALS providers lacked proficiency when caring for paediatrics. These included airway management; support for ventilations and cardiac function; inappropriate use of length-based treatment tapes; and inaccurate calculation and administration of medications/fluid. The reasons attributed to the lack of proficiency in these areas were found to stem from inadequate paediatric training, limited opportunity to perform high risk technical skills and lack of experience. In addition, the lack of the appropriate paediatric advance airway management equipment was highlighted as a common problem for emergency services.

Al-Anazi's (2012) findings were also echoed in a cross-sectional survey conducted in the United States of America where ALS providers working in the critical care environment

reported that they were required to work with equipment and perform skills which had not formed part of their training (Raynovich et al., 2013). The consequences of this may be dire because when a patient is critical, a high level of proficiency and accuracy is required to avert a negative outcome.

Studies have also found that compared to adults, paediatric patients often receive less aggressive pre-hospital care. The “scoop and run” approach is frequently applied as fewer procedures are performed in order to move the child on to definitive care (Spaite et al., 2000).

However, studies have also investigated the benefit of having ALS providers in an EMS system. A prospective “before-and-after” controlled trial conducted by Stiell et al. (2007) focused on the benefit of ALS interventions for patients in respiratory distress in countries such as the United States and Canada. In these countries, prehospital care for critically ill and injured patients is provided by ALS providers while EMS is frequently called upon to transport patients in respiratory distress. The study results showed that the presence of ALS providers “significantly reduced mortality for patients with shortness of breath” (Stiell et al. 2007). A previous study by Persse, Key, Bradley, Miller and Dhingra (2003) had recognised ALS providers as an integral component of the EMS with the dispatch of ALS providers in a tiered EMS model leading to improved response times and better patient outcomes.

In the Western Cape Province, the largest prehospital EMS organisation is the government Medical Emergency Transport and Rescue Emergency Medical Service. This provides a 24-hour medical response and pre-hospital service on scene and transport to the nearest appropriate health care facility for further treatment (Western Cape Government, Department of Health, 2015). The staff complement represents a microcosm of the prevailing EMS qualification landscape in the country, with large numbers of Basic Ambulance Assistants (BAAs) qualified staff, followed by Ambulance Emergency Assistants (AEAs) and a minority of ALS providers.

According to O'Reilly (2010):

We are of the opinion that the current short course training duration and content is inadequate to meet the demands of the prehospital environment, if you take into account that almost 80% of ambulance crews are made up of practitioners with three to four weeks' basic training (BAAs), attending and transporting sometimes critically ill and injured patients, we have to ensure that the citizens of South Africa are in qualified and

well trained hands in any emergency situation. The HPCSA has a legislative responsibility to review and align education and training of the professions registered with it under the Health Professions Act, 1974 to ensure the registration of competent practitioners. The HPCSA has, since 2002, been engaging with various stakeholders to align the emergency care profession to that of other health professionals and the changes in the emergency care education and training model are necessary to meet the demanding requirements and challenges of this profession.

Hopefully, the migration of EMS training from “short-course training” to tertiary education will also lead to an improvement in neonatal critical care, with enhanced neonatal skills and procedures capabilities on the part of all emergency care providers.

2.5. Limited resource settings in which ALS providers function

According to UNICEF (2014), the neonatal period is

... the most vulnerable time for a child’s survival. Over the past twenty years the global death toll for children under-five has been astounding. During the period from 1990 till 2013, 223 million children died before reaching the age of five. In 2013 almost 1 million newborns (36%) died on the day they were born, and another 1 million (37%) died within the next six days of birth. Some 0.8 million neonatal deaths (27%) occurred between day 7 and day 27 of life.

Most neonatal deaths are preventable. Children who die in the first 28 days of life suffer from diseases and conditions that are often associated with quality of care around the time of childbirth and are readily preventable or treatable with proven, cost-effective interventions. In 2013, 3.1 million deaths — half of under-five deaths globally — occurred in Sub-Saharan Africa. It is the only region where the number of live births and child population is expected to rise substantially over the next two decades. By 2050 close to 40% of live births will take place in Sub-Saharan Africa and 37% of the world’s children under age five will live there. Thus, the number of under-five deaths may stagnate or even increase without further progress in the region”. (UNICEF 2014)

As a developing country in sub-Saharan Africa, South Africa (SA) forms part of the BRICS (Brazil, Russia, India, China and SA) world economies. However, South Africa has the

smallest economy of the group at \$390 billion and a population of 50.5 million (Fin24.com, 2013). According to Blecher, Kollipara, De Jager and Zulu (2011: 29–48), 8.5% of South Africa's gross domestic product (GDP) is spend on health care. However, members of the socioeconomic elite (on whom half of the 8.5% is spent) are guaranteed access to health care at well-resourced private facilities, while the remaining 84% of the population is forced to depend on the under-resourced public health care sector. In addition, in view of their poor socioeconomic circumstances and a lack of service delivery (such as clean water, flushing toilets, refuse removal, etc.), these members of the population carry a greater burden of disease.

According to the Department of Health Strategic Plan 2014, South Africa is in the grip of two major epidemics, namely, the human immunodeficiency virus (HIV) and tuberculosis (TB). The country has the largest population of HIV-positive people (approximately 6.4 million in 2012) in the world while it was estimated that, by 2013, 10% of the total population would be HIV positive. In addition, the incidence of tuberculosis in the country places South Africa third in the world, after China and India (Department of Health Strategic Plan, 2014).

The socioeconomic inequality created by the previous apartheid government is still present throughout South Africa, even more than 20 years after the dawn of democracy. Health care is still divided along racial lines. Statistics South Africa's *Annual General Household Survey* (2013d) (Figure 2.4.) indicated that more than three-quarters (77%) of white South Africans, compared to 10, 8% only of black Africans, had medical aid.

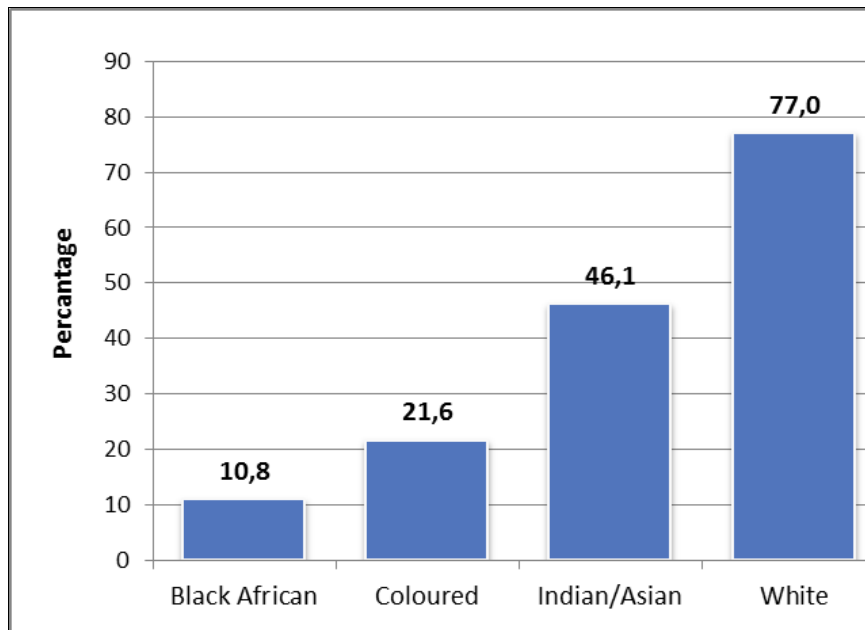


Figure 2.4: Percentage of individuals who are members of medical aid schemes by population group (Statistics South Africa, 2013: 30)

Numerous reports of State Capture and financial mismanagement, combined with a lack of effective leadership also contribute to poor service delivery and prevent the public healthcare facilities from functioning optimally. Subsequently, this sector remains poorly resourced (The Sunday Times, 2017). In addition, according to the Heath Systems Trust, there is a major shortage of skilled healthcare workers (including nurses, doctors and specialists). Prevailing factors, such as “low pay packages, enormous workloads and horrible working conditions” also fail to attract skilled workers (Heath Systems Trust, 2017).

Nevertheless, despite all the challenges, numerous positive programmes have been implemented in the country, including the following:

- A successful immunisation programme, placing the country on target to be declared polio-free by 2018
- The largest HIV treatment programme in the world, with approximately three million HIV-positive individuals on anti-retroviral (ARV) treatment

- A successful programme to prevent mother-to-child HIV transmission, reducing perinatal HIV transmission rates to 2.7%, compared to an estimated 30% transmission rate prior to any intervention (The Presidency, Republic of South Africa, 2014).

In addition, Dorrington, Bradshaw, Laubscher and Nannan (2015) estimate that the mortality rate in South Africa is improving although they did point out that “the neonatal mortality rates have shown a modest decline in the last few years. Further declines in child mortality will require improvements to health care services, particularly for the newborns, as well as addressing environmental and social factors associated with poor infant and child health”.

A 2008 study by Khilnani and Chhabra (2008) highlighted the high mortality and morbidity risk involved in the transportation of critically ill children in developing countries (mainly India and Africa) as a result of the personnel and resource limitations in these countries. A systematic review of available literature by Ralston, Day, Slusher, Musa and Doss (2013) on paediatric ALS provider management in limited-resource settings found that the regions in the world where the majority of childhood deaths occur also had the least paediatric emergency and critical care. These regions lack basic resources, such as oxygen therapy and equipment with which to detect hypoxemia.

According to Enoch, English and Shepperd (2016), hypoxemia is a common complication of numerous diseases including “pneumonia, bronchiolitis, asthma and sepsis and is associated with increased risk of death in children. Pulse oximetry is a low-cost intervention that could reduce child mortality, by enabling early detection of hypoxemia and improving accurate diagnosis, thereby increasing the chance of prompt, effective treatment”. Pulse oximetry has been accepted in protocols for the clinical assessment of children with bronchiolitis. Research data has shown that it can reliably detect hypoxemia, which may be overlooked during the physical examination of a patient. Thus, it may decrease child mortality as it is used to diagnose and monitor children with hypoxemia.

In the Western Cape Province, Hatherill et al. (2003) conducted a one-year prospective audit at a university children’s hospital. They found that the majority of ICU paediatric and neonate inter-hospital transfers were carried out by ALS providers (82%). The researcher has also worked as an ALS provider in this environment and was acutely aware of the shortage of functioning monitoring equipment and the lack of resources. It was in light of these shortages that, in 2012, the Western Cape Provincial Government, in partnership with the Red Cross

Children's Hospital Trust, established and equipped dedicated neonatal ICU ambulances (Siren Newsletter, 2012). However, despite the fact that this meant that ALS providers now had improved monitoring and procedural equipment, no additional neonatal training was implemented to ensure that these ALS providers were prepared for neonatal intensive care, thus virtually nullifying this innovation.

2.6. Evolution of specialist critical care retrieval teams

There is worldwide acceptance that a significant number of pre-term and critically ill neonates will require transportation to definitive care. Specialist retrieval teams have evolved to include a multitude of specialists who are able to use their subspecialty capabilities to best manage the critically ill during inter-facility transportation (Neil et al., 1999). Team members must be able to perform invasive and critical procedures. A database review of specialised paediatric, intensive care unit (PICU) retrieval teams showed a reduction in risk-adjusted mortality (Ramnarayan et al., 2010). According to the Paediatric Intensive Care Audit Network (PICANet, 2010), 29 PICUs provide inter-facility critical care to more than 11 million children (aged ≤ 16 years) in England and Wales.

A study conducted by Britto, Nadel, Maconochie, Levin and Habibi (1995) reported that the transfer of critically ill children is inherently unsafe and that up to 75% of cases transferred by non-specialised teams may suffer serious clinical complications.

In the Western Cape province, the ambulances and fixed/rotor wing aircraft used for critical care inter-facility transport are staffed primarily by ALS providers. The researcher is aware of the ongoing debate on which transport mode is a better option (Muhlbauer, 2015). Although aviation should automatically be a faster and safer transport option for the critically ill patient, there is also a perception that there are prolonged on-scene times when aero-medical transport is used. A study by Van Hoving, Smith and Wallis (2008) compared the mean on-scene times of aero-medical versus ground ambulance transportation of critically ill patients in the Western Cape. Their retrospective observational study analysed 7 924 transports of which 7 580 (95.7%) were road transports. They found that "on-scene time for transports done by road is significantly less than those done by air".

Traditionally, the effectiveness of EMS is measured by the shortest possible "mission times" it achieves. For the majority of EMS calls, speed of the transfer is emphasised as, especially in

trauma and cardiac cases, the so-called “golden hour” has been advocated to ensure the patient receives definitive care and to decrease mortality. The term “golden hour” describes the critical time period in which to mitigate further injury and prevent death when a patient has sustained a traumatic injury (Zuidgeest, Jonkheijm, Van Dijk & Van As, 2013). In addition, in the case of cardiac patients, “time is muscle” and muscle is life. The Heart Foundation states that “half of the deaths from heart attack occur in the first 3 or 4 hours after the onset of symptoms. Every minute you delay can result in more damage to the heart muscle” (The Heart Foundation, 2016).

However, Meyer, Mikhailov, Kuhn, Collins and Scanlon (2015) highlight that paediatric inter-facility transport is a complex process which utilises various health care professionals and different transport modes requiring adequate planning, precision and sufficient time to ensure a safe inter-facility transfer.

The objective of every ICU inter-facility transfer should be either to improve or to maintain the level of care the patient was receiving at the referring facility until the patient is handed over at the accepting health facility. Every effort should be made to limit any adverse events. According to Droogh, Smit, Absalom, Ligtenberg, and Zijlstra (2015),

... incidents may be divided into medical and technical incidents (Table 2.1). Medical adverse events are most often cardiovascular or respiratory events. The most common cardiovascular events are hyper- and hypotension, brady- and tachycardia and arrhythmias, with a reported incidence varying from 6% to 24%. Respiratory events are most often inadequate ventilation or oxygen desaturation with reported incidences ranging from 0 to 15%.

Table 2.1: Incidence (Droogh et al., 2015)

	Medical		Technical
	Cardiovascular	Respiratory	
Incidence	6–24%	0–15%	9–36%
Common events	Hypo-/hypertension	Inadequate ventilation	Power failure
	Brady-/tachycardia	Oxygen desaturation	Gas supply problems
	Arrhythmias		Missing equipment
			Damaged equipment

A study by Flabouris, Runciman and Levings (2006) reported that most adverse events could have been prevented. They found that almost 91% of the reported adverse events occurring during critical ICU transfers were avoidable. They highlighted the following mitigating factors:

- Improved team dynamics
- Continuous technical equipment checks
- Continuous monitoring of the patient
- Improved interpersonal communication skills

There has been a movement towards establishing paediatric and neonatal specialist critical care retrieval teams (SCCRTs), as described by Orr et al. (2002). They found that non-specialised teams had limited paediatric training and exposure to true paediatric emergencies and hypothesised that a SCCRT would lead to improved survival rates and less adverse events. Their conclusion was that SCCRTs did lead to improved patient safety.

In the Western Cape province, the services of doctors and respiratory specialists are used on occasion during ICU inter-facility transfers, primarily when the neonate requires drugs or interventions that are not within the scope of practice of ALS providers. However, this is not the norm and, thus far, SCCRTs are not routinely part of EMS operations.

However, other studies have looked at these specialist teams (SCCRTs) and found that they also experience adverse events. Senthilkumar et al. (2011) conducted a prospective descriptive study of one of these teams. They found that over a 13-month period, a total of 1 289 emergency transfers were undertaken and that a total of 560 transfers documented adverse events. The majority of the clinical adverse events (50%) recorded related to inappropriate endo-tracheal tube positioning or over-ventilation.

2.7. ICU paediatric and neonate transportation adverse events

According to Baker et al (2004), “research into adverse events has highlighted the need to improve patient safety”. Baker and colleagues looked at the prevalence of adverse events in acute care hospitals in Canada. A total of almost 2.5 million annual hospital admissions were reviewed. Adverse events were found to be associated with 185 000 admissions. They also found that the majority (64.4%) of the adverse events had not led to physical impairment or

disability although permanent disability had affected 5.2%, while 15.9% of the adverse events had resulted in death. Negligence by omission (the failure to carry out necessary diagnosis or treatment) was highlighted as a factor which played a role more often than errors of commission (57.1% v. 42.9%). “By extrapolation, our results suggest that, in 2000, between 141 250 and 232 250 of 2.5 million similar admissions to acute care hospitals in Canada were associated with adverse events and that 9250 to 23 750 deaths from adverse events could have been prevented” (Baker et al 2004).

It is widely acknowledged that a significant number of pre-term neonates will require transportation to definitive care. Numerous studies have highlighted both varying adverse events and also solutions to these problems (Neil et al, 1999). Lim and Ratnavel (2008) conducted a prospective review of neonatal transfer adverse events and found human error to be a factor in the majority of these events. Their solution was to minimise the risk of adverse events through education, training and risk management.

Using clinical and administrative data, a retrospective cohort study by Singh, MacDonald et al. (2014) concluded that critical adverse events occurred in approximately one of every 15 patients. These events were associated with mechanical ventilation and the hemodynamic compromise of the patient.

As previously mentioned, a study in the Western Cape province by Hatherill et al. (2003) found that, during their one-year prospective study of inter-hospital paediatric ICU transfers (total of 202), the following adverse events were noted:

- One or more technical adverse events in 36% of the transfers (not associated with mortality)
- Clinical adverse events in 27% of the transfers
- Critical adverse events in 9% of the transfers.

As already stated, technical adverse events refer to harm resulting from a medical intervention or incorrect use of medical equipment causing harm to the patient (Garrouste-Orgeas et al., 2012). According to Waluube (2011), clinical adverse events may be described as unintended injury partially caused by medical management which prolongs the patient’s recovery and/or leads to a distinguishable disability when the patient is discharged. He further defines critical adverse events as the actions by medical practitioners which are directly responsible for the

effects observed in the patient. These detrimental effects may lead to a longer hospital stay or even death.

The technical, clinical and critical adverse events highlighted by Hatherill et al. (2003) may possibly have been caused by any of these factors, namely, cognitive factors (e.g. perception/understanding), performance factors (e.g. technical error in execution – skill based) and behavioural factors (e.g. fatigue and non-compliance). Although Hatherill et al.'s (2003) study may be said to have reflected negatively on EMS, the study did not, for example, take into account the limited resources (such as personnel shortages and lack of specialised equipment) or the high workload (call volume) to which the Western Cape EMS is exposed. These may have been contributing factors to adverse events such as the prolonged arrival times which led to the deterioration of the neonate before the arrival of the ALS provider.

2.8. Conclusion

There is a paucity of published literature specifically on ALS provider neonatal care, with most of the literature available referring to adult and paediatric pre-hospital care. Although the resource limitations in the Western Cape are being addressed in respect of paediatric and neonate transportation, this study aims to address the research question as to whether or not ALS providers are adequately prepared for the task at hand, either by road or in the aero-medical environment.

Chapter 3 – Research Methodology

3.1. Introduction

This chapter will discuss the research study design/methodology used for the purposes of the study. In addition, the chapter will focus on the study setting, population, data collection tool, pilot study, reliability of the study, research process, data analysis and ethical considerations.

3.2. Research design

The study used a quantitative approach. Aldous, Rheeder and Esterhuizen (2011) recommend that the most time and cost-efficient study design should be adopted in terms of achieving the objectives of the study. This study did not involve an intervention. The research enquiry was exploratory in nature, with a non-experimental prospective design, seeking to provide a descriptive analysis of the preparedness of current ALS providers to manage critically ill neonates. According to Brink (2009), descriptive study designs are ideal for collecting data from a sample of the population under focus, either by means of structured observation or by a survey.

3.3. Study setting

The Western Cape province offers a comprehensive range of healthcare facilities, ranging from primary to tertiary healthcare centres. Statistics South Africa (StatsSA, 2016) estimates the population in the province at around 6.2 million (11.3% of the total population in SA). South Africa covers a total land surface of 129 462 km². The province's economic growth (2.7 % between 2015 and 2020) has outperformed the national average. "In 2015, around 53 per cent of the Western Cape's working age population – 2.3 million people – were employed. This is substantially higher than the national proportion of 43 per cent" (Western Cape Government Provincial Treasury, 2015).

Access to emergency medical services (EMS) is a right which is enshrined in the Constitution of South Africa. The Western Cape Government's EMS aims to respond to all communities as follows:

- "Urban Priority 1 responses within 15 minutes

- Rural Priority 1 responses within 40 minutes” (Western Cape Government, Department of Health. 2012:108)

3.4. Sample

A total of 179 questionnaires were despatched and 145 (n) were returned, thus giving an 81% response rate. Therefore, the final sample population, namely, the final study population was 145 (n).

3.5. Sampling and sample method

Sampling can be viewed as a specific principle used to select the participants of the population to be included in the study. The researcher employed a convenience sampling strategy, thereby selecting the most readily available participants. Convenience sampling is less complex compared to other sampling methods such as stratified random sampling and cluster sampling, as with these methods, one needs to divide the population into subgroups and perform further steps before selecting participants of the population (Aldous, Rheeder and Esterhuizen, 2011). The services of a recommended statistician were used to provide guidance on the number of participants required, as well as the minimum number of completed questionnaires that were needed to ensure the study was feasible.

3.6. Inclusion criteria

All ALS providers (CCA, NDip EMC, BTECH and BEMC) working in the pre-hospital environment in private and provincial EMS, as well as those working in the aero-medical environment in the Western Cape province were included in the study.

3.7. Data collection tool

The chosen method for this study was a survey, using a questionnaire as the data collection tool. According to Brink (2009), the advantages of a questionnaire include a greater sense of anonymity for the participants, thus increasing the chance of truthful answers; it is cost-effective in terms of time and money, it provides a rapid way of gathering data from a large population; and it allows the participants the convenience of completing it in their own time.

The research instrument consisted of 35 items, with a level of measurement on a scale – a nominal or an ordinal level.

As stated in the pilot study, the poor response received via the electronic survey, the researcher opted to distribute hard copies of the questionnaire. These copies, together with information letters and consent forms were hand delivered to qualifying study participants at operational EMS bases. In order to avoid collusion, an impartial individual (administration clerk) was requested to hand deliver the hard copies of the questionnaires and to collect them from the collection boxes at the bases on a weekly bases.

The questionnaire contained general questions relating to the objectives of the study. The majority of the questions were close-ended to facilitate the coding and analysing of the data. The diagrams below depict how the questions were formulated, using the objectives of the study:

Objective 1

- Assess ALS providers' knowledge and understanding regarding the management and intensive care of neonates. Their knowledge and understanding was indirectly assessed and self-reported.

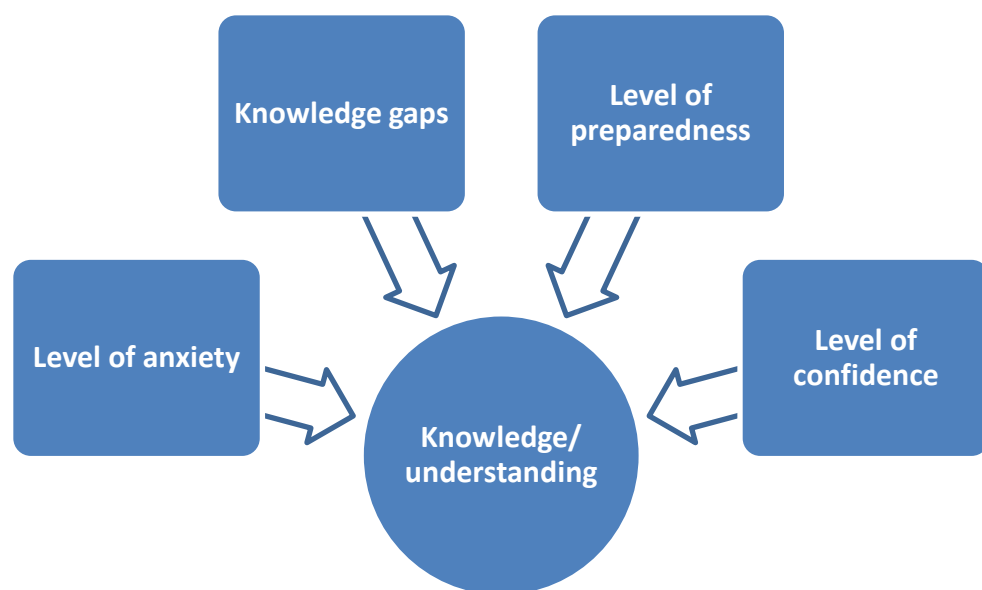


Figure 3.1: Objective 1

Objective 2

- Determine the type of technical neonatal skills/procedures undertaken by ALS providers in managing these neonates

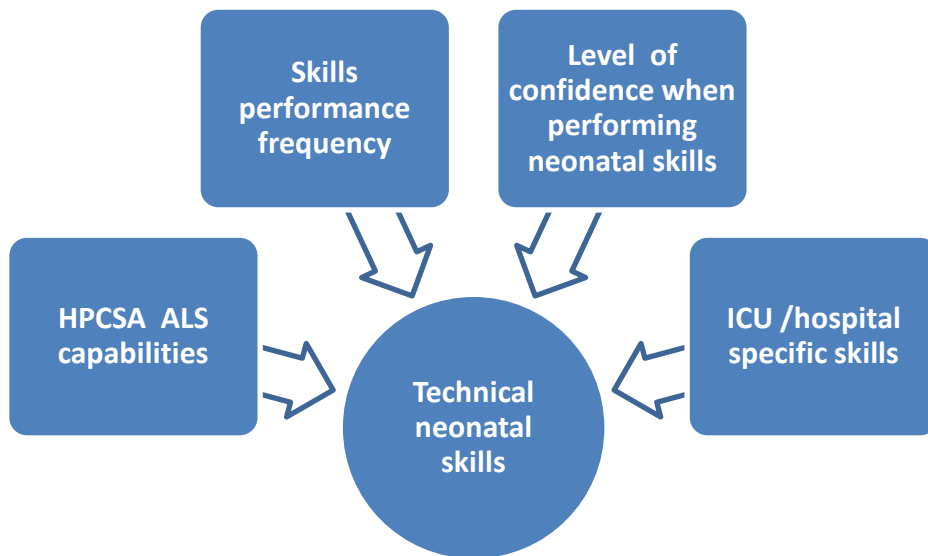


Figure 3.2: Objective 2

Objective 3

- Assess whether the training curriculum had equipped the ALS providers adequately to deal with critical neonates.

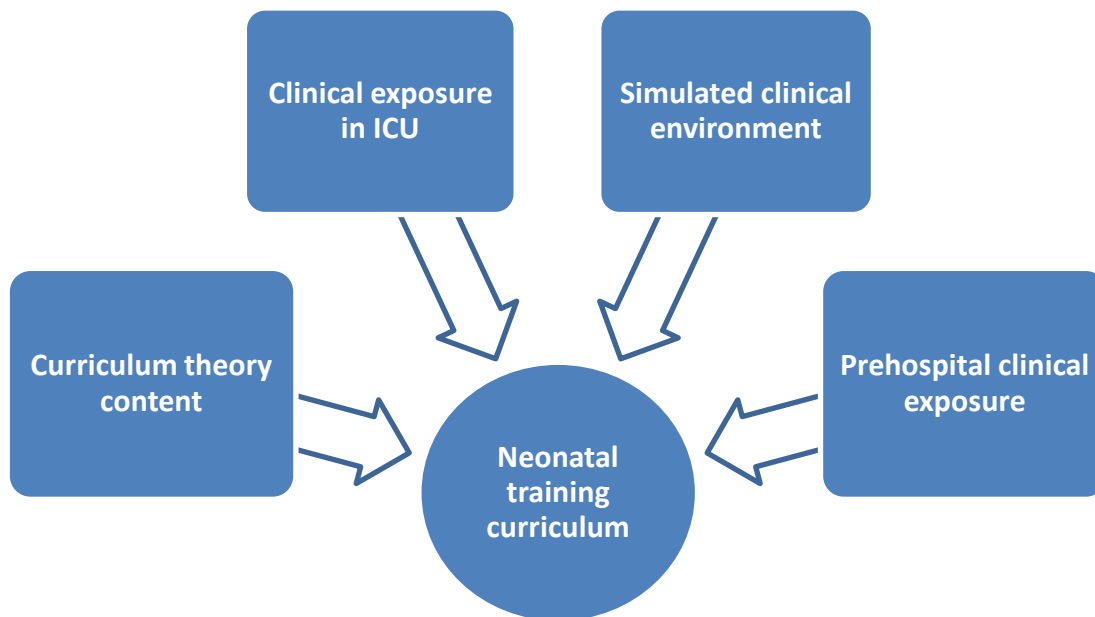


Figure 3.3: Objective 3

Objective 4

- Determine whether qualification and operational experience play a role in the preparedness of ALS providers to clinically stabilise and provide intensive care to neonates.

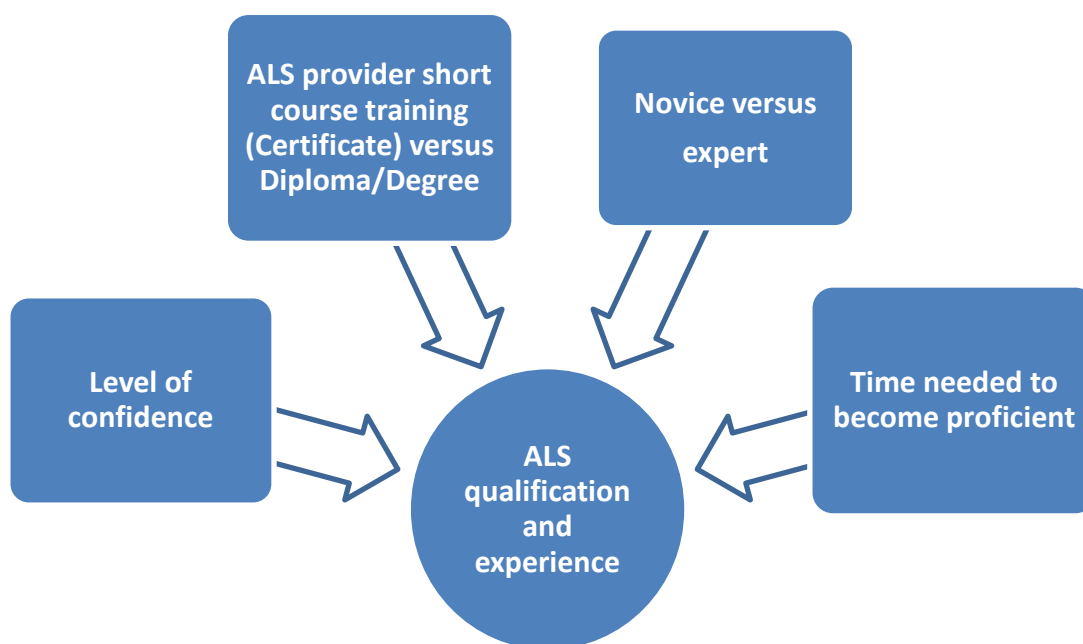


Figure 3.4: Objective 4

3.8. Pilot testing

According to Van Teijlingen, Rennie, Hundley and Graham (2001), it is beneficial to run a pilot study as this increases the success of the main study by enabling the researcher either to eliminate or to minimise potential pitfalls in the questionnaire. The benefits include

- identifying ambiguities and complicated questions
- removal of unnecessary questions
- assessing whether each question provides a sufficient range of responses and
- providing a reasonable amount of time in which to complete the questionnaire.

A pilot study was conducted with ten eligible ALS providers in order to obtain unbiased feedback. These volunteers were similar to the target population of the main study and the researcher approached each one individually, explaining the nature and importance of the study. The results of the pilot study were excluded from the final data analysis. The pilot group consisted of CCA, NDIP, BTECH and BEMC ALS providers who had all worked in the pre-hospital environment and who had varying degrees of post-qualification experience. An additional benefit was that the majority of them had been participants in previous studies and thus their input was extremely valuable. Hard copies of the questionnaire as well as an online survey instrument were piloted and tested for effectiveness.

The ten ALS providers were randomly separated into two groups of five. Hard copies of the questionnaire were given to the first group while the other group received email invitations to participate in the pilot study and complete the electronic questionnaire online. The first group had all completed and handed in their hard copy questionnaire by the third day. However, after three weeks of sending weekly reminders and friendly requests to the online group, only one completed and submitted the questionnaire online! Their reasons for not completing the online survey ranged from forgetfulness, internet connectivity issues to “other important inbox emails causing survey link reminders to move out of sight”!

In view of the poor online response, this group subsequently also received hard copies of the questionnaires. Surprisingly, these were completed and returned within a few days. On enquiry, the group indicated that the hardcopy had proved to be a visual reminder to complete the survey and did not require “going online”. With this in mind and also as a result of the lack of reliable email contact details of the majority of participants, all questionnaires and hence, the study data were issued and collected as hardcopies.

The results of the pilot study were excluded from the final data analysis. However, the valuable feedback provided by the pilot test was used to ensure maximum user-friendliness and accurate data capture in the final questionnaire which was used for mass dissemination.

3.9. Reliability

Reliability may be defined as the consistency of the performance of a measuring instrument (Welman et al., 2005: 145). This implies that the measuring tool (instrument) should provide similar results consistently. The researcher kept the research aims and objectives in mind during the development of the data collection tool template. After completion, the questionnaire was reviewed by the primary supervisor/co-supervisor for their input. Additional reliability testing was done by the researcher presenting the research proposal to the academia of the Durban University of Technology Department of Emergency Medical Care and Rescue.

3.10. Internal validity

Leedy and Ormrod (2005: 28) describe validity as the degree to which the research findings accurately represent what they intended to measure. The study design, data analysis and data interpretation processes all served to maximise the internal validity of the study.

3.11. External validity

Green (1977: 155–161) describes external validity as the “degree to which such results can be expected to recur in other places or at other times”. External validity may also be referred to as the study’s “generalisability”. In South Africa, all ALS training institutions have to comply with and are audited by the HPCSA in terms of curriculum/assessments for ALS provider students. This implies that the majority of ALS providers receive similar training across the provinces. As stated, a pilot study of the questionnaire was also undertaken to ensure validity, as these participants had characteristics similar to those of the target group.

Throughout both the internal and external validity developmental stages, the underlying purpose of the study, namely “assessing elements of preparedness” was constantly integrated to ensure that an unbiased and fair assessment of participant’s “emotional and mental preparedness” with regards to critical neonatal care could be solicited. In addition, all eligible

ALS providers in the Western Cape were included, thus avoiding any potential biases related to selection which may have compromised the study results.

3.12.1. Research process

The pilot study highlighted the poor return rate that had been achieved by using an established online survey website. In addition, human resource departments had inadequately updated email addresses for potential participants. Consequently, hard copies of the questionnaires were hand delivered to the operational bases where the ALS providers work (both government and private). Data collection boxes were placed at the operational bases, thus ensuring anonymity while an impartial individual (administration clerk) was requested to collect the completed questionnaires to avoid collusion. The researcher followed up weekly with the base managers in order to find out whether there were any copies in the boxes to be collected.

3.12.2. Information letters and consent forms

As stated in the pilot study, due to the poor response received via the electronic survey, the researcher opted to distribute hard copies of the questionnaire. These copies, together with information letters and consent forms were hand delivered to qualifying study participants at operational EMS bases. In order to avoid collusion, an impartial individual (administration clerk) was requested to hand deliver the hard copies of the questionnaires and to collect them from the collection boxes at the bases on a weekly basis.

3.12.3. Problems encountered with data collection

Most EMS organisations also had their own ethics committee to whom the researcher had to make presentations/submissions in order to obtain permission to approach their ALS staff. This tedious process led to additional delays before the data collection period could commence. The researcher reached an agreement with the majority of the EMS organisations to personally disseminate the study results to them, as well as to any participants who wished to receive a copy of the results.

3.13. Statistical analysis

Descriptive statistics were employed to describe the data which had collected and then analysed by the statistician, using the computer program SPSS version 24.0. Descriptive statistics in the form of frequency distributions, counts and percentages, as well as graphical techniques using pie and bar charts, were used to describe the data patterns. The inferential statistics techniques used included the Pearson's chi-square test (for nominal data) and correlations for ordinal relationships. Fisher's exact test would be used when the assumptions of the Chi-square test are violated rather than the test itself. Relationships between numerical and categorical data were obtained using an Eta score while reliability was determined using Cronbach's alpha.

3.14. Ethical approval

Ethical approval was obtained from the Durban University of Technology, Faculty of Health Sciences. Provisional approval to commence the pilot study (Appendix 1) was first obtained, followed by full approval to commence the main study (Appendix 2).

3.15. Ethical considerations

Ethical considerations include the right to autonomy and confidentiality, avoiding harm, fair treatment and seeking informed consent. In accordance with the recommendations of Brink (2009), the following ethical considerations were observed in the study:

- Respect for persons as autonomous individuals and protection of the participant's right to either participate or not participate in the study. This implies that participants should be presented with all relevant information, in a format they understand and should then voluntarily agree to participate. This was achieved in this study by creating a consent form (refer Appendix 7) which was attached to the front of the hard copies of the questionnaire. The participants would first read the consent form information, decide if they wanted to participate or not, then sign consent to participate in this study if they volunteered to do so.
- The right to confidentiality: There could have been a risk to the professional reputation of the participants, as well as the risk of participant identification based on the research data collected. However, these risks were mitigated by allocating participant numbers to

each responder. Any data containing areas of personal information such as date of birth, employment, registrations, training institutions or mention of specific patient incidents by the participants were restricted to the research investigators and were not for publication.

- Avoiding harm: No physical, psychological, emotional, social or financial harm was inflicted on any study participant.
- Right to fair treatment: The participants were aware that they had the right to withdraw from participating in the study at any time while all those who were eligible to participate were given a fair chance to do so.
- Informed consent: Each study participant was requested to sign a consent form which contained a full description of the purpose of the study, the data collection process and the intended use of the study.
- The study participants were made aware that participation was voluntary and that they would receive no compensation. Each completed questionnaire were allocated a numerical number to ensure confidentiality. A copy of the research results would be sent to the participants if they wished to receive feedback.

In addition, the identities of all the respondents were kept confidential throughout the data collection period, as a participant number was allocated to each respondent. The contact information of the primary researcher, study supervisor and co-supervisor was distributed to the participants to allow them the opportunity to seek additional information, if needed.

3.16. Conclusion

This chapter discussed the research design and methodology used in the study. The challenges encountered and recommendations made during the pilot study provided a valuable exercise in preparation for the main study. The data collection tool was “adjusted” to ensure that the study’s aims and objectives were addressed. The following chapter presents a comprehensive analysis of the study results and, where necessary, the descriptive narrative has been enhanced by the use of tables and graphs.

Chapter 4 – Results of the Primary Data

4.1. Introduction

This chapter presents the results and findings obtained from the questionnaires used in the study. The demographics and operational environment of the ALS providers in the Western Cape were also explored. The study findings were then considered and analysed to address the study objectives which referred to the ALS providers' neonatal knowledge and understanding; their technical neonatal skills/procedures performed; their neonatal training curriculum and whether qualifications and/or operational experience played a role in the preparedness of the ALS providers to clinically stabilise and provide continuum intensive care for critically ill neonates.

4.2. The sample

A total of 179 questionnaires were despatched and 145 (n) were returned, giving an 81% response rate. The participants were employed in both the public and private sectors.

4.3. Biographical data

Participants were requested to provide the following biographical data (Table 4.1):

- Age
- Current HPCSA ALS provider qualification
- Length of time (in years) that they have been registered as an ALS provider with the HPCSA.

Four of the participants did not provide their age and, therefore, in this respect there was complete data for 141 participants only. The average age and standard deviation were 36.4 ± 8.9 years, respectively. The mean age was 36 years old and the minimum age was 25.

Table 4.1 also presents the data reflecting the participants' current HPCSA ALS provider qualifications. These ranged from the previous short-course ALS provider training (Critical Care Assistant – CCA) to tertiary training (undergraduate – NDip EMC and BTech/BEMC

degree, leading to Emergency Care Practitioner – ECP HPCSA registration). The majority of the respondents were CCA (n = 84, 5%) qualified. The mean \pm standard deviation for the number of years registered as an ALS provider was 8.40 ± 7.2 years.

Table 4.1: Biographical data

Participant's age		
n	141	
Mean	36.4	
Std. Deviation	8.8	
Maximum	64	
Minimum	25	
Respondents' current HPCSA ALS provider qualification		
Qualification	Frequency	Percentage
CCA	84	58
NDip EMC	25	17
BTech EMC	35	24
BEMC	1	0.7
Total	145	100
Registration period with the HPCSA as ALS providers		
n	145	
Mean	8.4	
Std. Deviation	7.2	
Maximum	30	
Minimum	0.4	

4.4. Geographical data

The majority of the respondents (n = 98, 67.6%) were based in urban areas (Figure 4.1), compared to the minority (n = 18, 12.4%) who were based in rural districts. The remaining 20% (n = 29) of the respondents described their location as both rural and urban, thus meaning a central town surrounded by agricultural areas, which may or may not have had a primary and/or a secondary health care facility.

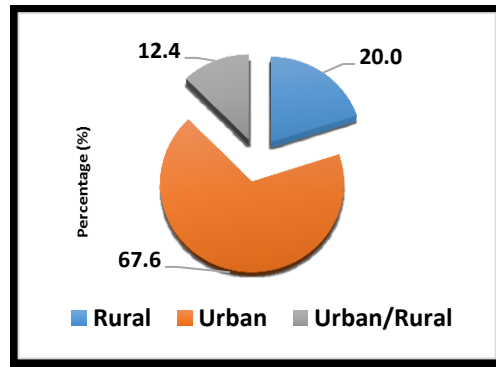


Figure 4.1: Geographical distribution of ALS providers in the Western Cape province

4.5. Demographic data

The following demographical data was supplied by the respondents (Table 4.2):

- EMS sector in which the respondents were employed in the Western Cape at the time of the study, as well as where they have been employed for the greater part of their ALS career
- Participants were asked to list their current function, based on their employment title, their transportation mode and the duty shifts they worked.

A total of 60.7% (n = 88) of the respondents were government employees while 14.5% (n = 21) were with a private EMS provider. A total of eight responses 5.5% (n = 8) were returned from ALS providers working in the aeromedical environment. The ALS providers employed by the Cape Town Municipality 2.1% (n = 3) have a dual function. They are both fire-fighters and ALS providers. Only one respondent (< 1%) was based at the University of Cape Town while 16.6% (n = 24) were based at both government and private EMS colleges. The majority of the respondents (n = 110, 75.9%) indicated that they had been employed in the government EMS sector for most of their careers. The private sector (n = 23, 15.9%) is the second largest employee of operational ALS providers. The “other” (0.7%) column refers to ALS providers who may have practised in other countries and returned to work in the Western Cape province.

A large group of the respondents (n = 73, 50.3%) described themselves as priority emergency responders. The aero-medical ALS providers (n = 6, 4.1%), inter-hospital ICU ALS providers

(n = 5, 3.4%) and those ALS providers working as both primary response ALS providers and as inter-hospital ICU ALS providers (n = 5, 3.4%) were the participants who would be the most likely to transport critically ill neonates on a regular basis (total n = 16, 10.9%).

The study found that the most widely used transport mode was the primary response vehicles (n = 57, 39.3%), followed by ALS provider ambulances (n = 52, 35.9%). A small group of ALS providers (less than 10% in total) worked on either neonatal intensive care (NICU) ambulances (n = 6, 4.1%) or NICU ambulance and primary response vehicles (n = 5, 3.4%). The aeromedical environment used both rotor and fixed wing modes of transportation. A similar minority of ALS providers (also less than 10% in total) worked in this environment, namely:

- Both rotor and fixed wing (n = 6, 4.1%)
- Primary response vehicle and rotor wing (n = 3, 2.1%)
- Rotor wing (n = 2, 1.4%)
- Fixed wing (n = 1, 0.7%)

With regard to the duty shifts, the majority of the participants indicated that they were primary response ALS providers. The ALS duty shifts are mainly day/night shifts (n = 93, 64.1%), as medical and trauma emergencies occur during both the day and at night. On the whole, the ALS providers, who worked as managers, lecturers and in clinical quality improvement, worked office hours (n = 39, 26.9%). However, a few of the primary response ALS providers (n = 12, 8.3%) worked day shifts only as a result of the greater call volumes during the day than at night.

Table 4.2: Demographical data

Current EMS employment sector		
	Frequency	Percent
Aero-med	8	5.5
College	24	16.5
Government	88	60.7
Municipality	3	2.1
Private	21	14.5
University	1	0.7
Total	145	100
EMS sector employed for the greater part of their ALS career		
Aero-med	6	4.1
College	2	1.4
Government	110	75.9
Municipality	3	2.0
Other	1	0.7
Private	23	15.9
Total	145	100
Current employment title		
Primary response paramedic	73	50.3
Manager	25	17.3
Lecturer	20	13.9
Aero-medical paramedic	6	4.1
Rescue paramedic	6	4.1
Inter-hospital ICU paramedic	5	3.4
Primary response paramedic and interhospital ICU paramedic	5	3.4
Senior fire fighter	3	2.1
Clinical quality improvement	2	1.4
Total	145	100
Current transportation mode for performing ALS duties		
Primary response vehicle	57	39.3
Paramedic ambulance	52	35.9
Service vehicle	11	7.6
Both rotor and fixed wing	6	4.1
NICU ambulance	6	4.1
NICU ambulance and primary response vehicle	5	3.4
Primary response vehicle and rotor wing	3	2.1
Rotor wing	2	1.4
Fixed wing	1	0.7
Other	2	1.4
Total	145	100
Duty shifts		
Day shift only	12	8.3
Day/ Night shift	93	64.1
Office hours	39	26.9
Other	1	0.7
Total	145	100

4.6. Objective 1: Exploring ALS provider's neonatal knowledge and understanding

The following results relate to the ALS providers' neonatal knowledge and understanding with regard to their initial neonatal critical care training.

4.6.1. ALS provider's neonatal curriculum

The ALS provider's neonatal curriculum consists of both theory and practicum phases (in-hospital and pre-hospital). Almost a third of the participants ($n = 45$, 31%) indicated that they felt that their initial ALS training, with regard to the neonatal curriculum, had been sufficient preparation for managing critically ill neonates (Table 4.3). However, an almost similar percentage ($n = 38$, 26.2%) believed that their neonatal curriculum had been inadequate. On the other hand, an almost equal number had chosen the extremes of the Likert scale, namely, "Excellent" and "Extremely inadequate", describing their initial neonatal curriculum as excellent ($n = 11$, 7.6%) versus extremely inadequate ($n = 10$, 6.9%), respectively.

The participants were also asked to indicate whether they believed their initial ALS neonatal practicum phase (in-hospital and pre-hospital) had provided adequate practical exposure to prepare them for managing critically ill neonates. In this instance, 38.6% ($n = 56$) indicated that their in-hospital and pre-hospital clinical practical blocks had provided inadequate practical exposure, while the second largest group indicated that their practical exposure had been adequate ($n = 37$, 25.5%). Smaller groups described their practical exposure as either extremely inadequate ($n = 9$, 6.2%) or excellent ($n = 8$, 5.5%).

When asked about their combined ALS neonatal theory hours and practical hours, 43.4% ($n = 63$) expressed the opinion that it had been inadequate to prepare them to deal with critically ill neonates. On the other hand, 23.4% ($n = 34$) only felt adequately prepared, while the third largest group ($n = 25$, 17.2%) were neutral/undecided. In addition, 2.8% ($n = 4$), only were of the opinion that their combined neonatal training (theory and practical hours) had been excellent preparation to deal with critically ill neonates, while 3.4% ($n = 5$) felt their initial neonatal training had proved to be extremely inadequate.

Table 4.3: Initial ALS neonatal training curriculum, practicum phase (in-hospital and pre-hospital), as well as ALS neonatal theory and practicum (combined)

Initial ALS training: neonatal curriculum		
	n	Percent
Adequate	45	31
Inadequate	38	26.2
Neutral/ Undecided	23	15.9
Fair	18	12.4
Excellent	11	7.6
Extremely inadequate	10	6.9
Total	145	100
Initial neonatal practicum phase (in-hospital and pre-hospital)		
Inadequate	56	38.6
Adequate	37	25.6
Neutral/ Undecided	19	13.1
Fair	16	11
Extremely inadequate	9	6.2
Excellent	8	5.5
Total	145	100
Total class hours and practical hours devoted to neonatal critical care		
Inadequate	63	43.5
Adequate	34	23.4
Neutral/ Undecided	25	17.2
Fair	14	9.7
Extremely inadequate	5	3.4
Excellent	4	2.8
Total	145	100

4.6.2. ALS provider's Continuing Professional Development (CPD)

After their initial training, ALS providers are encouraged and also required by law (HPCSA CPD Guidelines, 2011) to improve and maintain their clinical skills. However, Continuing Professional Development (CPD) activities include online workshops, attending conferences and/or clinical updates/courses, which may cover a multitude of topics. The ALS providers were asked if they had completed any additional training, specifically pertaining to the neonates/paediatrics post qualification. Certified ALS training courses have been developed for these populations, specifically the Neonatal Advanced Life Support (NALS) and the Paediatric Advanced Life Support (PALS) courses. However, as shown in Figure 4.2 below,

11% (n = 16) only had completed both the NALS and PALS courses while the majority (n = 74, 51%) had received no additional training pertaining specifically to neonates/paediatrics. In addition, 27.6% (n = 40) had completed the PALS course compared to 6.2% (n = 9) who had completed the NALS course.

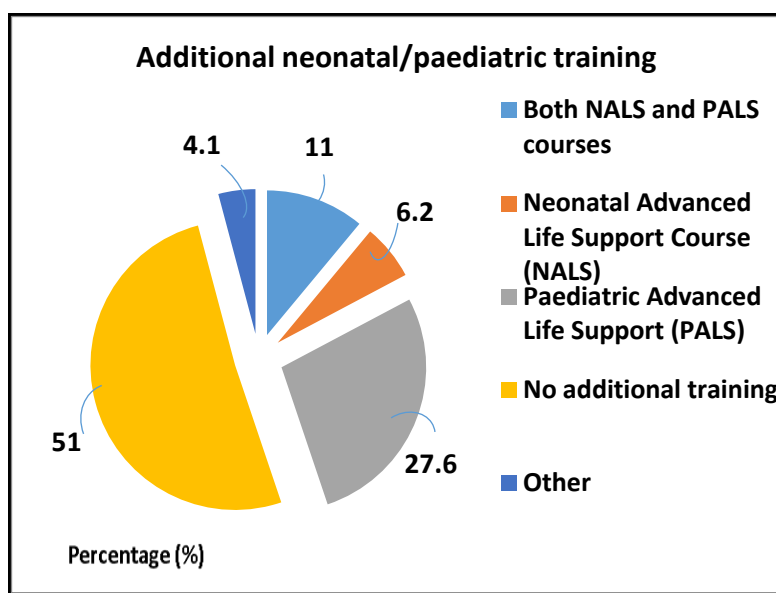


Figure 4.2: Additional neonatal/paediatric training post ALS provider qualification

4.6.3. In-service neonatal operational intensive care readiness training

The respondents were asked whether they had undergone in-service neonatal operational intensive care readiness training to complement their initial training, as some may not have been practising prior to securing employment. The results showed that 47.6% (n = 69) of the participants had not received any in-service neonatal operational readiness training (Table 4.4). The second largest group (n = 36, 24.8%) indicated they had received training of one month, followed by 12.4% (n = 18) who had undergone in-house training for three months. Smaller numbers indicated two months (n = 4, 2.8%) and six months (n = 7, 4.8%) respectively. It was interesting to note that 7.6% (n = 11) indicated that they had received in-service neonatal operational intensive care readiness training for “one year or more”.

Subsequently, they were asked whether they would have liked to have undergone in-service neonatal intensive care operational readiness training and how long they felt this period should have been. A group of 34.5% (n = 50) indicated that a three-month period would have been ideal, with 24.1% (n = 35) citing one month and 25.5% (n = 37) citing six months. The final groups expressed two opposing opinions, with 10.3% (n = 15) requesting training of “one year or more” versus the 4.1% (n = 6) who felt that in-service neonatal intensive care operational readiness training was not necessary.

Table 4.4: In-service ALS neonatal operational intensive care readiness training received and the desired intensive care readiness training period

In-service neonatal operational intensive care readiness training period		
	n	Percent
No in-service ops training	69	47.6
one month	36	24.8
three months	18	12.4
one year/ more	11	7.6
six months	7	4.8
two months	4	2.8
Total	145	100
Ideal in-service neonatal intensive care “operational readiness” training period		
three months	50	34.5
six months	37	25.5
one month	35	24.1
one year or more	15	10.4
in-service "ops readiness" training is not necessary	6	4.1
nine months	2	1.4
Total	145	100

4.7. Objective 2: Determine the most frequent technical neonatal skills/procedures performed by ALS providers

In view of the fact that the majority of these neonatal ALS skills would have been performed during the management of critically ill neonates, the frequency of managing such neonates on the part ALS providers was first explored (prevalence).

4.7.1. Frequency managing critically ill neonates

The ALS providers were asked how often, during the course of carrying out their normal duties, they clinically managed these critically ill neonates (Figure 4.3). A small group (n = 5, 3.4%) indicated that they were exposed to managing critically ill neonates on a daily basis (these are ALS providers working on NICU ambulances). However, 22.1% (n = 32) evidently dealt with critically ill neonates once in three months, followed by 18.6% (n = 27) who dealt with them once a month. A smaller group indicated that they dealt with them once a week (n = 21, 14.5%), while 4.1% (n = 6) indicated three to ten times a week. The general lack of neonatal exposure became apparent as the clinical exposure ranged from once in six months (n = 17, 11.7%) and nine months (n = 8, 5.5%) to once a year (n = 19, 13.1%). A group of 6.9% (n = 6) indicated that they had never managed critically ill neonates.

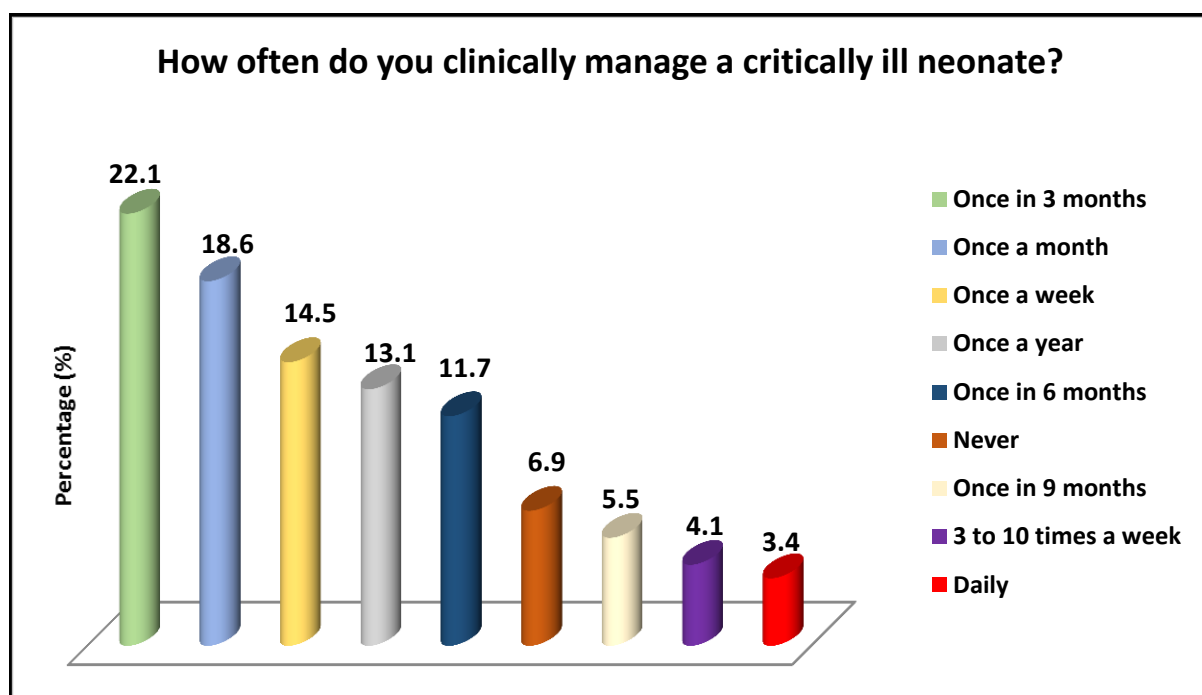


Figure 4.3: Frequency when ALS providers clinically manage a critically ill neonate

4.7.2. Most common neonatal diagnosis

It was also necessary to enquire about the actual neonatal diagnosis as it was felt this would provide an indication of the type of illness/disorders to which critically ill neonates are exposed, and also the technical neonatal skills/procedures that would be relevant. Table 4.5 below

indicates the most common neonatal diagnosis and identified by the ALS providers as the main reason why critically ill neonates are conveyed by EMS. Respiratory complications (NRDS – 76.6%) were recorded as the most frequent reason why EMS transports critically ill neonates, followed by dehydration and diarrhoea (37.2%), pre-term (36.6%) and sepsis (18.6%). Congenital abnormality (13.1%) and birth asphyxia (9%) featured as the least prominent reasons why critically ill neonates are conveyed by EMS.

Less common diseases which were highlighted included:

- Hyaline membrane disease (4.1%)
- Hypoxic-ischaemic encephalopathy (4.1%)
- Meconium aspiration syndrome (4.1%)
- Necrotising entero-collitis (0.7%)

Additional reasons why ALS providers conveyed critically ill neonates included for the purpose of scans, investigations and surgery, as well as the upgrading of an ambulance to a higher level of care. Two participants (1.4%) felt that they had not had enough exposure to indicate a specific diagnosis and, therefore, they indicated “unknown”.

Table 4.5: The most common diagnostic reason why critically ill neonates are conveyed by EMS

The most common diagnostic reason critically ill neonates are conveyed by EMS	n	%
Neonatal Respiratory Distress Syndrome (NRDS)	111	76.6
Dehydration and Diarrhoea	59	40.6
Preterm	53	36.6
Sepsis	27	18.6
Congenital abnormality	19	13.1
Birth asphyxia	13	9.0
Preterm and NRDS	6	4.1
Hypoxic-ischaemic encephalopathy	2	1.4
Meconium aspiration syndrome (MAS)	2	1.4
For scans, Investigations and surgery	2	1.4
Necrotizing Entero- Colitis	1	0.7
Upgrade ambulance to higher level of care	1	0.7
Not enough exposure –unknown	2	1.4
Nothing noted	1	0.7
(Multiple responses were allowed)		

4.7.3. Most frequent ALS technical neonatal skills/procedures

The respondents were then asked to indicate the most frequent technical neonatal skills/procedures they had performed. In view of the fact that respiratory complaints (NRDS – Table 4.6) were recorded as the most common diagnostic reason for the referral of critically ill neonates, it was not surprising that these neonates have to be placed on ventilators and then transported by EMS. Accordingly, the use of neonatal ventilators was recorded as the most frequent technical neonatal skill (n = 101, 69.7%) used by the ALS providers (Table 4.6). The second most frequent ALS skill used was neonatal peripheral intravenous (IV) access (n = 85, 58.6%). It is interesting to note that this corresponded with the second most common diagnostic reason why critically ill neonates are conveyed by EMS, namely, dehydration and diarrhoea. These conditions require a practitioner to institute IV therapy in order to replace the fluids lost. The next two neonatal ALS skills cited which had similar frequency performance rates included:

- Neonatal BVMR (n = 81, 55.9%)
- Neonatal infusion (n = 76, 52.4%)

The critical ALS skills of neonatal intubation (n = 62, 42.8%) and neonatal CPR (n = 49, 33.8%) reflected the lack of opportunity afforded to use these skills frequently in the pre-hospital environment. For the majority of ventilated inter-facility transfers, the neonate would already have been intubated in hospital. Intra-osseous cannulation and umbilical vein cannulation (both n = 10, 16.6%), are performed when peripheral IV access has been unsuccessful. The study found that neonatal CPAP (continuous positive airway pressure ventilation) and neonatal infusion were the skills that were performed the least often (both n = 1, 0.7%).

Table 4.6: The most frequent technical neonatal skills/procedures performed by ALS providers (from high to low frequency)

Neonatal technical ALS skills	n	%
Neonatal ventilator	101	69.7
Neonatal peripheral IV access	85	58.6
Neonatal BVMR	81	55.9
Neonatal infusion	76	52.4
Neonatal intubation	62	42.8
Neonatal CPR	49	33.8
Intra-osseous cannulation	24	16.6
Umbilical vein cannulation	24	16.6
Neonatal CPAP (continuous positive airway pressure ventilation)	1	0.7
Neonatal infusion	1	0.7
Not working with neonates	1	0.7
Nothing noted	1	0.7
(Multiple responses were allowed)		

4.7.4. ALS neonatal technical skill set

The respondents were asked whether they believed that the above-mentioned ALS neonatal technical skills were adequate to manage critically ill neonates (Table 4.7). A large group (n = 58, 40%) indicated that they felt that their ALS skills were adequate to manage critically ill neonates while 18.6% (n = 27) indicated “fair” or “neutral/undecided”. Other groups selected inadequate (n = 10, 6.9%) to extremely inadequate (n = 2, 1.4%), while 14.5% (n = 21) only felt “well-prepared”. In order to further gauge their confidence level, they were asked to respond to the following statement: “I feel confident and well-prepared to accept the further management of a critically ill neonate handed over by a neonatologist or other neonatal ICU trained nursing staff”. A large group (n = 48, 33.1%) felt “adequately” prepared, the second largest (n = 27, 18.6%) group indicated “fair” while similar groups indicated “well-prepared” (n = 26, 17.9%) and “neutral/undecided” (n = 24, 16.6%).

Table 4.7: ALS providers' confidence levels as regards their neonatal technical skills and to accept the further management of a critically ill neonate

ALS neonatal skills: sufficient to manage critically ill neonates?		
	n	%
Adequate	58	40
Fair	27	18.6
Neutral/Undecided	27	18.6
Well-prepared	21	14.5
Inadequate	10	6.9
Extremely inadequate	2	1.4
Total	145	100
"I feel confident to accept the further management of a critically ill neonate"		
	n	%
Adequate	48	33.1
Fair	35	24.1
Well-prepared	26	17.9
Neutral/Undecided	24	16.6
Inadequate	11	7.6
Extremely inadequate	1	0.7
Total	145	100

4.8. Objective 3: Whether qualifications and operational experience play a role in the preparedness of ALS providers to clinically stabilise and to provide intensive care to neonates

4.8.1. Health Professions Council of South Africa (HPCSA)

Before an ALS provider may practise, he/she must register with the Health Professions Council of South Africa (HPCSA). "Registration with the HPCSA is a pre-requisite for professional practice and it is also a legal requirement to keep all personal details up to date at all times" (HPCSA, 2016). This means that they only start gaining autonomous experience treating patients once they have been registered to practice (Table 4.8). The group who had been practising from one to two years ($n = 28$, comprising of 0.7%, 11.7% and 6.9%

respectively) can be described as relatively “new” graduates. On the other hand, smaller groups had been practising for five (n = 12, 8.3%) and eight (n = 10, 6.9%) years, respectively.

Table 4.8: Represents the length of time (in years and/or months) Western Cape ALS providers have been registered with the HPCSA

Period of HPCSA registration	n	%
5 months	1	0.7
1 year	17	11.7
2 years	10	6.9
3 years	15	10.3
4 years	17	11.7
5 years	12	8.3
6 years	6	4.1
7 years	9	6.2
8 years	10	6.9
9 years	1	0.7
10 years	6	4.1
11 years	1	0.7
12 years	3	2.1
13 years	1	0.7
14 years	3	2.1
15 years	5	3.4
16 years	3	2.1
17 years	2	1.4
18 years	4	2.8
19 years	1	0.7
20 years	6	4.1
21 years	5	3.4
24 years	3	2.1
25 years	1	0.7
28 years	1	0.7
30 years	2	1.4
Total	145	100
Mean 8.4 years	Standard Deviation	= 7.2 years

4.8.2. ALS provider's confidence level pertaining to neonatal clinical exposure

To further gauge whether qualification and operational experience played a role in the preparedness of ALS providers, they were asked what their personal reactions were to the following statement and to reply to the subsequent question: “As a newly qualified ALS provider, the first neonatal resuscitation/NICU transfer would naturally have been stressful. Do you believe that you acquired confidence as you gained more neonatal clinical experience or are you still apprehensive when called upon to manage critically ill neonates?” A group of 30.3% (n = 44) indicated “adequate”, 15.2% (n = 22) felt “well-prepared” while 20% (n = 29) still felt “apprehensive” (Figure 4.4).

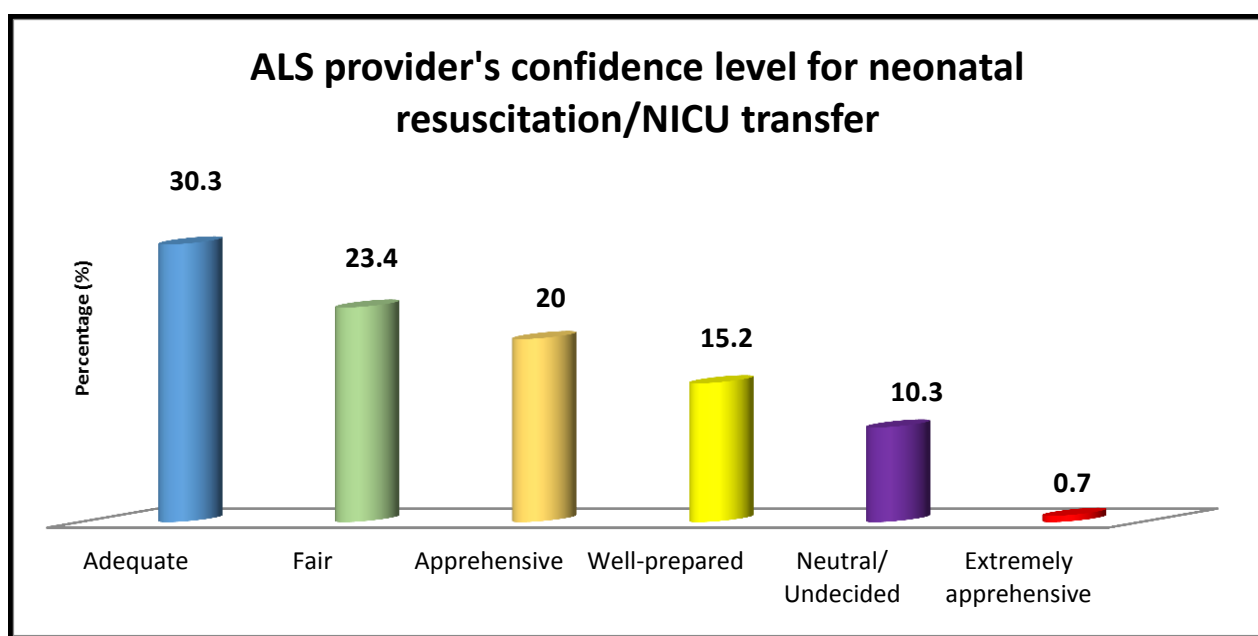


Figure 4.4: Confidence level of ALS providers as regards neonatal resuscitation/NICU transfers

4.8.3. Period of mentorship by a neonatologist

ALS providers either take over the care from or hand over critically ill neonates to neonatologists in NICU during inter-facility transfers. The participants were asked whether they felt a period of mentorship by a neonatologist in a NICU was necessary to acquaint them with the nuances/finer details of intensive neonatal care (Figure 4.5). The two larger groups of

either 44.8% (n = 64) “strongly agreed” or 42.7% (n = 62) “agree” that a period of mentorship by neonatologists was needed, while 9.6% (n = 14) were “neutral/undecided”. Smaller groups disagreed (n = 3, 2%) and strongly disagreed (n = 1, 0.7%).

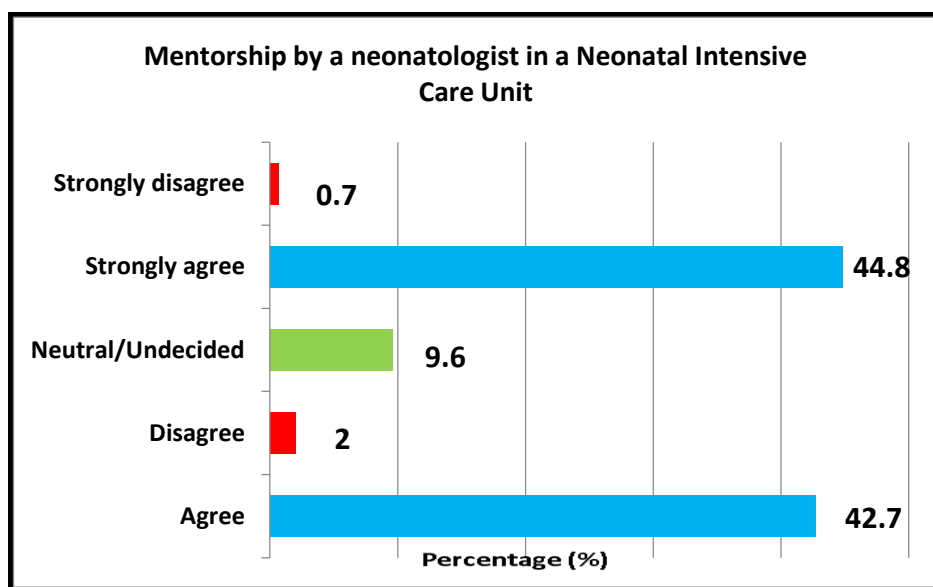


Figure 4.5: Mentorship by a neonatologist in a NICU

4.8.4. Ideal time period to learn the nuances of intensive neonatal care

The participants were also asked to indicate the ideal time period they felt would be sufficient to learn the nuances of intensive neonatal care under the mentorship of a neonatologist (Table 4.9). The majority felt that the mentorship period should be either three (n = 54, 37.2%) to six months (n = 55, 37.9%), while one group (n = 15, 10.3%) recommended that the mentorship period should be “one year or more”.

Table 4.9: Time period of the mentorship by a neonatologist to learn the nuances of intensive neonatal care

Ideal neonatologist mentorship period		
	n	%
6 months	55	37.9
3 months	54	37.2
1 month	21	14.5
1 year/ more	15	10.4
Total	145	100

4.9. Objective 4: Exploring the preparedness of ALS providers to clinically stabilise and to provide intensive care to neonates

Multiple factors play a role in the preparedness of ALS providers to clinically manage critically ill neonates. The following questions related to the essential specialised equipment that ALS providers require in order to safely perform an ICU neonatal inter-facility transfer.

4.9.1. Neonatal specialised equipment

The respondents were asked whether they had the necessary neonatal specialised equipment at their disposal. The functionality and cleanliness of this equipment were also explored (Table 4.10). A group of 26.2% (n = 38) “disagreed” or “strongly disagreed” (n = 29, 20%), thus indicating they appeared to lack the necessary equipment. The second largest group responded “agree” (n = 45, 31%), while only 9.7% (n = 14) indicated “strongly agree”.

In addition, they were asked to indicate if they agreed with the following statement pertaining to the “need” to have specialised equipment in order to care for the “unstable” neonate: “During the patient journey of critically ill neonates, they mostly remain ventilatorily/haemodynamically stable and only require monitoring”. Larger groups indicated that they “agree” (n = 61, 42.1%) or “strongly agree” (n = 66, 45.5%) with the statement. However, a total of 9.7% (n = 14), were undecided, while 2.1% (n = 3) chose “disagree” and 0.7% (n = 1) “strongly disagree”, thus indicating that they were of the opinion that critically ill neonates did not remain ventilatory/haemodynamically stable and required more than just monitoring.

Table 4.10: Availability of specialised neonatal ALS equipment and the perceptions of ALS providers regarding the “stable” critically ill neonate

Sufficient equipment to treat and monitor critically ill neonates		
	n	%
Agree	45	31
Disagree	38	26.2
Neutral/Undecided	19	13.1
Strongly agree	14	9.7
Total	145	100
Perceptions of ALS providers regarding the “stable” critically ill neonate		
	n	%
Strongly agree	66	45.5
Agree	61	42.1
Neutral/Undecided	14	9.6
Disagree	3	2.1
Total	145	100

4.9.2. Neonatal transport incubator

The respondents were asked whether the neonatal transport incubator at their base was in working order, warmed to the correct temperature and ready for use. In addition, the respondents were also asked to describe the general hygiene of their incubators and whether cleaning detergents were available to clean their incubators after every transfer.

Safety nets are used inside the transport incubator to secure the neonate and prevent detrimental/unwanted movement. The respondents were thus asked if safety nets were available when they carried out NICU inter-facility neonatal transfers. All of the factors cited here contribute to the ALS provider’s level of preparedness.

A similar number reported that their transport incubators were either in an “adequate working condition” (n = 30, 20.7%) or in “excellent working condition” (n = 32, 22.1%), while 22.8% (n = 33) reported their incubators to be in “fair working condition” (Table 4.11). Of concern was the finding that a total of 14.5% (n = 21) cited “extremely poor working condition (n = 11, 7.6%) or “inadequate working condition” (n = 10, 6.9%), thus indicating that their neonatal incubators

were not up to standard with the subsequent negative implications of this for critically ill neonates. In addition, 12.4% (n = 18) were also neutral/undecided which may have implied that they had, at times, experienced difficulty in sourcing a properly functioning transport incubator.

Regarding the cleanliness of the incubator, some indicated that their incubators were “clean to satisfaction” (n = 46, 31.7%), while 17.2% (n = 25) indicated “excellent cleanliness”. However, groups also reported that their incubators were “inadequately cleaned” (n = 18, 12.4%) and “extremely unhygienic condition” (n = 6, 4.1%). This would imply a lack of cleanliness with regard to their incubators. Another group (n = 40, 27.6%) were “neutral/undecided”.

With regard to the availability of cleaning detergents, the majority (n = 56, 38.6%) indicated that cleaning detergents were always available although a similar group (n = 36, 31.7%) indicated that cleaning detergents were only available sometimes, while 5.5% (n = 8) indicated that cleaning detergents were never available.

Finally, in relation to safety nets, the respondents were asked whether or not neonates were secured by a safety net in the incubator, as well as whether their monitoring equipment, neonatal ventilator, and so on were secured to the stretcher so that there was no risk of equipment damage or injury to the neonate during the patient journey. Although 20% (n = 29) indicated that both the neonate and equipment were secured, a similar group indicated “inadequately secured” (n = 38, 26.2%), while 9.7% (n = 14) indicated that neither the neonate nor equipment were secured.

Table 4.11: Neonatal transport incubator working order, hygiene, availability of cleaning detergents and safety nets

Neonatal incubator in working order and ready to use		
	n	%
Fair working condition	33	22.8
Excellent working condition	32	22.1
Adequate working condition	30	20.6
Neutral/Undecided	18	12.4
Extremely poor working condition	11	7.6
No incubator	11	7.6
Inadequate working condition	10	6.9
Total	145	100
Neonatal incubator clean or unhygienic		
	n	%
Clean to satisfaction	46	31.7
Neutral/Undecided	40	27.6
Excellent cleanliness	25	17.3
Inadequately cleaned	18	12.4
No incubator	10	6.9
Extremely unhygienic condition	6	4.1
Total	145	100
Cleaning detergents available to clean incubator after use		
	n	%
Cleaning detergents are always available	56	38.6
Cleaning detergents are only available sometimes	46	31.7
Neutral/Undecided	30	20.7
Cleaning detergents never available	8	5.5
No incubator	5	3.5
Total	145	100
Safety net in the incubator and equipment secured		
	n	%
Inadequately secured	38	26.2
Adequately secured	34	23.4
Both the neonate and equipment is secured	29	20
Neutral/Undecided	24	16.6
Neither the neonate/equipment is secured	14	9.7
No incubator	6	4.1
Total	145	100

4.10. Analysis of scoring patterns

This section contains an analysis of the scoring patterns of the respondents per cross-tabulation. The results are then further analysed according to the importance of the statements.

4.10.1. Q 2 vs Q 12

This cross-tabulation (Table 4.12: Q 2 vs Q 12) explored whether there was a relationship between the ALS provider's level of preparedness to deal with critically ill neonates and the number of years for which the respondents had been registered to practise as ALS providers. Since one of the variables is a number, the mean period of time per option was determined.

Table 4.12: Cross-tabulation Q2 vs Q 12

Do you believe that the time (total class hours and practical hours) devoted to the neonatal curriculum and practicum phase was adequate to prepare you to deal with critically ill neonates?	How long (in years) have you been registered as an ALS provider with the HPCSA?
Extremely inadequate	3.8
Inadequate	8.2
Neutral/Undecided	6.7
Adequate	9.7
Fair	6.5
Excellent	22
Total	8.4

The study found that the longer the period of HPCSA registration, the better the rating given by the respondents with regard to their training to manage critically ill neonates, and is supported by the Eta score (0.3) displayed below (Table 4.13). The Eta score is a measure of association between a categorical variable and a numerical variable with a high value implying a significant impact by one variable on the other.

Table 4.13: Eta score for Q2 vs Q12

Directional Measures			Value
Nominal Interval	by Eta	How long (in years and/or months) have you been registered as a paramedic/ECP with the HPCSA? Dependent	0.3

In this instance, the level of preparedness of ALS providers to deal with critically ill neonates is moderately impacted upon by the number of years for which they have been registered as ALS providers. This finding also highlights the need for improved mentorship programmes to guide the newly qualified, but inexperienced, ALS providers.

4.10.2. Q 4 vs Q 16

This cross-tabulation (Table 4.14: Q 4 vs Q 16) explored whether if there was a relationship between the frequency with which the ALS providers manage critically ill neonates and the EMS sector in which they work. For example, the government EMS sector is highlighted, which compares the total critical neonatal transfers performed for different time periods as indicated by the respondents.

Table 4.14: Cross-tabulation Q 4 vs Q 16

			In which EMS sector are you currently employed in the Western Cape?						Total
			Government	Private	University	College	Aero-Med	Municipality	
How often, during the course of performing your normal duties do you clinically manage a critically ill neonate?	3 to 10 times a week	Count	4	1	0	1	0	0	6
		% within In which EMS sector are you currently employed in the Western Cape?	4.5%	4.8%	0.0%	4.2%	0.0%	0.0%	4.1%
	Daily	Count	5	0	0	0	0	0	5
		% within In which EMS sector are you currently employed in the Western Cape?	5.7%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%
	Never	Count	7	1	0	2	0	0	10
		% within In which EMS sector are you currently employed in the Western Cape?	8.0%	4.8%	0.0%	8.3%	0.0%	0.0%	6.9%
	Once a month	Count	21	3	0	1	0	2	27
		% within In which EMS sector are you currently employed in the Western Cape?	23.9%	14.3%	0.0%	4.2%	0.0%	66.7%	18.6%
	Once a week	Count	12	0	0	4	5	0	21
		% within In which EMS sector are you currently employed in the Western Cape?	13.6%	0.0%	0.0%	16.7%	62.5%	0.0%	14.5%
	Once a year	Count	9	4	1	3	2	0	19
		% within In which EMS sector are you currently employed in the Western Cape?	10.2%	19.0%	100.0%	12.5%	25.0%	0.0%	13.1%
	Once in 3 months	Count	17	6	0	7	1	1	32
		% within In which EMS sector are you currently employed in the Western Cape?	19.3%	28.6%	0.0%	29.2%	12.5%	33.3%	22.1%
	Once in 6 months	Count	7	5	0	5	0	0	17
		% within In which EMS sector are you currently employed in the Western Cape?	8.0%	23.8%	0.0%	20.8%	0.0%	0.0%	11.7%
	Once in 9 months	Count	6	1	0	1	0	0	8
		% within In which EMS sector are you currently employed in the Western Cape?	6.8%	4.8%	0.0%	4.2%	0.0%	0.0%	5.5%
	Total	Count	88	21	1	24	8	3	145
		% within In which EMS sector are you currently employed in the Western Cape?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The Fisher's exact test (0.1) indicated that there was no significant relationship between the frequency with which the ALS providers managed critically ill neonates and the EMS sector in which they worked because statistically there was no significant difference by column percentages.

4.11. Conclusions of the data analysis

The results demonstrated that the ALS providers generally appeared to lack exposure to managing critically ill neonates and, consequently, they reported varying levels of preparedness to clinically stabilise and provide continuum intensive care for critically ill neonates. Significant areas of concern were highlighted, such as a lack of exposure to neonatal training/skill and the lack of specialised neonatal equipment. The following chapter contains an in-depth discussion of the study results.

Chapter 5 - Discussion

5.1. Introduction

This chapter presents a detailed discussion of the study results.

5.2.1. Biographical data

This study recruited a total of 145 (n) respondents who were ALS providers and who had undergone college and higher education ALS provider training. A small group of 5% (n = 7) had undergone a combination of both methods of ALS provider training. In other words, they had completed the Critical Care Assistant (CCA) course and then progressed to tertiary training, namely, NDip EMC and BTECH/BEMC. The mean and standard deviation of the number of years registered as an ALS provider was 8.40 ± 7.21 years. This large standard deviation was due mainly to the range (maximum – minimum) of values observed with the lowest number of years of registration being 0.42 (5 months) and the longest period of registration being 30 years. This was a useful statistic as it indicated that a fair proportion of the respondents had been employed in the field for a reasonably long period of time, thus indicating that the responses would be provided by informed (experienced) sources. This “older” cohort of participants may reflect the research findings echoed by Govender, P., 2010. He reported that “the younger ALS paramedics between the ages of 21 – 30 years were more likely to migrate. Accommodation, flights, and visas for global placements are all taken care of, this together with the multitude of global vacancies for ALS paramedics mean that ALS paramedics are not concerned with the decision to migrate, but rather the decision of when to migrate.

5.2.2. Geographical and demographical data

The majority of EMS calls occur in urban settings (WCG - CAD, 2016). This was reflected in the fact that the majority of the respondents (n = 98, 67.6%) were based in urban areas compared to the minority (n = 18, 12.4%) which were based in rural districts. The remaining 20% (n = 29) of the respondents described their location as both rural/urban, thus meaning that there was a central town, surrounded by agricultural areas.

The majority of the respondents (n = 88, 60.7%) were government employees while 14.5% (n = 21) were employed by a private EMS provider. Accordingly, the study explored the operational workload of the government EMS. The government EMS Computer Assisted Dispatch system (CAD, 2016) provided the following statistics for the Western Cape Department of Health. During the period from December 2014 to December 2015, there was a total of 970 (n) inter-facility neonatal transfers of which 83% (n = 805) occurred in the urban areas (City of Cape Town), while the other 17% (n = 165) occurred throughout the five other regions in the Western Cape province.

The ALS respondents employed by the Cape Town Municipality (n = 3, 2.1%) indicated they have a dual function as they are qualified fire fighters and also emergency responders. Routinely, they do not participate in inter-facility transfers and thus they do not carry out NICU inter-facility transfers. However, they may be called upon to provide emergency treatment if a maternity patient is in labour and delivers a neonate with complications. One respondent (< 1%) only was based at the University of Cape Town, while 16.6% (n = 24) were based at both government and private EMS colleges. Both government training institutions and private EMS colleges employ primarily lecturers who have worked as ALS providers in the pre-hospital environment.

A total of eight responses (n = 8, 5.5%) were received from ALS providers working in the aeromedical environment. Statistics obtained from the Red Cross Air Mercy Service indicated a total of 240 (n) neonatal transfers for the period December 2014 to November 2015 for both rotor and fix wing aircraft (South African Red Cross Air Mercy Service, 2016). These ALS providers reported that they did have the necessary specialised neonatal equipment. However, regarding their initial neonatal training, a range of responses was received with one indicating “excellent”, four indicating “adequate” and three indicating “inadequate”. The majority mentioned that they transported a critically ill neonate at least “once a week” while the majority also indicated a high level of preparedness and confidence in terms of safely resuscitating and transporting critically ill neonates.

The aero-medical environment offers numerous benefits compared to the benefits offered by road transport. McLaughlin (2002) cited greater speed while Butler, Anwar and Willet (2010) mentioned the benefit of retrieving patients by air transport from remote locations and taking

them to specialist centres for definitive care. However, a recent study by Muhlbauer (2015) concluded that it is extremely costly to operate in the EMS aviation environment. The study cited numerous factors which should be considered before this essential service is used. These included the incident location, authorisation criteria and the risk versus benefit as it was found that, after having been transported by air, a number of patients died 24 to 72 hours later. Ohning (2012) compared the advantages and disadvantages of air versus road transportation of the critically ill neonate (Table 5.1).

Table 5.1: Comparison of various modes of transport utilised for critically ill neonates (Ohning, 2012)

	Ground Ambulance	Rotor-wing Aircraft	Fixed-wing Aircraft
Departure times	Excellent	Excellent	Poor to fair
Arrival times	Fair to poor	Excellent	Good
Out-of-hospital time	Poor	Excellent	Fair to excellent
Patient accessibility	Good	Poor	Fair
Weather issues	Excellent	Poor	Fair to good
Cost	Low	High	High

The fact that neonatal intensive care ambulances (NICU) are in short supply was reflected by the low number of ALS providers (n = 5, 3.4%) working on these ambulances. This would suggest a lack of exposure to the management and care of critically ill neonates on the part of the majority of the respondents.

5.3. ALS provider's neonatal knowledge and understanding

Croskerry, Cosby, Schenkel and Wears (2009) describe competence as achieving and, importantly, maintaining an acceptable level of knowledge and skill. As stated this study did not directly assess knowledge and understanding, however the data presented here relate to indirect markers that may influence knowledge and understanding.

A group of 43.4% (n = 63) indicated that the combined neonatal theory hours and practical hours during their training had been inadequate to prepare them to deal with critically ill neonates. The study found that 23.4% (n = 34) only felt adequately prepared, while the third largest group (n = 25, 17.2%) were neutral/undecided. A possible reason for this finding may be that respondents were seldom called upon to manage critically ill neonates and, therefore, they were unsure whether their neonatal curriculum had been sufficient preparation to manage such cases. The study also found that 2.8% (n = 4) only were of the opinion that their combined neonatal training (theory and practical hours) had provided excellent preparation to deal with critically ill neonates, while 3.4% (n = 5) felt their initial neonatal training had proved to be extremely inadequate.

International studies have explored some of the factors affecting the training of ALS provider students. In Australia (Monash University), a qualitative study by McCall, Wray and Lord (2009) conducted focus group discussions with undergraduate students from the bachelor degree programme on emergency health. These undergraduate students stated that they “were not allowed to practice advanced life support skills and felt that operational ALS emergency care providers cast them as observers rather than active participators, which impacted negatively on clinical learning”.

A PhD study by Devenish (2014), which included ALS providers in Australia and the United Kingdom, highlighted the marginalisation and stigmatisation which students often face during university clinical placements, as well as during the transition phase to the on-road environment after graduating. He concluded that “the professional socialisation process for many of the participants was a challenging and, at times, difficult experience”.

Similar sentiments were echoed in a study conducted in South Africa by Moodley (2016). He found that “the clinical practice learning objectives for paramedic students were not adequately achieved and paramedic graduates felt ill prepared for independent practice”. Furthermore, his findings highlighted shortcomings in the EMS training curriculum (both theory and practicum). He concluded that “although the public EMS providers may be able to meet the mandate of early access to emergency care, the quality of that care will remain questionable”.

A possible reason for the inconsistent scores given to the clinical practicum by some of the respondents in this study (n = 8, 5.5% – excellent preparation to deal with critically ill neonates versus n = 84, 38.6% – initial neonatal training extremely inadequate) may possibly be explained by the fact that not all clinical shifts are able to guarantee the same practical exposure. For example, an ALS provider student may work a clinical shift in a maternity unit (MOU) where six healthy neonates are born with intervention being required. On another occasion, a different ALS provider student may work in the same MOU where ten neonates are born with five of them being born prematurely and requiring urgent intervention to save their lives, thus allowing the second student valuable supervised clinical exposure.

It is for this reason that EMS training uses high-fidelity simulation training for the assessment of the ALS provider's field performance and cognitive competency, as it is possible to simulate the same medical emergency multiple times, thus exposing each learner to the same critical outcomes. Simulation is thus an effective means for assessing both domains of competency simultaneously (Studnek, Fernandez, Shimberg, Garifo & Correll, 2011). Currently, high-fidelity simulation already plays an important role in the patient assessment examinations of ALS providers although paediatric and adult high-fidelity simulations feature more prominently during clinical simulation practice, while specialised high-fidelity simulation and assessment for neonatal training is less common.

The profession of emergency care is overseen by the Professional Board for Emergency Care (PBEC). ALS provider training institutions therefore have to apply and be accredited as Education and training providers by the PBEC beforehand. Accreditation Form 169 states that "In order to meet the criterion, the following is required at minimum:

Learning outcomes, curriculum, teaching and learning methods, modes of delivery, learning materials and expected completion time cater for the learning needs of its target student intake" (HPCSA, 2013). Although a training institution may exceed the minimum criteria as set out by the PBEC, this may not be a guarantee for academic excellence. Students may have various barriers which can negatively impact individual learning in class, leading some to excel and others to either drop out or perform poorly. Some of these barriers may include:

- socio-economic inequalities (example students unable to afford study fees and prescribed textbooks)
- lack of basic services (example no electricity to study at night)

- lack of transportation (example dependent on an unreliable train service, leading to either coming late to class or being “locked” out)
- language and communication (example for many learners, English is not their first language or mother tongue, however it is the primary teaching medium)

It is therefore important to not only quality assure the ALS training programme, but also to determine to what degree effective learning has occurred.

Training for ALS providers is designed in such a way that the theory taught in class may be implemented during clinical practical components. In other words, “learning by doing” is intended to promote the acquisition of new skills. This provides the basis for the rationale that there is an observed positive correlation between volume and outcome. The mantra is that “more acquired experience improves performance” (Luft, Hunt & Maerkiet, 1987). As regards their combined ALS neonatal theory hours and practical hours (curriculum), a greater majority of the respondents (n = 63, 43.4%) felt it had been inadequate to prepare them to deal with critically ill neonates. This implies that the ALS provider neonatal curriculum at the time of the study was characterised by shortcomings and needed to be revised.

Another traditional training model for nursing and medical education promotes the principle of “see one, do one, teach one”. This model combines theory, didactic teaching and observation of experienced colleagues at the bedsides of patients. This is followed by the clinical performance of technical procedures on actual patients (Yaeger et al., 2004). However, in interpreting the study data, there appeared to be a lack of neonatal practical exposure (“do one”) during the ALS provider training. A solution would be to increase the shifts required during the neonatal practicum, both on NICU ambulances and in NICU. However, achievable objectives should be in place, depending on the workload of the unit, to ensure that there is valuable engagement and interaction and thus not wasteful hours spent in ICU, only observing. The ideal would be a period of mentorship under an experienced ALS provider and a neonatologist.

It is accepted practice that a new employee requires a period of in-service induction to orientate him/her to the new workplace (Griffith, 2009). In addition, in the case of newly qualified ALS providers, they may not have been practising in the weeks/months prior to their

securing employment. Induction training for all new personnel may encourage an attitude of personal dedication to the service of people and the organisation and is meant to supplement any initial training the new personnel may have had (Halim & Ali, 1988).

A period of in-service operational training, especially when dealing with critically ill neonates when additional specialised equipment is utilised, is highly encouraged in EMS. However, the results from this study revealed that a group (n = 69, 47.6%) of the respondents had not received any in-service neonatal operational readiness training. This group may thus have been at a disadvantage in terms of their operational preparedness to treat critically ill neonates as, for example, the specialised equipment on which they trained may differ from that in their “new” environment.

The respondents were asked whether a period of mentorship under a neonatologist in an NICU was necessary to convey the nuances/finer details of intensive neonatal care as this could increase both their knowledge and understanding. A large group (n = 60, 87.5%) agreed that a period of mentorship under neonatologists is needed.

5.4. Technical neonatal skills/procedures performed by ALS providers

The study found that a small group of respondents (n = 5, 3.4%) had been exposed to managing critically ill neonates on a daily basis. These were mainly the ALS providers working on NICU ambulances. However, it emerged that 22.1% (n = 32) of the respondents dealt with critically ill neonates only once in three months, followed by 18.6% (n = 27) at once a month. A smaller group indicated once a week (n = 21, 14.5%), while 4.1% (n = 6) indicated three to ten times a week. The general lack of neonatal exposure became apparent as clinical exposure when managing critically ill neonates ranged from once in six months (n = 17, 11.7%), once in nine months (n = 8, 5.5%) to once a year (n = 19, 13.1%). A group of 6.9% (n = 10) indicated that they had never managed critically ill neonates.

Furthermore, during the same period (December 2014 to December 2015), the Western Cape Provincial EMS responded to a total of 232 262 incidents. This highlights the fact that the total number of inter-facility neonatal transfers (n = 970) amounted to only 0.42% of the total cases attended to by EMS. According to Perez et al. (2013), health care workers may fail to retain

specialised knowledge and skills if they use such knowledge and skills infrequently in practice. Thus, the infrequency which ALS providers clinically manage critically ill neonates may possibly impact negatively on their level of confidence and technical neonatal skill performance when they are eventually called upon to resuscitate a sick neonate.

Respiratory complications (NRDS – n = 111, 76.6%) were recorded as the most frequent reason why ALS providers transport critically ill neonates. Neonatal respiratory distress syndrome (NRDS) occurs in neonates when their lungs are not sufficiently mature to produce surfactant – a substance that coats the inside of the air sacs and allows the air sacs of the lungs to remain open. Lung compliance is decreased, thereby increasing the work of breathing (Kendig & Nawab, 2016). Accordingly, it was not surprising that the use of neonatal ventilators was recorded as the most frequent technical neonatal skill (n = 101, 69.7%) performed by ALS providers.

The lack of frequency of employing the critical ALS skills of neonatal intubation (n = 62, 42.8%) and neonatal CPR (n = 49, 33.8%) cited reflected the lack of opportunity to use such skills frequently in the pre-hospital environment. According to Walla, Leea and Niermeyerc (2009), approximately 2% of all neonates who do not breathe at birth will require advanced resuscitation (i.e. chest compressions, intubation or medications). Furthermore, neonates who require advanced resuscitation may not survive without ongoing ventilation and neonatal intensive care. Thus, for most ventilated inter-facility transfers, the neonate will already have been intubated in-hospital.

The study found that 14.5% (n = 21) of the respondents only felt “well-prepared” and indicated that their neonatal technical skills were adequate to manage critically ill neonates. Although all ALS provider training should be comparable, this low percentage may indicate that this is not the case.

Before ALS provider may practise, they have to register with the Health Professions Council of South Africa (HPCSA). “Registration with the HPCSA is a pre-requisite for professional practice and it is also a legal requirement to keep all personal details up to date at all times” (HPCSA, 2016a). This means that ALS providers only start gaining autonomous experience

treating patients when they have been registered to practise. The registration periods of the respondents ranged from 30 years to five months, thus implying that ALS providers are exposed to different curricula during their initial training.

The implication of ALS providers not updating the knowledge they were taught five, ten, fifteen, twenty years ago may be extremely serious if they are not abreast of the latest technical developments in neonatal critical care. As stated, an adverse patient incident refers to an event or circumstance that leads to unintended harm or injury to, suffering or illness of, a patient. According to the World Health Organization (2008), compelling evidence exists which identifies inadequate training as an “important component of unsafe care. Although estimates of the size of the problem are imprecise, it is likely that millions of people suffer disabling injuries or death directly attributable to medical care.” Indeed, a large group of the respondents had been practicing for between ten and thirty years ($n = 37$, 32.4%). This may have negative implications for their clinical practice if they have not kept up to date with evidence-based medicine. Evidence-based medicine may be defined as “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients” (Sackett, 1997).

5.5. Preparedness of ALS providers to clinically stabilise and provide intensive care to neonates

Only 9.7% ($n = 14$) of the respondents indicated “strongly agree” when asked whether they had at their disposal the necessary specialised monitoring equipment and the condition of such equipment in terms of functionality and cleanliness. In their randomised controlled trial for the out-of-hospital paediatric transport environment Stroud, Prodhan, Moss, Fiser, Schexnayder and Anand (2011) found that improved monitoring during inter-facility transfers may actually contribute to improved outcomes for critically ill children. It is therefore disquieting that such a small group of respondents in this study felt they did have the necessary specialised equipment to safely resuscitate and clinically manage critically ill neonates. This implies that the other ALS providers had only certain specialised equipment or even no equipment, thus possibly placing critically ill neonates at risk, as monitoring or the performance of technical procedures may be compromised due to a lack of equipment.

In addition, large groups of the respondents felt that critically ill neonates remained ventilatory/haemodynamically stable and required monitoring only. As stated previously, due to respiratory complications, neonates are frequently stabilized by placing them on ventilators in hospital, before a decision is made to transfer. Therefore, the ventilated neonate may present relatively stable during the inter-facility transfer. Neonates who are clinically unstable, for example those delivered prematurely at a Maternity Outpatients Unit (MOU), which is normally situated on the premises of a clinic in the Western Cape province, may require additional interventions, which requires more skill and competencies than just monitoring. The response from the majority of participants in this regard may be explained by the fact that they would not necessarily be send to these MOU's, but rather the NICU ambulances or aero-medical transportation crews (if the neonate is in a rural area), who have the necessary incubator and specialized equipment at their disposal.

A study by King, Foster, Woodward and McCans (2001) found that of 295 neonatal transfers, 19.8% of the neonates required intubation compared to 7.5% of infants and 4.9% of children. In addition, they noted that airway-related complications in neonates were common. It is for this reason that Whyte and Jefferies (2015) recommend that transport teams be equipped with the necessary specialised neonatal equipment and the supplies required to provide intensive care during inter-facility transport.

The neonatal transport incubator is an essential piece of specialised equipment in which critically ill neonates are placed during inter-facility transfers. The pre-hospital environments in which EMS operates may be exposed to cold weather extremes and thus pose a threat to the survival of small, premature neonates. The respondents were asked whether the neonatal transport incubators at their respective bases were in working order, warmed to the correct temperature and ready to use. A total of 14.5% (n = 11 – “extremely poor working condition” and n = 10 – “inadequate working condition”) indicated that their neonatal incubators were not up to standard. In addition, 12.4% (n = 18) were “neutral/undecided”, which may have implied that they had, at times, experienced difficulty in sourcing a properly functioning transport incubator.

According to Décima et al. (2012), the transport incubator is meant to provide an optimal thermal environment. It is thus vital, not only for the neonate's survival and growth, but also for the stability of various physiological functions that it is in optimal working order. Russo et al.

(2013) pointed out that even moderate hypothermia ($< 36^{\circ}\text{C}$), which is common in premature neonates, is associated with increased mortality and morbidity.

The American Heart Association (AHA, 2015) Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care highlight that the temperature of a non-asphyxiated neonate should be maintained between 36°C – 37.5°C after birth until stabilisation. However, 22.1% only of the respondents cited “excellent working condition” in respect of their neonatal incubators.

The hygiene of the neonatal incubator was also explored. This is extremely important as critically ill neonates may also have compromised immune systems. Neonatal sepsis is a recognised cause of neonatal mortality (Kim, Brousseau & Konduri, 2008). Globally, neonatal infections cause an estimated 36% of neonatal deaths. However, in countries with very high neonatal mortality rates (> 45 per 1000 live births), neonatal infections are the main cause of death in almost 40% to 50% of cases (Darmstadt, Zaidi & Stoll, 2011).

Of the respondents, 17.2% ($n = 25$) only indicated “excellent cleanliness”. A total of 31.7% ($n = 46$) indicated that cleaning detergents were available only sometimes to clean the incubator after use. This may thus imply that, at times, the respondents received and used an unhygienic incubator. This finding raises concerns about possible cross-contamination, especially in the small confines of a neonatal transport incubator in which it is vital that a critically ill neonate needs to be protected from microbial exposure. A KwaZulu-Natal study provided evidence of a wide variety of microbial contamination of ambulances, including a high level of potentially pathogenic species (Naguran, 2008).

In addition, safety nets should be used inside the incubator as this offers protection by securing the neonate to the mattress (Ohning, 2012). During the inter-facility transfer, if the ambulance comes to an abrupt stop (emergency stop), the resultant kinetic force would propel the neonate to move rapidly inside the incubator, possibly causing compression injuries, depending on the specific body part which impacts the “side-wall” of the incubator. Likewise, in the aero-medical environment, turbulence could also have the same effect for an unrestrained neonate in-flight. Any external or internal attachments/ monitoring devices used on the neonate may become dislodged, increasing the risk of adverse events. The use of safety nets will decrease these risks. In addition, the specialised equipment accompanying the neonate

must be secured to prevent injury to the neonate, as well as damage to the equipment should it fall.

Regarding safety nets and additional strapping or securing brackets to secure the specialised equipment which accompanies the neonate, 20% (n = 29) only of the respondents indicated that both the neonate and equipment were secured. During inter-facility transfers (by road or flight) neonates are exposed to various physiological stressors, such as vibration, noise, temperature, humidity, altitude (in-flight), as well as acceleration and gravitational forces.

Thus, every effort should be made to mitigate these risks and to strive to maintain the continuum of NICU care (Divya & Shalini, 2014). In addition, as reported earlier, there appeared to be a shortage of available specialised neonatal equipment, so every effort should be made to prevent damage to the existing operational equipment by securing it adequately.

5.6. Limitations of the study

The limitations of the study included the following:

1. The sample consisted of 145 ALS providers working in both the private and the government EMS sectors in the Western Cape province. The majority were employed in the government sector. It would thus have been statistically beneficial to have included additional rural private EMS and fire department personnel. This would also have resulted in a larger sample size.
2. Although the data was collected from both urban and rural districts, time constraints and collection logistics meant that a number of questionnaires were either “lost” or else the ALS providers for whom the questionnaires were intended for were on leave/off for the day, and thus they missed the research collection “deadline”.
3. The often out-dated and unverified email addresses of respondents which their human resource departments (HRD) provided, as well as a lack of reliable internet access in rural areas, also constituted a limitation as it was not possible to send electronic questionnaires.
4. The main limitation of this study was time. The study was conducted over a specific time period and therefore the research results were a snapshot which was dependent on the conditions prevailing at the time of the data collection.

5. Finally, the interpretation of some of the descriptions used in the Likert scale of the questionnaire may have been understood differently by participants (example “adequate”). This limitation may have affected the validity and reliability of certain questions.

5.7. Conclusion

The study highlighted numerous shortcomings. Training or the lack thereof in both neonatal theory and practicum featured prominently, as did the lack of specialised equipment to safely manage and transport critically ill neonates in the majority of the Western Cape province ALS providers who participated in the study.

The final chapter concludes the study and contains the researcher’s recommendations in respect of the improved preparedness of all Western Cape ALS providers to provide clinical stabilisation and intensive care for neonates during the patient journey.

Chapter 6 - Conclusions and recommendations

6.1. Conclusions

The Western Cape EMS will also soon have a specialised paediatric retrieval team, including a neonatal transfer team (SPRINTT) – a project which is supported by the Children’s Hospital Trust (Red Cross Children’s Hospital). The aim is to ensure the safe and effective emergency transport of critically ill babies and children under the age of thirteen. However, only a select few ALS providers will form part of this team (Haupt, 2016). Similarly, ER24, a private EMS organisation, has established a division known as Critical Care Retrieval Services (CCRS). “Units are staffed by ALS providers with advanced critical care training and international certification” (Priority one ER24, 2016). The aim of this study, however, was to provide a descriptive analysis of the preparedness of all Western Cape ALS providers to ensure the clinical stabilisation of and intensive care for neonates during the patient journey. Accordingly, the study explored elements before, during and after the inter-facility transfer of critically ill neonates by ALS providers.

The study participants highlighted perceived deficiencies in ALS provider training. As a result of these deficiencies the management and intensive care of neonates may be compromised. This was supported by the fact that the study found that many of the respondents felt ill prepared. The findings also suggest that a knowledge gap exists and that this translates to a lack of confidence on the part of the ALS providers when they are faced with a critically ill neonate. In addition, their lack of exposure to treating critically ill neonates as part of their daily routine is a matter of concern.

The disease profiles of these neonates, as well as the type of technical neonatal skills/procedures undertaken by ALS providers when managing these neonates, were explored. The technical neonatal skills set of ALS providers was found to be adequate despite the finding that the ALS providers were called upon to use these skills and procedures fairly infrequently. This raises concerns that knowledge and skill attrition might occur more rapidly, which could have disastrous consequences.

The findings also highlighted the lack of specialised neonatal equipment in the pre-hospital environment. This would directly affect the mental and emotional preparedness of the ALS providers to deliver optimum neonatal critical care, as well as creating additional anxiety during

the actual patient journey. The risk of cross-infection when using the limited available equipment was also explored with the findings suggesting that there should be increased efforts to encourage improved hygiene practices and an awareness of the risks of inadequate hygiene practices.

The findings relating to the qualifications and operational exposure of the ALS providers showed that these factors play a major role in preparing them for the “real” world. In order to progress from “novice” to “expert”, the newly qualified ALS provider requires both mentorship and coaching. It is not possible to learn critical decision-making skills from a textbook as this requires diligent nurturing together with the appropriate experience over a period of time.

6.2. Recommendations

The major recommendations arising from the results of this study include the following:

6.2.1. Training and development

At the time of the study, neonatal intensive care was focused on only during the exit year (fourth year of studies during the BEMC degree). This leaves limited time for ALS students to assimilate the required knowledge and skills and to gain confidence. Accordingly, a shift is recommended with an equal amount of time being spent on neonates, toddlers, teenagers and adult critical care/management.

The recommendation is therefore that the ALS provider neonatal training curriculum starts in the first year of studies and progresses during each consecutive year, leading up to a “neonatal intensive critical care module” in the final year. The researcher is proposing that the same amount of cognitive and psychomotor foundational knowledge focused on treating adults and pediatrics, be afforded to neonates. Currently neonatal training can be perceived as an “add on” and not a mayor priority. First year students are taught more about “rescue” than the basic anatomy/management of neonates. They will be able to handle the “jaws of life”, but might not know how to pick up a neonate safely from bed! As suggested, first year students (some of whom may not have smaller siblings – meaning they are the only child, with limited neonatal/infant family contact), should be encouraged to inculcate the “notion of care” for neonates. Hopefully in this way, by “early” exposure, greater empathy and improved

“preparedness” will be attained, as the “anxiety” of handling a fragile neonate will be reduced, especially when their third/fourth years of study will focus on the “crashing” critically ill neonate.

In addition, there is an urgent need in South Africa to standardise all ALS provider neonatal training programmes – both the theory and the practicum components. As referred to in this study, currently EMS is at a cross-road where the short-course ALS provider training will be phased out. The HPCSA Education Board has promulgated new Clinical Practice Guidelines (CPGs), with new curricula which will be offered by Universities. It is hoped that with the closure of the varied education and training programmes for ALS providers (example CCA, Ndip EMC and BTech EMC), a new era of standardisation and curriculum alignment will emerge which should incorporate the principle of evidence – based medicine. According to Wraga (1999), standardisation and curriculum alignment can be defined as “a method of educational quality control where the process of teaching and learning is predetermined, pre-paced, and pre-structured.” The aim is to achieve internal consistency between educational purposes, activities and assessments for a particular qualification. Special emphasis should also be placed on the transfer process and the subsequent potential detrimental implications for the critically ill neonate in the prehospital environment. The ideal would be the establishment of a mentorship programme, supervised by neonatologists.

During training there should be greater emphasis on the frequently used technical neonatal skills/procedures as highlighted in the study results, as well as greater emphasis on the disease profile (anatomy, physiology and pathology) of the neonates which ALS providers transport on a regular basis.

The study results also highlighted that qualifications and operational experience play an important role in the preparedness of ALS providers to clinically stabilise and to provide intensive care to neonates. It is, therefore, recommended that all “new” ALS providers are placed on a structured mentorship programme, under the supervision of experienced ALS providers (on either NICU ambulances or in the aero-medical environment) and preferably with ALS providers who have additional “neonatal critical care certification”. Only once there has been sufficient exposure and the “new” recruits have acquired enough confidence, may they be allowed to advance to independently manage NICU transfers.

Additional training is required to improve the current ALS providers' level of preparedness in terms of neonatal theory and practical exposure. The recommendation is, therefore, for greater inter-disciplinary training opportunities, for example EMS attending lectures, group discussions and mortality and morbidity (M and M) meetings in NICU, and possibly including a practical demonstration. Additional neonatal short-course/refresher training is also needed, possibly by designing Continued Professional Development (CPD) accredited activities.

6.2.2. Neonatal specialized critical care equipment

The introduction of improved neonatal ICU training manikins, specialised equipment and a skills laboratory (simulating the NICU environment) at EMS training institutions would greatly benefit student ALS providers. Difficult simulated scenarios may be reproduced effortlessly in a safe learning environment.

In order to improve patient safety, the procurement of sufficient specialised neonatal intensive care equipment and disposables, especially for the rural ALS providers, should be prioritised. The manufacturers of medical equipment have realised that specialised critical care equipment which caters for all age groups are extremely beneficial in the pre-hospital environment. Thus, the ideal would be to procure such equipment in order to limit costs.

6.2.3. Quality Assurance

It is recommended that all EMS cases in which critically ill neonates were transported by ALS providers be identified and filed separately in a Prehospital Neonatal Critical Care Database. Ideally, this database should include pre-arrival care, care during the transfer and post transfer care in-hospital in order to assess if the continuum of care occurred. Any shortcomings which occurred during the patient journey may then be positively addressed.

6.2.4. ALS provider neonatology sub-speciality

The medical fraternity may view us as “a jack of all trades”. These are some of our roles:

- A nurse, recording vital signs and stopping the bleeding
- A mid-wife, delivering babies in shopping malls
- A cardiologist, alleviating cardiac chest pain and stopping lethal arrhythmia
- An anesthetist, by sedating, relaxing (paralysis) and providing analgesia before/after the procedure, when for example performing pre-hospital intubation (Rapid Sequence Induction - RSI), including placing the patient on a ventilator
- An orthopedic surgeon, stabilizing, splinting and applying traction to fractured extremities
- A clinical psychologist, consoling a child whose parents have just passed away in a car accident or providing counselling to a patient who has attempted a parasuicide.
- A medical practitioner, administering life-saving medication during resuscitation
- A forensic pathologist, securing the crime scene and keeping evidence safe

However, we are mostly viewed by the general public as ambulance drivers (“masters of none”). The last recommendation, namely, the creation of an ALS neonatology sub-speciality, is, therefore, not only in the interests of the EMS but also in the interests of improved neonatal care. However, this would require additional training and certification. The, certification would also compel ALS providers to stay abreast of the latest developments and skills. The creation of an ALS neonatology sub-speciality would be congruent with other medical professions, like nursing, where, world-wide, a number of nursing sub-specialities has been created (Lippincott Nursing Center, 2017).

6.2.5. Conclusion

EMS is a relatively “new” profession compared to the established professions such as nursing and medicine. EMS is often not regarded as part of an inter-disciplinary hospital team as it is based outside of hospitals. Nevertheless, EMS is expected to serve as an ICU, delivering the same care outside of an in-hospital ICU. Greater cooperation and support in terms of training from in-hospital staff are therefore vital. It is not easy in the present environment (crime, high call volume, physical/verbal abuse, etc.) to serve in the EMS profession. However, by so doing EMS practitioners have proven their dedication to unselfishly serving others. Caring for the most vulnerable of society (fragile neonates) is a noble cause as they may be the leaders of tomorrow! The researcher is reminded of the story of the little boy who was throwing washed up starfish back into the ocean. A man walked by and said "You can't possibly save them all, there are thousands on this beach. You can't possibly make a difference". The boy looked

down and then bent down to pick up another starfish, smiling as he threw it back into the sea. He replied, "I made a huge difference to that one!" (Author unknown). The researcher sincerely hopes that the findings of this study will provide some insight into the daily difficulties which EMS experiences by trying to deliver optimum care and that the findings will be instrumental in changing perceptions and improving pre-hospital neonatal critical care.

References

- Al-Anazi, A.F. 2012. Pediatric emergency medical services and their drawbacks. *Journal of Emergency Trauma Shock* (online), 5(3). Available: [http://www.ncbi.nlm.nih.gov/pubmed/2440887/](http://www.ncbi.nlm.nih.gov/pubmed/2440887) (Accessed 3 March 2014).
- Aldous, C., Rheeder, P. & Esterhuizen, T. 2011. *Writing your first clinical research protocol*. Cape Town: Juta.
- American Academy of Pediatrics (AAP). 2015. Healthy life. Available: <https://www.healthychildren.org/English/family-life/health-management/pediatric-specialists/Pages/What-is-a-Neonatologist.aspx> (Accessed 15 May 2016).
- American Heart Association (AHA). 2015. *Guidelines for cardiopulmonary resuscitation and emergency cardiovascular care, Part 13: Neonatal resuscitation*. Available: <https://eccguidelines.heart.org/index.php/circulation/cpr-ecc-guidelines-2/part-13-neonatal-resuscitation/> (Accessed 3 March 2016).
- American Heart Association (AHA). 2015. *Advanced Cardiovascular Life Support (ACLS) 2015 Guidelines ACLS Course*. Available: http://cpr.heart.org/AHA/ECC/CPRAndECC/Training/HealthcareProfessional/AdvancedCardiovascularLifeSupportACLS/UCM_473186_Advanced-Cardiovascular-Life-Support-ACLS.jsp (Accessed 27 May 2017).
- Ashokcoomar, P. 2013. An analysis of inter-healthcare facility transfer of neonates within the eThekweni health district of KwaZulu-Natal (online). MTech, Durban University of Technology. Available: <http://ir.dut.ac.za/handle/10321/809>: 66 (Accessed 19 April 2014).
- Babl, F.E., Vinci, R.J., Bauchner, H. & Mottley, L. 2001. Pediatric pre-hospital advanced life support care in an urban setting. *Pediatric Emergency Care* (online), 17(1): 5–9. Available: http://journals.lww.com/pec-online/Abstract/2001/02000/Pediatric_pre_hospital_advanced_life_support_care.2.aspx (Accessed 19 April 2014).
- Baker, G.R., Norton, P.G., Flintoft, V., Blais, R., Brown, A., Cox, J., et al. 2004. The Canadian Adverse Events Study: the incidence of adverse events among hospital patients

in Canada. CMAJ May 25, 2004 170:1678-1686. Available: <http://www.cmaj.ca/content/170/11/1678.full> (Accessed 11 May 2016).

Baleta, A. 2011. South Africa takes steps to reduce perinatal mortality. *Lancet* (online), 377(9774): 1303–1304. Available: [http://dx.doi.org/10.1016/S0140-6736\(11\)60523-0](http://dx.doi.org/10.1016/S0140-6736(11)60523-0) (Accessed 17 July 2014).

Benner, P.E. 2013. *Current nursing, from novice to expert*. Available: http://currentnursing.com/nursing_theory/Patricia_Benner_From_Novice_to_Expert.html (Accessed 1 March 2015).

Blecher, M., Kollipara, A., De Jager, P. & Zulu, N. 2011. *Health financing: South African Health Review*. Durban: Health Systems Trust. Available: <http://www.hst.org.za/publications/south-african-health-review-2011> (Accessed 21 November 2015).

Bomont, R.K. & Cheema, I.U. 2006. Use of nasal continuous positive airway pressure during neonatal transfers. *Archives of Disease in Childhood. Fetal and Neonatal Edition* (online), 91(2). Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2672687/> (Accessed 13 May 2016).

Brink, H. 2009. *Fundamentals of research methodology for health care professionals*, 2nd ed. Cape Town: Juta.

Britto, J., Nadel, S., Maconochie, I, Levin, M. & Habibi, P. 1995. Morbidity and severity of illness during interhospital transfer: impact of a specialised paediatric retrieval team. *BMJ* (online), 311(7009): 836-839. Available: <http://www.bmj.com/content/311/7009/836#ref-20> (Accessed 3 March 2014).

Butler, D.P., Anwar, I. & Willett, K. 2010. Is it the H or the EMS in HEMS that has an impact on trauma patient mortality? A systematic review of the evidence. *Emergency Medicine Journal* (online), 27(9): 692–701.

Cardiocare. 2017. *Neonatal Life Support Course*. Available: <http://www.cardiocare.co.za/Courses-Overview/ANLS-Course/> (Accessed 28 May 2017).

Cape Peninsula University of Technology (CPUT). 2014. Bachelor of Emergency Medical Care. Available: <http://www.cput.ac.za/academic/faculties/healthwellness/prospectus/>

course?i=375&seo=QkVNQyBCYWNoZWxvciBvZiBFbWVyZ2VuY3kgTWVkaWNhbCBDYXJl (Accessed 17 July 2014).

Croskerry, P., Cosby, K.S., Schenkel, S.M. & Wears, R.L. 2009. *Patient safety in emergency medicine*. Philadelphia: Wolters Kluwer, p. 243.

Cullinan, K., Heath Systems Trust, 2017, *Hospitals in crisis*. Available: <http://www.hst.org.za/news/hospitals-crisis> (Accessed 26 May 2017).

Darmstadt, G.L., Zaidi, A.K.M. & Stoll, B.J. 2011. *Neonatal infections: A global perspective in infectious diseases of the fetus and newborn infant*. Elsevier. Available: <http://www.sciencedirect.com/science/article/pii/B978141606400800002X> (Accessed 7 March 2016).

Decelle, L., Thys, F., Zech, F. & Verschuren, F. 2013. Ventilation-associated pneumonia after intubation in the prehospital or the emergency unit. *Eur J Emerg Med.*, 20(1). Available: <http://www.ncbi.nlm.nih.gov/pubmed/22198160> (Accessed 11 July 2016).

Décima, P., Stéphan-Blanchard, E., Pelletier, A., Ghyselen, L., Delanaud, S., Dégrugilliers, L., et al. 2012. Assessment of radiant temperature in a closed incubator. *European Journal of Applied Physiology* (online), 112(8): 2957–2968. Available: <http://www.ncbi.nlm.nih.gov.dutlib.dut.ac.za/pmc/articles/PMC3395352/> (Accessed 27 May 2016).

Department of Health. 2014. *Strategic Plan, 2014/15–2018/19*. Available: <https://www.health-e.org.za/wp-content/uploads/2014/08/SA-DoH-Strategic-Plan-2014-to-2019.pdf> (Accessed 15 November 2015).

Department of Health. 2016. *Integrated Plan for reducing mortality in mothers, newborns and under-fives in South Africa*. Available: <http://www.health.gov.za/index.php/2014-03-17-09-09-38/strategic-documents/category/266-2016-str> (Accessed 25 July 2016).

Devenish, A.S. 2014. Experiences in becoming a paramedic: A qualitative study examining the professional socialisation of university qualified paramedics. Available: http://eprints.qut.edu.au/78442/1/Anthony_Devenish_Thesis.pdf (Accessed 7 July 2016).

De Vries, S., Wallis, L.A. & Maritz, D. 2011. A retrospective evaluation of the impact of a dedicated obstetric and neonatal transport service on transport times within an urban

setting. *International Journal of Emergency Medicine* (online). Available: <http://www.ncbi.nlm.nih.gov/pubmed/2611248/> (Accessed 9 July 2015).

Divya, S. & Shalini, S. 2014. When place and time matter: How to conduct safe inter-hospital transfer of patients. *Saudi Journal of Anaesthesia* (online), 8(1): 104–113. Available: <http://www.ncbi.nlm.nih.gov/pubmed/250432/> (Accessed 15 May 2016).

Dorrington, R.E., Bradshaw, D., Laubscher, R. & Nannan, N. 2015. *Rapid mortality surveillance report 2014*. Cape Town: South African Medical Research Council. Available: <http://www.mrc.ac.za/bod/RapidMortalitySurveillanceReport2014.pdf> (Accessed 29 June 2016).

Droogh, J.M., Smit, M., Absalom, A.R., Ligtenberg, J.J. & Zijlstra, J.G. 2015. Transferring the critically ill patient: Are we there yet? *Critical Care*, 19(1). Available: <http://www.ncbi.nlm.nih.gov/pubmed/255540/> (Accessed 05 August 2016).

eNews Channel Africa (eNCA), 2016. *Ambulance crew attacked and robbed, Western Cape, South Africa*. Available: <https://www.enca.com/south-africa/ambulance-crew-attacked-and-robbed> (Accessed 15 August 2016).

Enoch, A.J., English, M. & Shepperd, S. 2016. Does pulse oximeter use impact health outcomes? A systematic review. *Archives of Disease in Childhood*, 101(8), 694–700. Available: <https://www.ncbi.nlm.nih.gov/pubmed/267806/> (Accessed 15 August 2016).

Fin24.com. 2013. *Get the facts on BRICS*. Sapa. Available: <http://www.fin24.com/Economy/Get-the-facts-on-Brics-20130326> (Accessed 15 March 2014).

Flabouris, A., Runciman, W.B. & Levings, B. 2006. Incidents during out-of-hospital patient transportation. *Anaesthesia Intensive Care*, 34(2). Available: <http://www.ncbi.nlm.nih.gov/pubmed/16617646> (Accessed 15 June 2015).

Foltin, G. L. 1995. Critical issues in urban emergency medical services for children. *Pediatrics* (online). Available: <http://web.b.ebscohost.com/dutlib.dut.ac.za/>

ehost/detail?vid=7&sid=cc1bb68a-c976-402a-9c7a-3594d25b7ecd%40sessionmgr112&hid=124&bdata=JnNpd GU9ZWhvc3QtbGl2ZQ%3d%3d#bib17up (Accessed 4 March 2014).

Gaffney, P. & Johnson, G. 2001. Paediatric prehospital care: Postal survey of paramedic training managers. *Archives of Disease in Childhood* (online). Available: [http://www.ncbi.nlm.nih.gov/pubmed/11718601/](http://www.ncbi.nlm.nih.gov/pubmed/11718601) (Accessed 3 March 2014).

Garrouste-Orgeas, M., Philippart, F., Bruel, C., Max, A., Lau, N. & Misset, B. 2012. Overview of medical errors and adverse events. *Annals of Intensive Care* (online). Available: [http://www.ncbi.nlm.nih.gov/pubmed/2310841/#B9](http://www.ncbi.nlm.nih.gov/pubmed/2310841) (Accessed 25 March 2014).

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. & Trow, M. 1994. *The new production of knowledge: the dynamics of science and research in contemporary societies*. California: Sage. Available: <https://uk.sagepub.com/en-gb/afr/the-new-production-of-knowledge/book204307> (Accessed 15 August 2016).

Govender, K., Grainger, L., Naidoo, R. & MacDonald, R. 2012. The pending loss of advanced life support paramedics in South Africa. *African Journal of Emergency Medicine* 2: 59–66. Available: <http://hdl.handle.net/10321/987> (Accessed 11 April 2016).

Govender, P., 2010. The development of a framework to retain migrating South African undergraduate Advanced Life Support paramedics. Available: <https://ir.dut.ac.za/handle/10321/599> (Accessed 30 May 2017)

Govender, P. 2014. Big money lures SA paramedics to greener pastures, *Sunday Times*, 22 June. Available: <http://crm.bhfglobal.com/big-money-lures-sa-paramedics-greener-pastures> (Accessed 25 May 2015).

Green, L.W. 1977. Evaluation and measurement: Some dilemmas for health education. *Am J Public Health*, 67(2). Available: [http://www.ncbi.nlm.nih.gov/pubmed/1653552/](http://www.ncbi.nlm.nih.gov/pubmed/1653552) (Accessed 25 July 2016).

Griffith, S. 2009. Introduction to part 2. *Country by country guide: Asia*. 9th ed. Richmond: Crimson Business Ltd. Available: <http://search.proquest.com/docview/189252479?accountid=10612> (Accessed 23 March 2016).

Halim, A. & Ali, M.M. 1988. *Training and professional development*. Available: <http://www.fao.org/docrep/W5830E/w5830e0h.htm> (Accessed 23 April 2016).

Hatherill, M., Waggle, Z., Reynolds, L. & Argent, A. 2003. Transport of critically ill children in a resource-limited setting. *Intensive Care Medicine* (online). Available: <http://www.ncbi.nlm.nih.gov/pubmed/12897999> (Accessed 3 March 2014).

Haupt, E. 2016. Helping babies breathe easier. *People's Post*.

Health Professions Council of South Africa (HPCSA). 2011. *Continuing professional development guidelines for the health care professionals*. Available: http://www.hpcsa.co.za/Content/Docs/guidelines_2011.pdf (Accessed 17 April 2016).

Health Professions Council of South Africa (HPCSA). 2013. *Professional Board for Emergency Care (PBEC)*. Available: http://www.hpcsa.co.za/downloads/emergency_care/form_169_a_accreditation_crite_mar_2013.pdf

Health Professions Council of South Africa (HPCSA). 2016a. *Registrations*. Available: <http://www.hpcsa.co.za/Registrations/Criteria> (Accessed 23 May 2016).

Health Professions Council of South Africa (HPCSA). 2016b. *Iregister*. Available: <http://isystems.hpcsa.co.za/iregister/> (Accessed 23 May 2016).

Health Professions Council of South Africa (HPCSA). 2017. *Education and Training*. Available: <http://www.hpcsa.co.za/Professionals/EducationTraining> (Accessed 28 May 2017).

International Association of Flight Paramedics (IAFP), 2009, Critical Care Paramedic Position Statement, Available: http://c.ymcdn.com/sites/www.iafccc.org/resource/resmgr/docs/critical_care_paramedic_posi.pdf (Accessed 05 June 2016).

Jha, A., Larizgoitia, I., Audera-Lopez, C., Prasopa-Plaizier, N., Waters, H. & Bates, D. 2013. The global burden of unsafe medical care: An observational study. *BMJ QualSaf*. Available: <http://qualitysafety.bmj.com/content/22/10/809.full> (Accessed 27 July 2015).

Karlsen, K.A., Trautman, M., Price-Douglas, W. & Smith, S. 2011. National Survey of Neonatal Transport Teams in the United States. *Pediatrics* (online), 128(4): 685–691.

Available: <http://search.proquest.com.dutlib.dut.ac.za/nursing/printviewfile?accountid=10612> (Accessed 3 March 2014).

Kendig, J.W. & Nawab, U. 2016. *Respiratory Distress Syndrome in neonates*. Available: <http://www.merckmanuals.com/professional/pediatrics/perinatal-problems/respiratory-distress-syndrome-in-neonates> (Accessed 23 May 2016).

Khilnani, P. & Chhabra, R. 2008, Transport of critically ill children: How to utilize resources in the developing world. *Indian J Pediatric*.75(6). Available: <http://www.ncbi.nlm.nih.gov/pubmed/18759088> (Accessed: 3 March 2014).

Kim, U.O., Brousseau, D.C. & Konduri, G.G. 2008. Evaluation and management of the critically ill neonate in the emergency department. *Clinical Pediatric Emergency Medicine* (online), 9(3): 140–148. Available: <http://search.proquest.com.dutlib.dut.ac.za/nahs/docview/1032807585/fulltextPDF/DDE32DADF6324F97PQ/5?accountid=10612> (Accessed 19 February 2016).

King, B.R., Foster, R.L., Woodward, G.A. & McCans, K.M. 2001. Procedures performed by pediatric transport nurses: How “advanced” is the practice? *Pediatric Emergency Care* (online) 17(6): 410–413. Available: <http://www.ncbi.nlm.nih.gov.dutlib.dut.ac.za/pubmed/11753183> (Accessed 9 May 2016).

Kubalo, L. 2000. *Infant and child mortality. A South African Demographic and Health Survey 1998: Full Report*. Pretoria: Government Printer. Available: <http://www.mrc.ac.za/bod/dhsfin1.pdf> (Accessed 12 July 2014).

Leedy, P.D. & Ormrod, J.E. 2005. *Practical research: Planning and design*. 8th edition. Upper Saddle River, NJ: Merrill Prentice-Hall.

Leedy, P.D. & Ormrod, J.E. 2010. *Practical research: Planning and design*. 9th edition. New York: Merrill.

Lim, M.T. & Ratnavel, N. 2008. A prospective review of adverse events during interhospital transfers of neonates by a dedicated neonatal transfer service. *Pediatric Critical Care Medicine* (online), 9(3): 289–293. Available: <http://www.ncbi.nlm.nih.gov/pubmed/18446101> (Accessed 10 March 2014).

Lindsey, P.L. & Jenkins, S. 2013. Nursing students' clinical judgment regarding rapid response: the influence of a clinical simulation education intervention. In *Nursing forum* (Vol. 48, No. 1, pp. 61-70). Available: <http://onlinelibrary.wiley.com/doi/10.1111/nuf.12002/full> (Accessed 29 May 2017).

Lippincott Nursing Center, 2017. Nursing Certification Boards By Specialty. Available: <http://www.nursingcenter.com/career/guideto-certification>. (Accessed 10 July 2017).

Lloyd, L.G. & De Witt, W. 2013. Neonatal mortality in South Africa: How are we doing and can we do better? *South African Medical Journal* (online), 103(8): 518–519. Available: <http://www.samj.org.za/index.php/samj/article/view/7200/5281>>doi:10.7196/samj.7200 (Accessed 17 July 2014).

Luft, H.S., Hunt, S.S. & Maerkiet, S.C. 1987. The volume-outcome relationship: Practice-makes-perfect or selective-referral patterns? *Health Services Research* (online), 22(2): 157–182. Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1065430/> (Accessed 25 April 2015).

Lupton, B.A. & Pendray, M.R. 2004. Regionalized neonatal emergency transport. *Seminars in Neonatology* (online), 9(2): 125-133. Available: <http://www.ncbi.nlm.nih.gov/pubmed/16256716> (Accessed 3 March 2014). Mathison, D.J., Berg, E. & Beaver, M. 2013. Variations in inter-facility transport: Approach to call intake, team composition and mode of transport. *Clinical Paediatric Emergency Medicine* (online), 14(3): 193-205. Available: <http://search.proquest.com.dutlib.dut.ac.za/nursing/docview/1440903246/8D9BB26900114FADPQ/6?accountid=10612> (Accessed 26 March 2014).

McCall, L., Wray, N. & Lord, B. 2009. Factors affecting the education of pre-employment paramedic students during the clinical practicum. *Journal of Emergency Primary Health Care*, 7(4): 9. Available: <https://ajp.paramedics.org/index.php/ajp/article/view/189> (Accessed 10 July 2016).

McKerrow, N. & Mulaudzi, M. 2010. *Child mortality in South Africa: Using existing data*. Available: http://www.healthlink.org.za/uploads/files/sahr10_5.pdf (Accessed 10 June 2015).

McLaughlin, M. 2002. To fly or not to fly? *Air Medical Journal*, 21(4): 26–27.

Meakim, C., Boese, T., Decker, S., Franklin, A. E., Gloe, D., Lioce, L., et al. 2013. Standards of best practice: Simulation Standard I: Terminology. *Clinical Simulation Nursing*, 9(6): S3–S11. [http://www.nursingsimulation.org/article/S1876-1399\(13\)00071-6/abstract](http://www.nursingsimulation.org/article/S1876-1399(13)00071-6/abstract) (Accessed 19 April 2014).

Meyer, M.T., Mikhailov, T.A., Kuhn, E.M., Collins, M.M. & Scanlon, M.C. 2015. Pediatric specialty transport teams are not associated with decreased 48-Hour pediatric intensive care unit mortality: A propensity analysis of the VPS, LLC Database. *Air Medical Journal*, 35(2). Available: <http://www.sciencedirect.com.dutlib.dut.ac.za/science/article/pii/S1067991X15003284> (Accessed 23 May 2016).

Moodley, K. 2016. An investigation into the clinical practicum experience of ALS paramedic students and their preparedness for professional practice. Available: http://ir.dut.ac.za/bitstream/handle/10321/1551/MOODLEY_2016.pdf?sequence=1&isAllowed=y (Accessed 17 August 2016).

Morgan, G.A., Leech, N.L., Gloeckner, G.W. & Barrett, K.C. 2004. *SPSS for introductory statistics: Use and interpretation*. 2nd edition. Hove, UK: Psychology Press.

Muhlbauer, D. 2015. An analysis of patients transported by a private helicopter emergency service within South Africa (online). MTech, Durban University of Technology. Available: http://ir.dut.ac.za/bitstream/handle/10321/1326/MUHLBAUER_2015.pdf (Accessed 25 April 2015).

Naguran, S. 2008. An assessment of ambulance infection control in an emergency medical service in the Ilembe District of KwaZulu-Natal (online). MTech, Durban University of Technology. Available: <http://ir.dut.ac.za/handle/10321/334> (Accessed 25 April 2015).

Neil, R., Roy, D., Langford, S., Chaberna, J.L., Petresenc, S., Peitersenc, N., et al. 1999. Newborn transport around the world. *Seminars in Neonatology* (online), 4(4): 219–235. Available: http://ac.els-cdn.com/S1084275699901094/1-s2.0-S1084275699901094-main.pdf?_tid=e8e8213e-b043-11e3-8b23-00000aaccb35e&acdnat=1395329326_d51b07ab152c22254902cc9fadc2701c (Accessed 4 March 2014).

Nolan, T., Angos, P., Cunha, A.J., Muhe, L., Qazi, S., Simoes, E.A., et al. 2001. Quality of hospital care for seriously ill children in less-developed countries. *Lancet*, 357: 106–110. Available: <http://www.ncbi.nlm.nih.gov/pubmed/11197397> (Accessed 14 July 2015).

- Oestergaard, M.Z., Inoue, M., Yoshida, S., Mahanani, W.R., Gore, F.M., Cousens, S., et al. 2011. Neonatal mortality levels for 193 countries in 2009 with trends since 1990: A systematic analysis of progress, projections, and priorities. *PLoS Med* (online), 8(8): e1001080. Available: <http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001080> (Accessed 1 April 2015).
- Ohning, B.L. 2012. *Transportation of the critically ill newborn*. Available: <http://emedicine.medscape.com/article/978606-overview> (Accessed 10 December 2013).
- O'Reilly, M. 2010. *HPCSA on issue of review of BAA and CAA training courses*. Available: <http://www.bizcommunity.com/Article/196/155/48620.html> (Accessed 17 May 2016).
- Orr, R.A., Felmet, K.A., Han, Y., McCloskey, K.A., Dragotta, M.A., Bills, D.M., et al. 2009. Pediatric specialized transport teams are associated with improved outcomes. *Pediatrics* (online), 124(1): 40-48. Available: <http://pediatrics.aappublications.org/content/124/1/40.short> (Accessed 1 March 2014).
- Paediatric Intensive Care Audit Network (PICANet). 2010. *National report of the Paediatric Intensive Care Audit Network, January 2006–December 2008*. Available: http://www.picanet.org.uk/Documents/General/Annual%20report_2009/PICANet%20National%20Report%202006%20-%202008_new.pdf (Accessed 25 November 2014).
- Patient Safety Global Action Summit (2016). Available: http://www.who.int/patientsafety/news_events/global-movement/en/ (Accessed 25 April 2016).
- Perez, R.S., Skinner, A., Weyhrauch, P., Niehaus, J., Lathan, C., Schwaitzberg, S.D., et al. 2013. Prevention of surgical skill decay. *Military Medicine* (online), 178(10 Suppl): 76–86. Available: <http://www.ncbi.nlm.nih.gov/pubmed/?term=Perez%2C+R.S.+et+al.%2C+2013.+Prevention+of+Surgical+Skill+Decay.+Military+Medicine%2C+pp.76%E2%80%9386> (Accessed 25 April 2016).
- Persse, D.E., Key, C.B., Bradley, R.N., Miller, C.C. & Dhingra, A. 2003. Cardiac arrest survival as a function of ambulance deployment strategy in a large urban emergency medical services system. *Resuscitation*, 59: 97–104. Available: <http://www.ncbi.nlm.nih.gov/pubmed/14580739> (Accessed 25 July 2015).

Priority one ER24. 2016. Quarterly magazine, Issue 1, March. Available at: https://issuu.com/er24ems/docs/priority_one_-_pdf_pages/1?utm_source=Priority%20One%20Magazine%20Q1-16&utm_medium=Email%20Banner&utm_term=Priority%20One&utm_content=Priority%20One%20Magazine&utm_campaign=ER24%20Priority%20One%20Magazine%20Q1-16 (Accessed 02 April 2016).

Ralston, M.E., Day, L.T., Slusher, T.M., Musa, N.L. & Doss, H.S. 2013. Global paediatric advanced life support: Improving child survival in limited-resource settings. *Lancet* (online), 381(9862): 256-265. Available: <http://search.proquest.com.dutlib.dut.ac.za/sciencejournals/docview/1315199968/fulltext/A7F73567E4F2497APQ/3?accountid=10612> (Accessed 19 April 2014).

Ramnarayan, P., Thiru, K., Parslow, R.C., Harrison, D.A., Draper, E.S. & Rowan, K.M. 2010. Effect of specialist retrieval teams on outcomes in children admitted to paediatric intensive care units in England and Wales: A retrospective cohort study. *Lancet*, 376. Available: http://ac.els-cdn.com/S0140673610611130/1-s2.0-S0140673610611130-main.pdf?_tid=b271ed82-685c-11e6-add6-00000aacb360&acdnt=1471865982_9e753f2f90c7f1c24d4d0f5167f8ff65 (Accessed 22 February 2015).

Raynovich, W., Hums, J., Stuhlmiller, D.F., Bramble, J.D., Kasha, T. & Galt, K. 2013. Critical care transportation by paramedics: A cross-sectional survey. *Air Medical Journal* (online), 32(5): 280–288. Available: <http://www.ncbi.nlm.nih.gov/pubmed/24001916> (Accessed 21 April 2014).

Republic of South Africa. 2013. Protection of Personal Information Act 4 of 2013. *Government Gazette* (online), 581(37067). Available: <http://www.justice.gov.za/legislation/acts/2013-004.pdf> (Accessed 15 August 2015)

Reston, J. 2013. Smart pumps and other protocols for infusion pumps: Brief review (Chapter 6). In: *Making health care safer II: An updated critical analysis of the evidence for patient safety practices*. Rockville, MD: Agency for Healthcare Research and Quality (US). Available: <http://www.ncbi.nlm.nih.gov/books/NBK133356/> (Accessed 21 May 2016).

Russo, A., McCready, M., Torres, L., Theuriere, C., Venturini, S., Speight, M., et al. 2013.Reducing hypothermia in pre-term infants following delivery.*Pediatrics* (online), 133(4): 468–474. Available: <http://pediatrics.aappublications.org/content/133/4/e1055.long> (Accessed 21 May, 2016).

Sackett, D.L., 1997. Evidence-based medicine.*Seminars in Perinatology, Foetal and Neonatal Hematology for the 21st Century* (online), 21(1): 3–5. Available: <http://www.sciencedirect.com/science/article/pii/S0146000597800134> (Accessed 03 March 2016).

Seid, T., Ramaiah, R. & Grabinsky, A. 2012.Pre-hospital care of pediatric patients with trauma.*International Journal of Critical Illness and Injury Science* (online), 2(3): 114-120. Available: <http://www.ncbi.nlm.nih.gov/pubmed/?term=Seid%20T%5Bauth%5D> (Accessed 03 March 2014).

Senthilkumar, R., Corpuz, N., Ratnavel, N., Sinha, A. & Mohinuddin, S. 2011. Adverse events during emergency transfer of neonates performed by regionalised dedicated transfer service. *Archives of Disease in Childhood* (online), 96(Suppl 1): A91. Available: http://adc.bmj.com/content/96/Suppl_1/A91.1.abstract (Accessed 10 March 2014).

Simon, M.K. 2011.*Dissertation and scholarly research: Recipes for success*. Seattle, WA: Dissertation Success. Available: <http://dissertationrecipes.com/wp-content/uploads/2011/04/AssumptionslimitationsdelimitationsX.pdf> (Accessed 24 May 2015).

Singh, J.M., MacDonald, R.D. & Ahghari, M. 2014.Critical events during land-based interfacility transport.*Annals of Emergency Medicine* (online), 64(1). Available: <http://www.ncbi.nlm.nih.gov/pubmed/24412668> (Accessed May 4, 2014).

Siren Newsletter (PGWC). 2012. Issue 7, Cape Town. Available: https://www.westerncape.gov.za/Text/2012/5/siren_newsletter_march_2012_final_low_res.pdf (Accessed 19 April 2014).

South African Red Cross Air Mercy Service (AMS). 2016. Operational Database. (Accessed 06 March 2016).

South African Government. 2012. *Campaign on Accelerated Reduction of Maternal and Child Mortality in Africa (CARMMA)*. Available: <http://www.gov.za/launch-campaign-accelerated-reduction-maternal-and-child-mortality-south-africa> (Accessed 10 May 2016).

South African Qualifications Authority (SAQA). 2000. Available: http://www.saqa.org.za/structure/nqf/docs/curriculum_dev.pdf. (Accessed: 3 March 2014)

South African Qualifications Authority (SAQA). 2017. *NQF Objectives*. Available: <http://www.saqa.org.za/show.php?id=5661> (Accessed: 29 May 2017)

Spaite, D.W., Karriker, K.J., Seng, M., Conroy, C., Battaglia, N., Tibbitts, M., et al. 2000. Increasing paramedics' comfort and knowledge about children with special health care needs. *American Journal of Emergency Medicine*, 18(7), 747–752. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/11103722> (Accessed: 21 April, 2014).

Statistics South Africa. 2013a. *Census 2011*. Available: http://www.statssa.gov.za/1D40939C-1286-4AA5-B0FC-FB89A4A76A7E/FinalDownload/DownloadId-EF321A435CCDE7AC0C6DCC6E43255347/1D40939C-1286-4AA5-B0FC-FB89A4A76A7E/MDG/MDGR_2013.pdf (Accessed 10 June 2015).

Statistics South Africa. 2013b. *Demographic and Health Survey 1998*. Department of Health; Mortality and Causes of Death, Mid-year Population Estimates. Available: http://www.statssa.gov.za/1D40939C-1286-4AA5-B0FC-FB89A4A76A7E/FinalDownload/DownloadId-EF321A435CCDE7AC0C6DCC6E43255347/1D40939C-1286-4AA5-B0FC-FB89A4A76A7E/MDG/MDGR_2013.pdf (Accessed 5 May 2015).

Statistics South Africa. 2013c. *Mid-year population estimates 2013*. Available: <http://www.statssa.gov.za/publications/P0302/P03022013.pdf> (Accessed 10 May 2015).

Statistics South Africa, 2013d. *General household survey 2013*. Available: <http://www.statssa.gov.za/publications/P0318/P03182013.pdf> (Accessed 10 May 2015).

Statistics South Africa, 2016. *Mid-year population estimates 2015*. Available: <https://www.statssa.gov.za/publications/P0302/P03022015.pdf> (Accessed 22 June 2016).

Stiell, I.G., Spaite, D.W., Field, B., Nesbitt, L. P., Munkley, D., Maloney, J., et al. 2007. Advanced life support for out-of-hospital respiratory distress. *N Engl J Med* (online); 356:2156–2164. Available at: <http://www.nejm.org/doi/pdf/10.1056/NEJMoa060334> (Accessed 21 October 2015).

Stroud, M.H., Prodhan, P., Moss, M., Fiser, R., Schexnayder, S. & Anand, K. 2011. Enhanced monitoring improves pediatric transport outcomes: A randomized controlled trial. *Pediatrics* (online), 127: 42–8. Available: <http://www.ncbi.nlm.nih.gov/pubmed/?term=Enhanced+monitoring+improves+pediatric+transport+outcomes%3A+a+randomized+controlled+trial> (Accessed 10 May 2016).

Studnek, J.R., Fernandez, A.R., Shimberg, B., Garifo, M. & Correll, M. 2011. The association between emergency medical services field performance assessed by high-fidelity simulation and the cognitive knowledge of practicing paramedics. *Academic Emergency Medicine : Journal of the Society for Academic Emergency Medicine* (online), 18: 1177–1185. Available: <http://www.ncbi.nlm.nih.gov/pubmed/?term=The+Association+Between+Emergency+Medical+Services+Field+Performance+Assessed+by+High-fidelity+Simulation> (Accessed 10 May 2016).

Su, E., Schmidt, T.A., Mann, N.C. & Zechin, A.D. 2000. A randomized controlled trial to assess decay in acquired knowledge among paramedics completing a paediatric resuscitation course. *Academic Emergency Medicine : Journal of the Society for Academic Emergency Medicine* (online), 7(7). Available at: <http://www.ncbi.nlm.nih.gov/pubmed/10917328> (Accessed 21 April 2014).

Swingler, G., Hendricks, M., Hall, D., Hall, S., Sanders, D., McKerrow, N., et al. 2012. Can a new paediatric sub-specialty improve child health in South Africa? *South African Medical Journal* (online), 102(9): 738–739. Available: <http://www.samj.org.za/index.php/samj/article/view/5714/4416> (Accessed 08 July 2015).

The Heart Foundation, 2016. Available: <http://www.theheartfoundation.org/heart-disease-facts/about-heart-disease/> (Accessed 20 May 2016).

The Presidency, Republic of South Africa. 2014. *Twenty-year review South Africa, 1994-2014*. Pretoria: Government Printers. Available:

<http://www.poa.gov.za/news/Pages/Twenty%20Year%20Review%20South%20Africa%201994%20to%202014.aspx> (Accessed 13 November 2015).

The Sunday Times, 2017, online news, Available: <http://www.timeslive.co.za/politics/2017/05/23/Audit-finds-R17-billion-in-irregular-expenditure-in-municipalities> (Accessed 26 May 2017)

Trbovich, P.L., Pinkney, S., Cafazzo, J.A. & Easty, A.C. 2010. The impact of traditional and smart pump infusion technology on nurse medication administration performance in a simulated inpatient unit. *Quality Safety Health Care* (online), 19: 430–434. Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2975961/pdf/qhc32839.pdf> (Accessed 26 May 2016).

UNICEF. 2014. *Levels & Trends in Child Mortality, Report 2014*. Available: http://www.unicef.org/media/files/Levels_and_Trends_in_Child_Mortality_2014.pdf (Accessed 6 March 2016).

Van Hoving, D.J., Smith, W.P. & Wallis, L.A. 2008. Comparison of mean on-scene times: Road versus air transportation of critically ill patients in the Western Cape of South Africa, *Emerg. Med. J.* 25: 136–139. Available: <http://www.emssa.org.za/wp-content/uploads/2009/09/comparison-of-mean.pdf> (Accessed 21 November 2015).

Van Teijlingen, E.R., Rennie, A.M., Hundley, V. & Graham, W. 2001. The importance of conducting and reporting pilot studies: the example of the Scottish Births Survey. *Journal of Advanced Nursing* (online), 34(3): 289–295. Available: <http://sru.soc.surrey.ac.uk/SRU35.html> (Accessed 13 May 2014).

Walla, S.N., Leea, A.C.C., Niermeyerc, S. & English, M. 2009. Neonatal resuscitation in low-resource settings: What, who, and how to overcome challenges to scale up? *International Journal of Gynaecology and Obstetrics* (online), 107: s47–s64. Available: <http://www.ncbi.nlm.nih.gov/pubmed/19411114> (Accessed 10 June 2015).

Waluube, D., 2011. *Medical errors and adverse events: Managing the aftermath*. Available: <http://www.wewoek.com/load-medical-errors-and-adverse-events.html> (Accessed 6 March 2014).

Welman, J.C., Kruger, S.J. & Mitchell, B. 2005. *Research methodology*. 3rd edition. Cape Town.: Oxford University Press.

Western Cape Government. 2005. *Annual Report 2004-2005*. Available: https://www.westerncape.gov.za/text/2005/10/annual_report_2004-2005_2005-09-20.pdf (Accessed 10 June 2015).

Western Cape Government. 2015. *Medical Emergency Transport and Rescue*. Available: <https://www.westerncape.gov.za/service/medical-emergency-transport-and-rescue-metro> (Accessed 02 March 2016).

Western Cape Government, Department of Health, 2011. *The future of health care in the Western Cape 2020*. Available: https://www.westerncape.gov.za/other/2011/12/healthcare_2020_-_9_december_2020.pdf (Accessed 17 July 2015).

Western Cape Government, Department of Health. 2015. Strategic Plan 2015-2019. Available: <https://www.westerncape.gov.za/sites/www.westerncape.gov.za/files/department-of-health-strategic-plan-2015-2019.pdf> (Accessed 10 June 2015).

Western Cape Government, Department of Health. 2016. Emergency Medical Services, Computer Assisted Dispatch system (CAD). (Accessed 15 March 2016).

Western Cape Government Provincial Treasury. 2015. *Provincial Economic Review and Outlook 2015*. Available: https://www.westerncape.gov.za/assets/departments/treasury/Documents/2015_pero_final_to_web_15_otober_2015.pdf (Accessed 22 June 2016).

Whyte, H.E. & Jefferies, A.L. 2015. The interfacility transport of critically ill newborns. *Paediatrics and Child Health* (online), 20(5): 265–269. Available: <http://www.ncbi.nlm.nih.gov/pubmed/26111111> (Accessed 24 March 2016).

Williams, T.A., Finn, J., Perkins, G.D. & Jacobs, I.G. 2013. Prehospital continuous positive airway pressure for acute respiratory failure: A systematic review and meta-analysis. *Prehosp Emerg Care*, 17(2):261–273. Available: <http://www.ncbi.nlm.nih.gov/pubmed/23373591> (Accessed 11 July 2016).

Woodward, G.A., Insoft, R.M., Pearson-Shaver, A.L., Jaimovich, D., Orr, R.A., Chambliss, C.R., et al. 2000. The state of Inter-facility transport: Consensus of the Second National Paediatric and Neonatal Inter-facility Transport Medicine Leadership Conference. Available: <http://www2.aap.org/sections/transmed/StateofPIT.pdf> (Accessed 15 May 2014).

World Health Organization. 2006. *Neonatal and perinatal mortality: country, regional and global estimates*. Available: whqlibdoc.who.int/publications/2006/9241563206_eng.pdf (Accessed 17 July 2014).

World Health Organization. 2008. *Summary of the evidence on patient safety: implications for research*. Available: http://www.who.int/patientsafety/information_centre/Summary_evidence_on_patient_safety.pdf (Accessed 28 June 2017)

World Health Organization. 2009. *Conceptual framework for the International Classification for Patient Safety*. Available: http://www.who.int/patientsafety/taxonomy/icps_full_report.pdf (Accessed 20 August 2014).

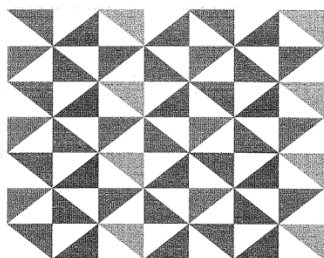
World Health Organization. 2010. *Countdown to 2015 decade report (2000–2010): Taking stock of maternal, newborn and child survival*. Available: <http://www.who.int/pmnch/topics/child/CountdownReportOnly.pdf?ua=1> (Accessed 15 August 2016).

Wraga, W.G., 1999. The educational and political implications of curriculum alignment and standards-based reform. *Journal of Curriculum and Supervision*, 15(1), 4. Available: <https://search.proquest.com/docview/196367588?accountid=10612> (Accessed 30 May 2017).

Yaeger, K.A., Halamek, L.P., Coyle, M., Murphy, A., Anderson, J., Boyle, K., et al. 2004. High-fidelity simulation-based training in neonatal nursing. *Advanced Neonatal Care* (online), 4(6): 26–31. Available: <http://www.ncbi.nlm.nih.gov/pubmed/15609254> (Accessed 17 July 2014).

Zuidgeest, J., Jonkheijm, A., Van Dijk, M., & Van As, A. 2013. Is the golden hour optimally used in South Africa for children presenting with polytrauma? *South African Medical Journal*, 103(3). Available: <http://www.sciencedirect.com.dutlib.dut.ac.za/science/article/pii/S1067991X15003284> (Accessed 05 March 2016).

Appendix 1: Provisional approval to commence the pilot study



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

P O Box 1334, Durban, South Africa, 4001

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

www.dut.ac.za

24 August 2015

IREC Reference Number: **REC 69/15**

Mr E Ismail
54 Olifant Road
Primrose Park
Cape Town
7764

Dear Mr Ismail

Preparedness of Western Cape paramedics, to provide clinical stabilization and intensive care for neonates during the patient journey

I am pleased to inform you that Provisional Approval has been granted to your proposal REC 69/15 subject to:

- Piloting of the data collection tool and
- Obtaining and submitting the necessary gatekeeper permission/s to the IREC.

Full approval is subject to meeting the above conditions.

The Proposal has been allocated the following Ethical Clearance number **IREC 087/15**. Please use this number in all communication with this office.

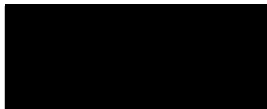
Approval has been granted for a period of two years, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's.

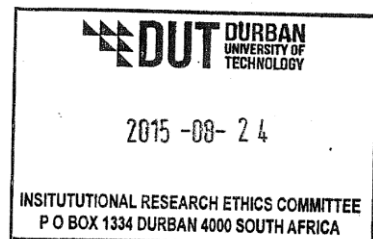
Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Please note that you may continue with validity testing and piloting of the data collection tool. Research on the proposed project may not proceed until IREC reviews and approves the final document. If there are no changes to the data collection tool, kindly notify the IREC in writing.

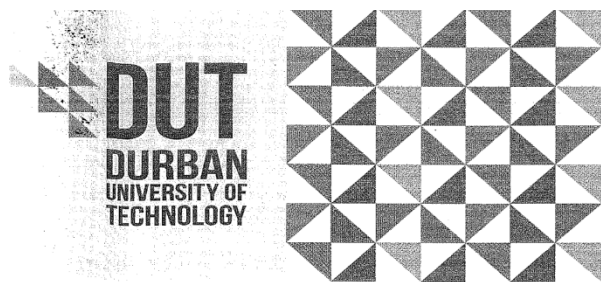
Yours Sincerely



Professor J K Adam
Chairperson: IREC



Appendix 2: Full approval to commence with the study



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

P O Box 1334, Durban, South Africa, 4001

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

11 December 2015

IREC Reference Number: **REC 69/15**

Mr E Ismail
54 Olifant Road
Primrose Park
Cape Town
7764

Dear Mr Ismail

Preparedness of Western Cape paramedics, to provide clinical stabilization and intensive care for neonates during the patient journey

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

We are pleased to inform you that the questionnaire has been approved. Kindly ensure that participants used for the pilot study are not part of the main study.

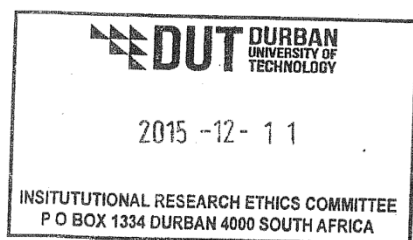
In addition, the IREC acknowledges receipt of your gatekeeper permission letter.

Please note that **FULL APPROVAL** is granted to your research proposal. You may proceed with data collection.

Yours Sincerely



Professor J K Adam
Chairperson: IREC



Appendix 3: Western Cape Department of Health gatekeeper permission letter



**Western Cape
Government**

Health

STRATEGY & HEALTH SUPPORT

Health.Research@westerncape.gov.za
tel: +27 21 483 6857; fax: +27 21 483 9895
5th Floor, Norton Rose House, 8 Riebeeck Street, Cape Town, 8001
www.capegateway.gov.za

REFERENCE: WC_2015RP33_694
ENQUIRIES: Ms Charlene Roderick

**Steve Biko Rd & Botanic Gardens Rd
Durban 4001
P O Box 1334.
Durban
4000**

For attention: **Mr Erefaan Ismail and Mr Raveen Naidoo**

Re: PREPAREDNESS OF WESTERN CAPE PARAMEDICS, TO PROVIDE CLINICAL STABILIZATION AND INTENSIVE CARE FOR NEONATES DURING THE PATIENT JOURNEY.

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.

Please contact the following people to assist you with any further enquiries in accessing the following sites:

Head of Emergency Medicine

N Narker

Contact No: 021 932 1966

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final feedback (annexure 9) within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za)
3. The reference number above should be quoted in all future correspondence.

Yours sincerely

DR A HAWKRIDGE
DIRECTOR: HEALTH IMPACT ASSESSMENT
DATE: 20/11/2015.
CC

Appendix 4: EMS permission letters

PG 2a (Former PG 4a and PG 4b)

Annexure A



Date: 2015

To: Dr. S. De Vries

DIRECTOR: WESTERN CAPE GOVERNMENT EMERGENCY SERVICES

SUBJECT: REQUEST FOR APPROVAL TO UNDERTAKE RESEARCH

I am currently registered at Durban University of Technology, through the Department of Emergency Care and Rescue with the aim of completing a Master's Degree: Emergency Medical Care in 2015. I wish to undertake a research project within Western Cape Government Emergency Services.

Student Name: Erefaan Ismail

Student no: 21447856 (Ethical clearance number: IREC 087/15)

Supervisor: Mr Raveen Naidoo

Contact no: 031 3735203

Co-Supervisor: Dr D R Prakashchandra

Contact no: 031 3736885

Title of Research: Preparedness of Western Cape paramedics to provide clinical stabilization and intensive care for neonates during the patient journey

Aim of Research:

High-risk neonates, for referral between intensive care units (ICU) or from primary and secondary hospitals to ICU, require skilled personnel and specialized monitoring equipment. Globally, teams are composed of various specialized medical professionals, including doctors, nurses, respiratory therapists and paramedics (Ohning, 2012). The aim of the study, therefore, will be to determine the preparedness of paramedics for the intensive care and clinical stabilization of neonates in order to ensure safe patient care during their journey.

Benefits of Research:

The potential benefits of the study may include, highlighting the need for standardization of a paramedic neonatal training programme. This training program, should ideally include the provision of improved neonatal ICU training manikins, specialized equipment and a skills lab (simulating the ICU environment), for EMS training institutions in South Africa. The study may also lead to discussion for the establishment of a paramedic neonatology sub-speciality, which could possibly include a compulsory period of mentorship by a neonatologist, ultimately leading to improved paramedic intensive care of neonates.

A bound hard copy of the research proposal will be forwarded to your office once approval has been received, from the faculty research committee of the Durban University of Technology. All data will be handled with the strictest confidentiality. All participants will remain anonymous and only the researcher and supervisors will have access to the data. All research findings will be made available to you, in an encrypted report.

I therefore, respectfully request permission to hand deliver or email a questionnaire, for voluntary completion by all operational ALS paramedics, whether working on the road or in the aero-medical environment, within the EMS organization. Should you require any further details regarding the proposed study, please do not hesitate to contact me or the research supervisor. I trust this will meet your favourable consideration and approval.

Yours sincerely

Erefaan Ismail

Office: 0219386731 Cell: 0835106459

Erefaan.Ismail@westerncape.gov.za

Approved



Disapproved



EMS Director: Dr S. De Vries

Signature: _____

Date: _____

28/10/15



21 December 2015

Dear Erefaan,

Re: Access to AMS Records and AMS Personnel for research purposes

The AMS Research Committee has received your request to have access to the AMS database to establish the merits of your proposed research topic and to conduct a survey amongst our staff.

Access to the SA Red Cross Air Mercy Service (AMS) records (your email dated 18/12/2015) and the personnel of the Western Cape Operations has been granted in accordance with your request, with the following provisos:-

1. The records will be made available to you from our Regional Office located at the General Aviation Area - Cape Town International Airport,
2. Guidance to the use and maintenance of the record files will be advised on site by local management – Garth Moys,
3. No staff member should be expected to or specifically be tasked to collate/ interpret etc data that may be required. The student can be given access under supervision.
4. AMS operations and AMS paramedic duties take precedence at all times,
5. The outcomes / conclusion of your research shall be shared with the AMS.

Standard Ethical Rules together with the organisation's restriction on removal of confidential information offsite and the patients' right to confidentiality, apply.

Thank You

Yours faithfully



Gary Mc Cormick

Quality & Technical Manager

Fax: (+27) 86 554 6313

E-mail: gary@ams.org.za

Telephone - National: 086 11 MERCY (63729) • 24hr Emergency: 0861 AMS AMS (267 267) • International: +27 21 935 6900
Fax: 021 934 8383 • E-mail: info@ams.org.za • P.O. Box 93, Cape Town International Airport 7525 • Web: www.ams.org.za

Established by SA Red Cross Society
Trust Reg No. T3404/94 • NPO No. 017-180



Netcare Hospitals (Pty) Ltd

Tel: + 27 (0)11 301 0000
Fax: Corporate +27 (0)11 301 0499
76 Maude Street, Corner West Street, Sandton, South Africa
Private Bag X34, Benmore, 2010, South Africa
www.netcare.co.za

RESEARCH OPERATIONS COMMITTEE FINAL APPROVAL OF RESEARCH

Approval number: UNIV-2016-0003

Mr Erefaan Ismail

E mail: Erefaan.Ismail@westerncape.gov.za

Dear Mr Ismail

RE: PREPAREDNESS OF WESTERN CAPE PARAMEDICS TO PROVIDE CLINICAL STABILIZATION AND INTENSIVE CARE FOR NEONATES DURING THE PATIENT JOURNEY

The above-mentioned research was reviewed by the Netcare Research Operations Committee's delegated members and it is with pleasure that we inform you that your application to conduct this research at Netcare Emergency Services – Western Cape, has been approved, subject to the following:

- i) Research may now commence with this FINAL APPROVAL from the Netcare Research Operations Committee.
- ii) All information regarding Netcare will be treated as legally privileged and confidential.
- iii) Netcare's name will not be mentioned without written consent from the Netcare Research Operations Committee.
- iv) All legal requirements with regards to participants' rights and confidentiality will be complied with.
- v) Netcare must be furnished with a STATUS REPORT on the progress of the study at least annually on 30th September irrespective of the date of approval from the Netcare Research Operations Committee as well as a FINAL REPORT with reference to intention to publish and probable journals for publication, on completion of the study.
- vi) A copy of the research report will be provided to the Netcare Research Operations Committee once it is finally approved by the relevant primary party or tertiary institution, or once complete or if discontinued for any reason whatsoever prior to the expected completion date.
- vii) Netcare has the right to implement any recommendations from the research.

Directors: J du Plessis, S Chetty, R H Friedland, K N Gibson


Company Secretary: L Bagwandeem

Reg. No. 1996/006591/07

- viii) Netcare reserves the right to withdraw the approval for research at any time during the process, should the research prove to be detrimental to the subjects / Netcare or should the researcher not comply with the conditions of approval.
- ix) APPROVAL IS VALID FOR A PERIOD OF 36 MONTHS FROM DATE OF THIS LETTER OR COMPLETION OR DISCONTINUATION OF THE STUDY, WHICHEVER IS THE FIRST.

We wish you success in your research.

Yours faithfully,


Prof Dion du Plessis

Full member: Netcare Research Operations Committee & Medical Practitioner evaluating research applications as per Management and Governance Policy


Shannon Neil
Chairperson: Netcare Research Operations Committee
Netcare Hospitals (Pty) Ltd
Date:

15/01/2016

Directors: J du Plessis, S Chetty, R H Friedland, K N Gibson

Company Secretary: L Bagwandeem

Reg. No. 1996/006591/07



Cambridge Manor Office Park, Manor 1, Cnr Stone Haven and Witkoppen Roads, Paulshof, Sandton, South Africa, 2056
PO Box 242, Paulshof, Sandton, South Africa, 2056
Tel: Local: 0861 084 124 • International: + 27 (0) 11 3196300 • Email: info@er24.co.za • www.er24.co.za
Ethics Line: 0800-005-316

27 December 2015

Erefaan Ismail
Department of Emergency Medical Care and Rescue
Durban University of Technology

Dear Mr Ismail,

RE: PROJECT 2015/12
PROJECT TITLE: Preparedness of Western Cape paramedics, to provide clinical stabilization and intensive care for neonates during the patient journey

The above research protocol has been reviewed by the ER24 Research Committee and I am pleased to inform you that your request has been approved. Access is hereby granted to the data required as stipulated in your protocol. Unfortunately, based on company policies, we cannot provide employee details to you. However, we can distribute the questionnaire on your behalf. You may also approach each individual ER24 branch for sampling.

Should your methodology change or any concerns arise during the data collection period, it is your responsibility to inform the ER24 Research Committee in due course. You are also required to forward the completed project to ER24. In addition, an annual report is due yearly in April, regardless of when the project was approved or when it is due for completion.

I look forward to viewing the results of your study. I am positive that the science that you will generate will be of benefit to the profession.

Kind Regards,



Willem Stassen
Chair: ER24 Research Committee



ER24 is a 100% subsidiary of Mediclinic Southern Africa
ER24 EMS (PTY) LTD t/a ER24
Registration No. 2000/005657/07 • VAT Registration No. 4730193887

realhelprealfast



Date: 15 December 2015

To: Mr. Neil Gargan

South African Paramedic Services

SUBJECT: REQUEST FOR APPROVAL TO UNDERTAKE RESEARCH

I am currently registered at Durban University of Technology, through the Department of Emergency Care and Rescue with the aim of completing a Master's Degree: Emergency Medical Care in 2016. I wish to undertake a research project within the Western Cape Emergency Services.

Student Name: Erefaan Ismail

Student no: 21447856

Supervisor: Mr Raveen Naidoo

Contact no: 031-373 5203

Co-Supervisor: Dr D R Prakaschandra

Contact no: 031-3736885

Title of Research: Preparedness of Western Cape Advanced Life Support practitioners to manage and provide intensive care for critically ill neonates

Aim of Research:

In the Western Cape, ICU neonatal transport crews, consist of an Advanced Life Support (ALS) and Intermediate Life Support (ILS) practitioner, recruited from normal operational duties (Siren Newsletter, 2012). The implications of this practice have not yet been documented, but the limited data available indicates a high number of technical, clinical and critical adverse events (Hatherill, Waggie, et al, 2003; Lloyd & de Witt, 2013). The current available data (Ashokcoomar, 2012) points to these factors mentioned, which are possibly the underlying causes of the increasing neonatal mortality. However, the influence of the preparedness of ALS practitioner's to manage critically ill neonates, have not been explored. The aim of the study will be to provide a descriptive analysis of ALS practitioner's clinical experience of continuum care and management of critically ill neonates. The chosen method for this study will be a survey, using a questionnaire as data collection tool.

Benefits of Research:

The potential benefits of the proposed study may include recommendations for the standardization of ALS neonatal training nationally, in South Africa. Possibly creating discussion for mentorship by a neonatologist and creating discussion for the creation of an ALS paramedic neonatology sub-speciality. Also, possible recommendations for the establishment of improved neonatal ICU training manikins, specialized equipment and a skills lab (simulating the ICU environment) for EMS training institutions, ultimately leading to improved critical care of neonates.

A bound hard copy of the research proposal will be forwarded to your office once approval has been received, from the faculty research committee of the Durban University of Technology. All data will be handled with the strictest confidentiality. All participants will remain anonymous (numerical numbers will be allocated) and only the researcher and supervisors will have access to the data. All research findings will be made available to you, in an encrypted report.

I therefore, respectfully request permission to hand deliver or email a questionnaire for voluntary completion by all operational ALS paramedics, within your EMS organization. Should you require any further details regarding the proposed study, please do not hesitate to contact me or the research supervisor. I trust this will meet your favourable consideration and approval.

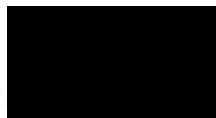
Yours sincerely

Erefaan Ismail
ECT Lecturer: WCG College of Emergency Care
Office: 0219386731 Cell: 0835106459
Erefaan.Ismail@westerncape.gov.za

Approved ☒ Disapproved ☐

Mr. Neil Gargan

Signature:



Date: 21-12-2015

Appendix 5: Letter of information (for participants in the pilot study)



LETTER OF INFORMATION (for participants in pilot study)

Dear Colleague

Firstly, thank you for taking time from your busy schedule, to allow me a few minutes, to inform you about participation in this pilot study.

The purpose of the pilot study will be to:

- Identifying ambiguities (questions possibly being open to more than one interpretation) and complicated questions
- Removal of unnecessary questions
- To assess for leading questions
- Assessing whether each question provides a sufficient range of responses
- Provision of a reasonable amount of time to complete the questionnaire

Your valuable input provided from this initial trial, will be used to ensure maximum user-friendliness and accurate data capture, which will be incorporated into the final questionnaire, for mass dissemination (electronic and hardcopy).

After completion, kindly forward any concerns/questions you may have regarding the questionnaire to either:

Mr E. Ismail (Contact no: 021 938 6731), my supervisor Mr Raveen Naidoo
Contact no: 031 3735203 or Co-Supervisor: Dr D R Prakashchandra (Contact no: 031-3736885)

Thanking you in advance, for your time and valued participation.

Kind regards

E. Ismail

NDip ECT Lecturer: WCG College of Emergency Care

Appendix 6: Letter of information (for potential participants)



LETTER OF INFORMATION (for potential participants)

Dear Colleague

Firstly, thank you for taking time from your busy schedule, to allow me a few minutes, to inform you about this study.

I am currently registered at Durban University of Technology, through the Department of Emergency Care and Rescue, with the aim of completing a Master's Degree: Emergency Medical Care. The aim of the study will be to provide a descriptive analysis of ALS practitioner's clinical experience of continuum care for critically ill neonates, during transportation.

I hereby request your valuable participation in the study, as your clinical exposure with neonates (limited or otherwise), will contribute to the improvement of critical care for this population.

Title of Research: Preparedness of Western Cape ALS providers, to provide clinical stabilization and intensive care for neonates during the patient journey

Potential benefits of the study:

The potential benefits of the study may include, highlighting the need for standardization of the ALS provider's neonatal training programme. This training program, should ideally include the provision of improved neonatal ICU training manikins, specialized equipment and a skills lab (simulating the ICU environment), for EMS training institutions in South Africa. The study may also lead to discussion for the establishment of a paramedic neonatology sub-speciality, which could possibly include a compulsory period of mentorship by a neonatologist, ultimately leading to improved paramedic intensive care of neonates.

Brief introduction and purpose of the Study:

The management and intensive care of critically ill neonates, is inherently prone to adverse events, as they are often preterm neonates in distress, meaning they have been born too early and their frail bodies need external support to survive. High-risk critically ill neonates, for referral between intensive care units (ICU) or from primary and secondary hospitals to ICU, require skilled personnel and specialized monitoring equipment. Globally, teams are composed of various specialized medical professionals, including doctors, nurses, respiratory therapists and paramedics (Ohning, 2012). In the Western Cape, ICU neonatal transport crews, consist of an ALS provider and an Ambulance Emergency Assistant, recruited from normal operational duties (Siren Newsletter, 2012).

The aim of the study, therefore, will be to determine the preparedness of paramedics for the intensive care of neonates in order to ensure safe patient care during their journey.

Outline of the procedures:

If you agree to participate in the study, you will be asked to complete a consent form (to be returned with completed questionnaire). This study will be a survey, using a questionnaire as data collection tool.

You will be invited to complete the questionnaire either in hard-copy or in electronic format (for those with internet access). You have been chosen to share your experiences of continuum care for critically ill neonates, during transportation.

The majority of the questions will be close-ended questions, requiring a tick in the appropriate box. The last section of the questionnaire will contain open-ended questions, to provide you with a platform to give your valuable personnel input.

Confidentiality:

You will remain anonymous, as you will be allocated a numerical number. No demographic or personal information will be collected for the purpose of data analysis or final report. Any data containing area of employment, registrations, training institution or mention of specific patient incidents by the participants, will be restricted to the research investigators and not for publication.

Risks or Discomforts to the participant: Not applicable

Withdrawal from the study:

Your participation is voluntary and there is no obligation. If you decide to take part you will be given this information sheet to keep and you will be asked to sign a consent form. If you decide to take part and then withdraw, you are free to withdraw, at any time without giving a reason. A decision to withdraw at any time or a decision not to take part, will not affect you in anyway.

Remuneration: No remuneration will be offered for participation in the study

Costs of the study: You will not be asked to cover any costs associated with the study

Research-related injury: Not applicable

Persons to Contact in the event of any problems or queries:

Please contact the researcher Mr. E. Ismail (tel no. 021 938 6731), my supervisor: Mr Raveen Naidoo (Contact no: 031 3735203), Co-Supervisor: Dr D R Prakaschandra (Contact no: 031 3736885) or the Institutional Research Ethics administrator on 031 373 2900. Complaints can be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or dvctip@dut.ac.za.

Thanking you in advance, for your time and valued participation. A copy of the research results will be send to you, if you so desire.

Kind regards

E. Ismail

NDip ECT Lecturer: WCG College of Emergency Care

Appendix 7: Consent form



CONSENT FORM (Research Ethics Clearance Number: REC 69/15)

Statement of Agreement to Participate in the Research Study:

I hereby confirm that I have been informed by the researcher, Mr. Erefaan Ismail, about the nature, conduct, benefits and risks of this study:

- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research, which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	Date	Time	Signature / Right thumbprint

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

_____	_____	_____
Full Name of Researcher	Date	Signature

_____	_____	_____
Full Name of Witness (If applicable)	Date	Signature

_____	_____	_____
Full Name of Legal Guardian (If applicable)	Date	Signature

Appendix 8: Data collection tool - Questionnaire



Questionnaire

Dear Paramedic/ECP Colleague

Thank you for taking the time to complete this questionnaire. Completion of the questionnaire will take approximately 30 minutes. Your valuable input, which may advance EMS education and training, is highly appreciated.

Please be assured that the information you provide in this questionnaire will remain confidential. Your personal details will not be disclosed and any data used in the final report will not be linked to any respondents.

This study aims to provide a descriptive analysis of your clinical experience of providing stabilization and intensive care to critically ill neonates. To generate the most accurate account of the current status quo, please do your best to provide truthful answers. While the questions are mostly Likert-scale in nature, I have also included open-ended questions in the last section of the questionnaire to enable you to raise concerns or highlight solutions.

.....

(Please make an 'X' in the applicable box)

1. Please indicate your HPCSA ALS provider (paramedic) qualification:

CCA	NDip EMC	BTech	BEMC

2. How long (in years and/or months) have you been registered as a paramedic/ECP?

----- Years/ months

3. Date of Birth: Day..... Month..... Year.....

4. In which EMS sector are you currently employed in the Western Cape?

Government	Private	University	College	Aero-Med	Other (Specify)

5. In which EMS sector have you been employed for the greater part of your paramedic/ECP qualification?

Government	Private	University	College	Aero-Med	Other (Specify)

6. In which geographical location have you been employed for the greater part of your paramedic/ECP registration?

Urban	Rural	Urban/Rural	Other (Specify)

7. What is your current employment title?

Primary response paramedic/ECP	Inter-hospital ICU paramedic	Aero-Medical paramedic	Manager	Lecturer	Other (Specify)

8. What is your current transportation mode for performing your duties?

Primary response vehicle	Paramedic ambulance	NICU Ambulance	Rotor-wing	Fixed-wing	Other (Specify)

9. What duty shifts do you work?

Day shift only	Night shift only	Day/night shift	Office hours	Other (Specify)

10. Regarding your initial paramedic training, do you believe your neonatal curriculum was adequate to preparing you for dealing with critically ill neonates?

Extremely inadequate	Inadequate	Neutral/Undecided	Adequate	Fair	Excellent

11. Regarding your initial paramedic training, do you believe your neonatal practicum phase (in-hospital and pre-hospital) provided adequate practical exposure to prepare you for dealing with critically ill neonates?

Extremely inadequate	Inadequate	Neutral/Undecided	Adequate	Fair	Excellent

12. Do you believe that the time (total class hours and practical hours) devoted to the neonatal curriculum and practicum phase was adequate to prepare you to deal with critically ill neonates?

Extremely inadequate	Inadequate	Neutral/Undecided	Adequate	Fair	Excellent

13. Kindly identify the specific knowledge gaps (if applicable) from your critical neonatal exposure thus far:

Theoretical knowledge	Simulated clinical environment	Clinical practicum exposure in ICU	Clinical practicum exposure prehospital	I have no knowledge gaps regarding the critical management of neonates

14. Have you completed any additional neonatal/paediatric training after obtaining your paramedic/ECP qualification?

Neonatal Advance Life Support Course	Paediatric Advance Life Support Course	Other (Specify)	No additional training

15. Do you believe your neonatal skills (such as neonatal resuscitation; umbilical vein cannulation; neonatal intubation; neonatal ventilator; intra-osseous cannulation and peripheral IV access) are adequate to manage critically ill neonates?

Extremely inadequate	Inadequate	Neutral/Undecided	Adequate	Fair	Well-prepared

16. What are your personal feelings with regard to the following statement?

“I feel confident and well-prepared to accept the further management of a critically ill neonate handed over by a neonatologist from the ICU.”

Extremely inadequate	Inadequate	Neutral/Undecided	Adequate	Fair	Well-prepared

17. How often, during the course of performing your normal duties do you clinically manage a critically ill neonate?

Daily	Once a week	Three to ten times a week	Once a month	Once in three Months	Once in six Months	Once in nine Months	Once a year	Never

18. As a newly qualified paramedic/ECP, your first neonatal resuscitation/NICU transfer would naturally have been stressful. Do you believe that you've gained confidence as you've gained more neonatal clinical experience or do you still feel apprehensive when you are called upon to manage critically ill neonates?

Extremely Apprehensive	Apprehensive	Neutral/Undecided	Adequate	Fair	Well-prepared

19. How much clinical experience do you feel a newly qualified paramedic/ECP will require to progress from a beginner to an experienced paramedic/ECP for the intensive care of critically ill neonates?

Three months	Six months	One year	One and six months	Two years	Three years or more

20. How much clinical experience do you have in managing critically ill neonates?

Three months	Six months	One year	One and six months	Two years	Three years or more

21. Do you believe your current clinical exposure and experience in managing critically ill neonates has been adequate to prepare you to safely resuscitate and transport critically ill neonates?

Extremely inadequate	Inadequate	Neutral/Undecided	Adequate	Fair	Excellent

22. Which neonatal technical skills do you perform most frequently when managing a critically ill neonate?

(You may mark {X} for any skills you feel appropriate)

Neonatal intubation	Neonatal BVMR	Neonatal CPR	Neonatal ventilator	Infusion device	Umbilical vein cannulation	Intra-osseous cannulation	Neonatal infusion	IV access	Other skills

23. How often is the incubator you use for neonatal transfers in working order, warmed to correct temperature and ready to use?

Extremely poor working condition	Inadequate working condition	Neutral/Undecided	Adequate working condition	Fair working condition	Excellent working condition

24. Is the incubator always clean or do you find that the last crew to use it, left it unhygienic?

Extremely unhygienic condition	Inadequately cleaned	Neutral/Undecided	Satisfactorily cleaned	Fairly clean condition	Excellent cleanliness

25. Are cleaning detergents readily available to wipe/clean incubator after use?

Cleaning detergents never available	Cleaning detergents only available sometimes	Neutral/Undecided	Cleaning detergents always available

26. During the ventilated transfer of a critically ill neonate, is the neonate secured by a safety net in the incubator and is your monitoring equipment, infusion pump, etc. secured to the stretcher, so that there is no risk of equipment damage during the patient journey?

Neither the neonate or equipment is secured	Inadequately secured	Neutral/Undecided	Adequately secured	Both the neonate and equipment is secured

27. Identify the most common diagnostic reason, based on your own experience, critically ill neonates are conveyed by EMS:

Preterm	Birth asphyxia	Sepsis	Diarrhoea	Congenital abnormality	Other, please specify

28. Indicate how you feel about the following statement:

“During the patient journey of critically ill neonates, they mostly remain ventilatory/haemodynamically stable and only require monitoring.”

Strongly disagree	Disagree	Neutral/Undecided	Agree	Strongly agree

29. Indicate how you feel about the following statement:

“I have adequate monitoring equipment, in good working order (for example neonatal NIBP; pulse; Sats; ETCO₂; ECG; HGT and temperature probe), including ALS technical equipment (IO set; UVC set; neonatal BVMR/ETT; ventilator; incubator; suction device; etc.) to safely resuscitate and clinically manage critically ill neonates.”

Strongly disagree	Disagree	Neutral/Undecided	Agree	Strongly agree

30. My in-service neonatal intensive care training period was for a period of:

No in-service operational readiness training specific to neonates provided	One month	Two months	Three months	Six months	One year or more

31. What is your personal feeling with regards to the following statement?

“I received adequate in-service operational readiness training on duty to prepare me for neonatal intensive care transfers.”

Extremely inadequate	Inadequate	Neutral/Undecided	Adequate	Fair	Excellent

32. I would like to receive in-service neonatal intensive care “operational readiness” training of at least:

In-service “operational readiness” training not necessary	One month	Three months	Six months	Nine months	One year or more

33. Indicate how you feel about the following statement:

“A period of mentorship by a neonatologist in a Neonatal Intensive Care Unit is necessary to provide the nuances/finer details of intensive neonatal care”

Strongly disagree	Disagree	Neutral/Undecided	Agree	Strongly agree

34. What time period do you believe will be sufficient to learn these nuances of intensive neonatal care? In other words, how long should the neonatology mentorship period be? Possible areas of focus during neonatal mentorship:

- **Theory:** Current neonatal physiologic principles and their application to clinical diagnosis and management
- **Practical:** Neonatal resuscitation (many paramedic/ECP students complete their training and may not perform a pre-term neonatal resuscitation or may only have observe one neonatal resuscitation, during their practical training)
- IV access (No neonatal manikins to practice on during EMS training, often only provided with CPR manikin - large baby)
- Advanced airway management (The neonatal airway manikin head for endotracheal intubation skill practice is often disproportionate to actual pre-term neonate)

1 month	3 months	6 months	1 year or more

Thank you for your input thus far. Kindly complete the last two open-ended questions.

35. How do you think our future paramedic/ECP students can be better prepared to deal with critically ill neonates?

36. Do you feel strongly about any issues raised from the previous questions or can you recall any incident/issue pertaining to intensive neonatal care/resuscitation that you feel needs to be highlighted?

Once again, thank you for your time and your valuable input!