AIR AMBULANCE TRANSPORT IN SUB-SAHARAN AFRICA: CHALLENGES EXPERIENCED BY HEALTH CARE PROFESSIONALS

by

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Declaration

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I, Marlize Visser, declare this research study entitled "Air ambulance transport in sub-Saharan Africa: challenges experienced by health care professionals" to be my own work. All sources used or quoted have been indicated and acknowledged by means of complete references. I further declare that this work has not been submitted for any other degree at any other institution.

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Marlize Visser Date

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Abstract

Introduction

Air ambulances transport patients to their home country or to centres of medical excellence when they are critically ill or injured. From stranded hikers to cancer patients, individuals worldwide use air ambulance transport when they need care that cannot be provided in the country or area where they are situated.

Aim

The overall aim of this study was to explore the challenges experienced by health care professionals during air ambulance transport of patients in sub-Saharan Africa.

Research method

A quantitative, non-experimental, descriptive, exploratory design was used. The study was conducted in three phases. **Phase 1** was the planning of the questionnaire**, Phase 2** was the pre-testing of the questionnaire and **Phase 3** was the execution phase in which the questionnaires were distributed, and data were captured and analysed.

Results

The researcher used the data generated from the questionnaires to indicate short falls within air ambulance transport services in sub-Saharan Africa.

Conclusion

The researcher made recommendations in order to increase the level of air ambulance services in sub-Saharan Africa.

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List of abbreviations

ALS	Advanced life support
AMREF	African Medical Research Foundation
AMS	Air Mercy Services
BLS	Basic life support
CAMTS	Commission on Accreditation of Medical transport Systems
CINAHL	Cumulative Index to Nursing and Allied Health
DOH	Department of Health
EMS	Emergency medical Services
EURAMI	European Medical Air Institute
ICU	Intensive Care unit
ILS	Intermediate life support
NSRI	National Sea Rescue Institute
PPE	Personal Protective Equipment
UK	United Kingdom
USA	United States of America
WWI	World War I
WWII	World War II

*For the purpose of **anonymity**, the ambulance service providers who participated in this study will be referred to in the text as **Country A to F.***

1 ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Air transport of critically ill or injured patients is at the forefront in the ever-changing world of modern health care (Pollak 2011: 4). Air ambulance service providers form an integral part of medical service for patients either returning to their home country for health care or patients in need of advanced health care. From stranded hikers to cancer patients, individuals worldwide use air ambulance transportation when they need health care in areas where medical aid is non-existent or inadequate and expert medical attention is necessary.

Air transport greatly improves the speed of specialised health care delivery, especially in Africa where tertiary health care and critical care units are largely inaccessible (Rajah & Lasersohn 2000: 21). Air transport decreased the morbidity and mortality of patients transported in this manner (Naylor & McLellan 1996: 1348; Rajah & Lasersohn 2000: 21; Van Hoving, Smith & Wallis 2008: 136). Health care professionals involved in accompanying patients during air transportation are trained extensively in this field and are often allowed to perform more sophisticated procedures than their pre-hospital and hospital counterparts (Pollak 2011: 7).

Air ambulance companies provide an integral service by transporting the critically ill or injured patients (Air Ambulance Service Companies Directory 2009). Air ambulance transport can be provided by means of helicopters or fixed wing aircrafts. Fixed wing aircrafts are considered in cases where patients are transported further than 200 km (Lamond 2004: 377; Exadaktylos, Haffejee, Wood and Erasmus 2005: 106). In sub-Saharan Africa air transport by means of fixed wing aircrafts are currently provided by twelve service providers, situated in South Africa, Namibia, Botswana, Zimbabwe, Angola, Tanzania, Zambia, Kenya and Gabon. The aim of this study was to explore and describe the challenges experienced by health care professionals during air transport of patients in sub-Saharan Africa.

1.2 BACKGROUND

Part of the researcher's duties is to accompany patients being transported by fixed wing aircraft to and from various health care facilities in sub-Saharan Africa.

The researcher has a special interest in air ambulance transport and has found that, despite the historical reports on air transportation and evacuation of patients, limited references exist describing the services provided by health care professionals on air ambulances. The challenges these professionals have to face and master include:

- quality assurance of air ambulance service providers;
- accruement of costs both for the air ambulance service providers and the patient;
- unique challenges experienced by the health care professionals working in this specialised environment; and
- patient outcomes.

The researcher's own experiences together with feedback from health care professionals involved in the air ambulance transport of patients inspired her to undertake this study. Colleagues from the air ambulance service provider where the researcher is currently employed as well as from other air transport service providers in sub-Saharan Africa often expressed their concerns and shared ideas about the challenges they encounter in their working environment. The following concerns are often raised:

- Long flight times with minimum rest periods make it difficult to work.

- The small cabin space and limited storage for all the equipment is challenging.
- Receiving patients in sub-Saharan Africa is difficult. The language barriers hamper communication and in the end the management of patients.

Health care professionals involved in the accompaniment of patients during air transport include medical doctors, registered nurses and paramedics. The types of patients considered for this mode of transport include critically ill patients (myocardial infarctions, malaria and infectious diseases such as haemorrhagic diseases) and injured patients (motor vehicle accidents, mining accidents, and accidents related to sports such as mountain climbing or diving).

When accompanying critically ill or injured patients health care professionals often experience unique and daunting challenges that could influence their performance and, in turn, may jeopardise patient care. An example is sleep deprivation. As explained by Thomas, Hopkins, Handrahan, Walker and Carpenter (2006: 216), sleep deprivation could lead to errors made during patient management.

The researcher embarked on a thorough literature search on the medical air transport of critically ill or injured patients. In Table 1.1 the key words and search engines that were utilised to search for information related to air ambulance transport are summarised.

Table 1.1: Summary of key concepts used during literature search

Key concepts	Data base
1. Emergency medical service 2. Air transportation of patients 3. Air ambulances 4. Aircraft 5. Aviation medicine 6. Air/Helicopter ambulances/services	○ CINAHL (Cumulative Index to Nursing and Allied Health) ○ EbscoHost ○ Medline (Ovid) ○ PubMed ○ Google

Key concepts	Data base
7. Flying doctors/nurses 8. Air transportation and critically injured patients	

Despite the assistance provided by the two subject librarians from the University of South Africa (UNISA) and the University of Pretoria, limited information and scientific research could be found on the challenges experienced by health care professionals during the air transport of patients.

1.3 PROBLEM STATEMENT

As noted in the introduction and background, the challenges that health care professionals working in air ambulance transport services face, are unique. Managing seriously injured or critically ill patients in a confined space, in changing and adverse weather conditions and where the physics associated with air pressure play a constant role, can have a significant impact on the physiological and psychological well-being of the health care professionals' ability to manage these patients. Furthermore, in this unpredictable environment, operational preparations and risks associated with flying and crossing country borders whilst transporting patients with often unconfirmed diagnoses, place additional stress on the health care professionals.

Air transportation of critically ill and injured patients in the sub-Saharan Africa region is provided by health care professionals who have appropriate expertise and training in this field. To meet the required outcomes for the critically ill or injured patient being transported, managers of services need to understand the challenges that these professionals experience during the air transportation process in order to support them in this challenging environment.

1.4 RESEARCH QUESTION

Based on the problem statement, the following research questions were formulated:

- *What are the challenges experienced by health care professionals during air ambulance transportation of patients in sub-Saharan Africa?*
- *How can management contribute to limit the perceived challenges experienced by health care professionals during air ambulance transportation of patients?*

1.5 AIM AND OBJECTIVES OF THE STUDY

The overall aim of this study was to explore the challenges experienced by health care professionals during the air ambulance transport of patients in sub-Saharan Africa.

To fulfil the aim of the study the following objectives were formulated based on the systems approach:

- describe the challenges experienced by health care professionals during the pre-flight (input) phase;
- describe the challenges experienced by health care professionals during the in-flight (throughput) phase;
- describe the challenges experienced by health care professionals during the post-flight (output) phase; and
- recommend strategies for management in order to address the challenges experienced by health care professionals during air ambulance transport of patients in sub-Saharan Africa.

1.6 RESEARCHER'S FRAME OF REFERENCE

The frame of reference or framework of the study aims to give a logical structure or guide to develop the study (LoBiondo-Wood & Haber 2006: 114). The frame of reference of the study is described in terms of the role of the researcher, the research paradigm, assumptions, the conceptual framework, clarification of the key concepts, and planning of the study.

1.6.1 Role of the researcher

The role of the researcher is described as the influences that the researcher brings to the study (Struwig & Stead 2001: 227). According to Terre Blanche and Durrheim (1999: 49), these influences should be considered before the data collection period since this is the time they are most influential. The researcher considered her experience in the emergency setting, involvement in an air ambulance service provider, compilation of the questionnaire and involvement in the data collection as possible influences on the study.

The researcher completed her basic degree in nursing in 2002, after which she worked for two years in the emergency unit of a Level III public hospital as part of her compulsory community service. In 2005 the researcher enrolled for a two year programme in Emergency Nursing at the Department of Nursing, University of Pretoria. The researcher is currently working as a registered nurse in an emergency unit of a Level III hospital in a public hospital in Gauteng, South Africa. The Department of Health (DOH) (2006: 10) derived the following preliminary definition of a Level III (tertiary) hospital based on the classification of health establishments as promulgated by the South African National Health Act (61 of 2003). It includes a facility that provides in-patient services as well as specialist and sub-specialist care within the public sector. The emergency unit admits, manages, stabilises and refers critically ill or injured patients of all ages to appropriate specialists.

In January 2008 the researcher started working on an ad hoc basis for an air ambulance service provider in South Africa. As a prerequisite for employment the researcher successfully completed the following courses: Basic Life Support, Advanced Cardiac Life Support, Paediatric Advanced Life Support, Neonatal Resuscitation Program, International Trauma Life Support, and Aviation Health Care Provider. During her work as a flight nurse, the researcher encountered a vast field of interesting cases that enriched her clinical practice and stimulated her interests. Examples of these cases are summarised in Table 1.2. Air transporting these patients made the researcher aware of the challenges experienced in this environment.

Table 1.2: Summary of patients evacuated via air ambulances

Medical patients	Trauma patients
Complicated malaria	Animal attacks
Meningitis	Motor vehicle accidents
Pneumonia	Fall from height
Diving incidents	Traumatic amputations
Intracranial haemorrhage	Assaults
Prematurely born infants	Pedestrian vehicle accidents
Congenital defects in infants	Traumatic brain injuries
Complications during pregnancy	Crush injuries

The conceptual framework and questionnaire were developed by the researcher based on her experience in the field of air ambulance transportation, and were evaluated by experts to decrease any possible bias influences from the researcher.

The researcher could not be present when respondents completed the questionnaire due to the widespread location of the respondents. Therefore, she chose to use an electronic questionnaire to ensure that all possible respondents had an opportunity to complete the questionnaire. The researcher acknowledged that this had both advantages and disadvantages. In the view of Terre Blanche and Durrheim (1999: 49), the absence of the researcher will reduce the effects that personal traits and relationships might have; on the other hand, there will be no opportunity to clarify information for both the respondents and the researcher.

1.6.2 The setting

The research setting refers to the surroundings in which the research will be conducted (Burns & Grove 2009: 35; Polit & Beck 2010: 62). Polit and Beck (201: 62) distinguish between two types of settings by referring to the amount of control that the researcher will enforce, namely naturalistic (uncontrolled) and laboratory settings (highly controlled). Burns and Grove (2009: 35) agree by indicating that the naturalistic setting entails real life situations where no manipulation occurs. Laboratory settings entail artificially created surroundings that allow the researcher to limit variables from affecting results. Further, Burns and Grove (2009: 362) mention settings where partial control is practiced. This means that some variables, though not all, have been manipulated in the setting, resulting in partial control over variables. According to Polit and Beck (201: 62), the site within a setting refers to the overall location where the study will be conducted, for example "an institution is a community". One or more sites may be used.

For the purposes of this study, air ambulance service providers in sub- Saharan Africa were involved. All these air ambulance service providers were involved in the transport of patients via air utilising mainly fixed wing aircrafts. These air ambulance service providers were identified by means of networking. Health care professionals known to the researcher were asked to identify air ambulance service providers in sub-Saharan Africa as suggested by Burns and Grove (2009: 356). Once all the air ambulance service providers were identified and contact details known, these providers were contacted during Phase II, Step 2 to obtain informed consent.

A total of 11 air ambulance service providers were contacted in sub-Saharan Africa. Following is a list of their locations and the numbers contacted in each location:

- Angola (1)
- Botswana (1)
- Gabon (1)

- South Africa (4)
- Tanzania (1)
- Kenya (1)
- Zambia (1)
- Zimbabwe (1)

The data were collected in the naturalistic setting since the health care professionals were requested to complete the questionnaires in their own time and in a setting in which they felt comfortable. Partial control was practiced since the health care professionals were asked to forward the electronic questionnaire to an unknown e-mail address, therefore ensuring that their anonymity was protected; the possibility that they might have felt threatened and thus answered less truthfully was further minimised in this way.

1.6.3 Paradigm

A paradigm is regarded as a worldview or a general perspective on the complexity of the real world (Polit & Beck 2008: 13). In addition, Appleton and King (2002: 642) state deciding on the appropriateness of a chosen methodology and its philosophical underpinnings is essential. LoBiondo-Wood and Haber (2006: 133) hold that philosophical beliefs form the basis for all research, but not all researchers use the same paradigm. Polit and Beck (2008: 14) note the paradigms accepted in nursing research are positivistic and naturalistic paradigms.

This study was based on the positivist paradigm, which is rooted in nineteenth century thought and guided by philosophers such as Comte, Newton and Locke (Polit & Beck 2010: 14). This implies that, as a nurse researcher, the researcher believes in the general principles of evidence developed in the natural sciences. This view is consistent with the view of Stommel and Wills (2004: 23). Furthermore, objectivity, control and a neutral observer, free of values and bias, are of utmost importance during data collection (LoBiondo-Wood & Haber 2006: 135; Polit & Beck 2008: 14). Positivism implies that only observable phenomena are true, theoretical speculation is rejected, and there is a causal relationship between phenomena.

Evidence that this study was rooted in the positivist paradigm includes:

- the use of a quantitative research design (view section 3.2.1);
- the use of deductive reasoning to generate predictions that were tested in the real world (view section 3.3.1 and Annexure C);
- the fact that the research process used was systematic and followed a logical step-wise approach (view section 3.3.1.1);
- the use of mechanisms to control the study so that biases were minimised (view section 3.3.1.3); and
- the gathering of empirical evidence (view Chapter 4).

1.6.4 Assumptions

Polit and Beck (2008: 14) explain assumptions as basic principles believed to be true without verification. It is expected of the reader to believe it without offering evidence (Hofstee 2006: 88). LoBiondo-Wood and Haber (2006: 31) summarise assumptions as accepted truths. Burns and Grove (2009: 40) point out these assumptions can be found in the philosophical framework of studies.

Stommel and Wills (2004: 23) maintain that a paradigm therefore includes approaches to research based on certain assumptions about the nature of reality. In this study, the specific assumptions made were derived from Stommel and Wills (2004: 23), LoBiondo-Wood and Haber (2006: 134), Giddings and Grant (2007: 54-5) and Polit and Beck (2010: 15). The assumptions are summarised in Table 1.3.

Table 1.3: Summary of positivist assumptions

Philosophical question	Description in positivism	Application in study
Ontology: What is the nature of reality?	**Determinism**: A causal relationship exists between phenomena and can be observed, measured and understood.	The challenges experienced by health care professionals during air transport of patients were exposed and could be measured to create better understanding.
Epistemology: Why, how and what does the researcher know about the phenomena?	**Objectivism**: Reality exists and can be sought via replicable observation. Researcher independent of the phenomena.	Findings with regard to challenges experienced by health care professionals during air transportation of patients replicated what had been found in other parts of the world.
Axiology: What is the role of values in the inquiry?	**Objectivism**: Empirical knowledge is separable and should be kept separate from morality. Facts speak for themselves and thus valuable and neutral knowledge should be obtained.	Closed-ended electronic questionnaires limited the effect of bias and values. Morality did not affect answers provided by respondents thus findings were valuable and neutral.
Methodology: How is the evidence obtained?	**Reductionism**: Experience can be reduced to discrete, specific concepts.	Specific concepts from health care professionals' views of challenges experienced during air transportation of patients were investigated.
	Scientism: Scientific knowledge is the only true and reliable knowledge. This knowledge is to be obtained through fixed, specified design; measured, quantitative information; and statistical analysis to generalise findings.	A quantitative design ensured that empirical data were collected. Statistical analysis was performed. Researcher was able to generalise results.

1.6.5 Conceptual framework

Researchers follow either inductive or deductive reasoning when approaching a research problem (LoBiondo-Wood & Haber 2006: 121). In deductive reasoning the researcher uses a conceptual or theoretical framework from which to make predictions with regard to phenomena or behaviours (Polit & Beck 2010: 64). These assist in developing research questions and conceptual definitions.

This study was based on the systems model whereby the input-throughput-output systems approach and the environment were applied to the topic researched. The principles of the Systems Model are applied in section 1.6.6 where a diagrammatic conceptual framework based on this research is presented (view Figure 1.1).

1.6.5.1 Background to the Systems Model

The Systems Model has been used extensively and many varieties of conceptual frameworks have been derived from the initial model. Haines (2007: [2]) reports that the systems thinking approach is a heavily researched methodology and rigorously macro-scientific; it is regarded as a trans-disciplinary framework with its roots in the universal laws of living systems and human nature.

Haines (2007: [1]) defines a system as a "set of elements or components that work together in relationship for the overall good and objective (or vision) of the whole". Thus, the focus of all the elements in a system in an organisation, for example departments, should be the relationships with each other that assist with the attainment of an organisation-wide shared vision and values of customer satisfaction.

Open systems, according to Wright and McMahan (1992: 305), are based on the general systems models of von Bertalanffy from the 1950s. According to Wright and McMahan (1992: 305), organisations can be described in terms of input, throughput and output systems involved in transactions with a surrounding environment.

According to Katz and Kahn (in Wright & McMahan 1992: 305), organisations consist of the patterned activities of individuals aimed at some common output or outcome. These activities can be characterised as consisting of the energy that people put into the system, for example, **inputs** of people, money and technology. The **throughput** is the transformation of energies within the system such as, for example, putting the inputs (people, money, technology) to work together. The **outputs** are the resulting energy or product which is achieved.

According to Haines (2007: [1]), the systems approach and accompanied systems thinking is an advanced method of critical thinking. It is a holistically integrated and more purposeful outcome-orientated approach. The author adds that the systems theory has four distinct characteristics:

- it is a unique totality, in other words, the parts do not describe the characteristics of the entire system in the environment;
- it has openness and boundaries with the environment that are continually interacting – some systems are more open than others;
- it is an input-throughput-output feedback transformation framework; and
- is a multiple goal seeking outcomes/consequences oriented entity.

Wright and McMahan (1992: 306) explain that Mowday applied the Systems Model to human resources management practices in 1983 when he discussed strategies to reduce turnover of staff by investigating how organisations structure and control behaviour. Mowday used the Systems Model to generate various alternative programmes that would manage the turnover process in organisations. Similarly, in 1991 Wright and Snell (in Wright & McMahan 1992: 306) used an open Systems Model of the human resource system for generating human resource management strategies. Wright and McMahan (1992: 306) propose that the **inputs** in human resource systems are competencies such as skills and abilities to do the work by individuals in the organisation that the organisation must import from its external environment. Wright and Snell (in Wright & McMahan 1992: 306), state that the **throughput** process can be characterised by the behaviours of those individuals making up the organisational system. **Outputs** consist of both *performance*, for example productivity of individuals, and *effective outcomes*, such as job satisfaction. Using this model, they argue that systems imply that human resource management consists of two general responsibilities, namely competence management and behaviour management.

The input/throughput/output model, according to Nolan, Regenstein, Anthony and Siegel (2009: 2), provides a structure for examining factors that affect an organisation.

- **Input** factors are information and raw materials from external sources - in other words, demographics, personnel, equipment and so forth which come into the system.
- **Throughput** is the transformation of input and output. No information leaves a system in the exact state that it has entered it. This could be triage, documentation, care processes, staffing, specialities, and diagnostic services.
- **Output** refers to the information that the system feeds to the environment – in other words, hospital admission, availability of specialised care and post discharge care.

1.6.6 A systems approach to air ambulance transport

The Systems Model utilised to develop an input-throughput-output systems approach for air ambulance transport of patients is shown in Figure 1.1.

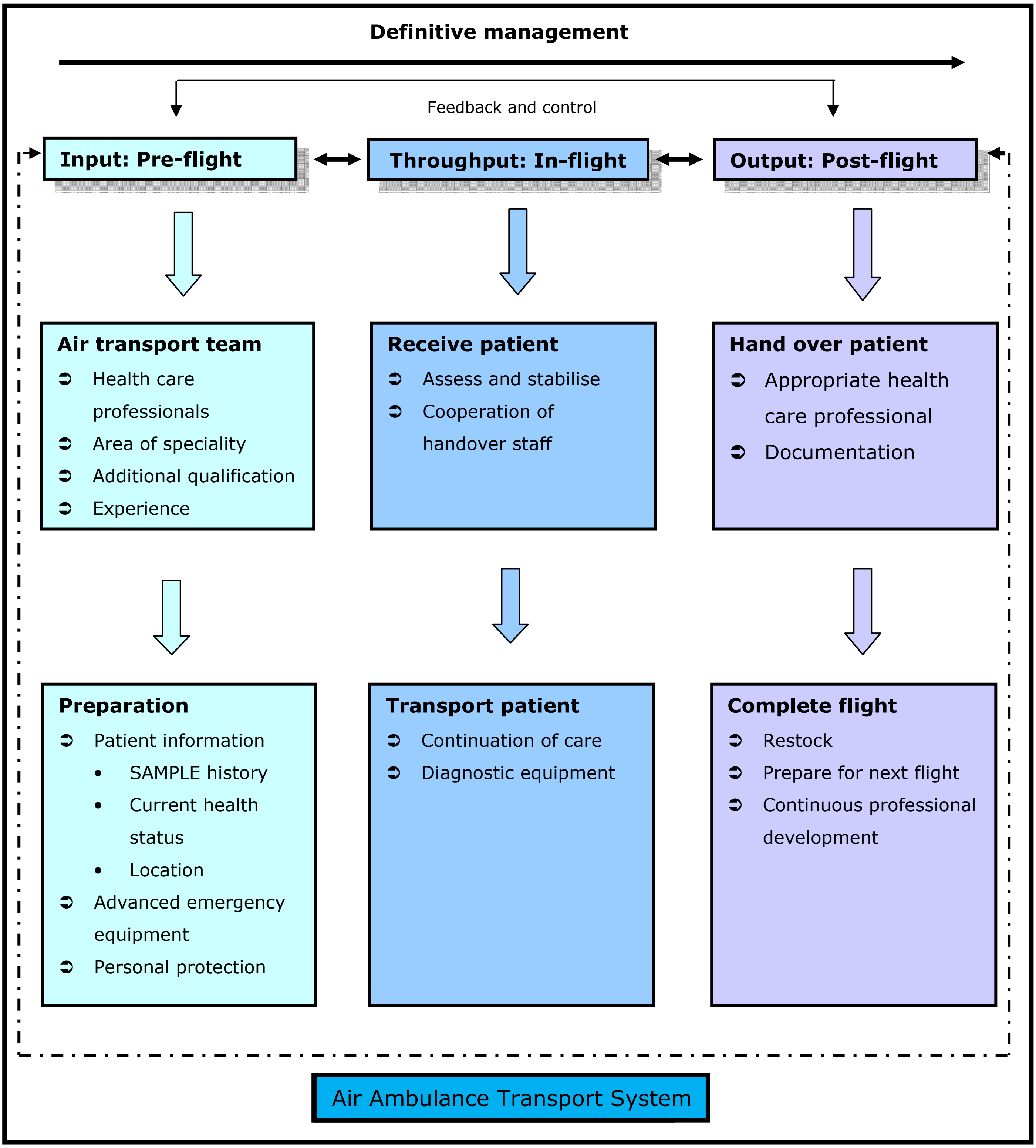


Figure 1.1: A systems approach to air ambulance transport *(adopted from Asplin et al. 2003: 176)*

1.6.6.1 Air ambulance transport system

The input-throughput-output approach on which the systems theory was based applied from operations management concepts to definitive patient management via air ambulance.

1.6.6.2 Input: Pre-flight

The input component consisted of two factors namely **air transport team** and **preparation for a flight**. The qualifications of the air transport team as well as any additional qualifications and courses were noted (Grissom & Farmer 2005: s15). It is important to note that most air ambulance service providers require air transport team members to have specific standardised minimum qualifications before the latter are allowed to transport patients for the particular service provider. Years of experience in this field is also noted as vital during the input phase as stated by Pollak (2011: 7). Stohler (1998: 116) further states that health care professionals involved in air transport are clinically skilled with highly developed critical thinking skills.

According to Beninati, Meyer and Carter (2008: s370) as well as Leggat and Fischer (2005: 142), preparation for a flight is based on knowledge regarding the patient, such as the patient's history, mechanism of injury and medical conditions. The patient's current medical illnesses or injuries, and prior predisposing conditions, are also noted. The importance of pre-flight information determines the equipment needs – such as mechanical ventilators, incubators and cardiac monitors - which will assist in the provision of optimal management of the patient. The information about the location of the patient is needed to assist the health care professionals in determining how much stock - such as oxygen, fluid therapy or continuous inotropic support would be needed.

During each air ambulance transport advanced emergency equipment must be carried. This is in case unforeseen circumstances and emergency situations such as, for example, a cardiac arrest, should arise (Grissom & Farmer 2005: s16).

The specific age considerations for each patient requiring air ambulance transport, for example, a newborn, paediatric or an adult patient, determine the relevant emergency equipment (Warren *et al*. 2004: 257; Venticinque & Grathwohl 2008: s288).

Personal protective equipment (PPE) for personnel who accompany patients need to be packed. The type of PPE will depend on the type of disease/condition of the patient. Basic and general PPEs include gloves, face masks and eye barrier protection devices, while full isolation attire and the patient isolation unit can be taken if the patient's condition requires it. Due to the weight and space limitations in the aircraft, personnel must carefully evaluate the necessity of carrying equipment since unnecessary, excessive aids add to the challenges of transporting patients. However, basic equipment such as a ventilator and a suctioning unit is obligatory on every flight (Teichman, Donchin & Kot 2007: 266; Pollak 2011: 769).

1.6.6.3 Throughput: In-flight

This component is divided into receiving the patient, and then transporting him or her to an appropriate health care facility, for example, a specialised cardiac or spinal unit in a specific hospital.

The first important aspect when the health care professional receives the patients is to assess her or him and manage life-threatening conditions and, secondly, to stabilise the patient (Gray, Bush & Whiteley 2004: 281; Proehl 2009: 2). The air transport team has to consider possible complications that may arise and prepare the patient prior to the flight. Due to the space confinement, invasive procedures inside the air ambulance may become extremely challenging and often impossible (Teichman *et al.* 2007: 264)

Cooperation from the personnel handing over at the transferring facility is extremely important. This will not only ensure the continuation of the management plan for the patient, but also that there is no repetition of diagnostic assessment or interventions. Furthermore, medication trade names may differ and therefore it is crucial to communicate what medications have to be administered. Overdosing can occur easily if communication and cooperation between the involved health care professionals are not optimal.

Smith (2008: s299) states that, during the air ambulance transport of the patient, it is important to continue the level of health care and management. At no stage should the level of health care be less than originally commenced with at the transferring hospital. Preplanning the air ambulance transport is of utmost importance to make the transfer as uneventful as possible. An example is to ensure that patients are sedated adequately and that all equipment is secured to prohibit accidental injuries. Preplanning of the air ambulance transfer limits anxiety of the health care professionals and contributes to optimal patient care and outcomes for the patient (Teichman *et al.* 2007: 267).

Furthermore, optimal preparation is necessary because physics may interfere with the equipment on board. As a result of the noise levels experienced in the air ambulance, it is not always possible to auscultate the lung fields for changes. Alarms cannot be heard inside the cabin, therefore, all monitoring equipment must have visual alarms that are visible at all times. These are some of the challenges not found in other emergency settings; they are exclusively encountered during air transportation of patients (Beninati *et al.* 2008: S373; Venticinque & Grathwohl 2008: s288).

1.6.6.4 Output: Post-flight

The post-flight components comprise two factors. The first is the handover of the patient to the receiving health care professionals and/or facility. The patient must be handed over to the appropriate health care professional. This means that the handover must be to a health care professional with an equal or higher qualification than the air ambulance team member. This ensures that the level of care does not decrease during the handover period. All relevant documentation must accompany the patient to ensure the continuation of the care plan. Complying with these procedures further contributes to the holistic picture of the patient's condition: from initial assessment through transfer to handover at the receiving facility (Gray *et al*. 2004: 283).

The second factor in the output component is completing the mission. After the flight, restocking, cleaning and checking of all the equipment should be done in preparation for the next flight. It is important to clean all equipment and gear to prevent transmission of diseases; thus for the protection of the health care professionals as well as for the next patient. All chargeable equipment should be placed on charge to ensure full battery power for the next flight. Making sure that the air ambulance is clean, restocked and that all the emergency equipment functions correctly is being courteous to the next air ambulance team members.

1.6.7 Clarification of key concepts

In the context of this study, and for simplicity and consistency throughout the key concepts are defined next.

1.6.7.1 Air ambulance

An ***ambulance*** is a vehicle transporting an ill or injured patient (Merriam-Webster online dictionary). An ***air ambulance*** is an airborne vehicle such as an airplane or helicopter which transports an ill or injured person.

An ***air ambulance utilised in emergency medicine*** is regarded as a helicopter or, less commonly, a fixed wing aircraft, which can be used to evacuate a person who requires immediate medical attention that cannot be provided at his or her current location (The Free dictionary).

For the purpose of this study, an 'air ambulance' will refer to an aircraft which is equipped with modern life-sustaining technology and equipment with the specific aim of transporting critically ill and injured patients by specifically trained competent professionals to more specialised and/or advanced facilities in sub-Saharan Africa.

1.6.7.2 Health care professional

Health is described as a state of an organism when it functions optimally without evidence of disease or abnormality. It can also be defined as a state characterised by anatomic, physiologic, and psychological integrity; ability to perform personally valued family, work, and community roles; ability to deal with physical, biologic, psychological, and social stress; a feeling of well-being; and freedom from the risk of disease and untimely death. In the third instance it is complete physical, mental, and social well-being, not just the absence of disease (Stedman's medical dictionary for the health professions and nursing).

The concept ***care*** can be utilised as a general term for the application of knowledge and experience in order to benefit a person, family, or community. In a more restricted medical sense, it means to provide medical or health care-related services to a patient (Stedman's Medical Dictionary for the Health Professions and nursing).

A ***professional*** refers to a person engaged in a learned career or a person having a particular profession as a permanent career (Merriam-Webster online dictionary).

For the purpose of this study, a 'health care professional' will refer to doctors, registered nurses and paramedics involved in the transportation of critically ill or injured patients via a fixed wing air ambulance in sub-Saharan Africa.

1.6.7.3 Paramedic

According to the South African DOH in Regulation 432 (2005: 4), an emergency care practitioner includes all persons registered in terms of section 17 of the Health Professions Act (56 of 1974) as a paramedic with basic, intermediate or advanced life support skills. Accordingly, these categories include:

- **Basic life support (BLS) paramedics**

A person who has obtained a certificate as a basic ambulance assistant, a certificate as an ambulance emergency care assistant, or a certificate as a basic life support paramedic from an approved institution. In this study these persons will be included under - and referred to as - 'paramedics (BLS)'.

- **Intermediate life support (ILS) paramedics**

A person who has obtained a certificate in intermediate life support emergency medical care, a certificate as an ambulance emergency assistant, or a certificate as an operational emergency care orderly from an approved institution. For the purpose of this study, these persons will also be included under - and referred to as - 'paramedic (ILS)'.

- **Advanced life support (ALS) paramedics**

This includes a person who has obtained a certificate in advanced life support emergency medical care, a certificate as a critical care assistant, or a national diploma in emergency medical care from an approved institution. For the purpose of this study, these persons will also be included under - and referred to as – 'paramedic (ALS)'.

For the purpose of this study the concept 'paramedics' will be utilised for all emergency care practitioners involved in transporting patients via air ambulance in sub-Saharan Africa. The level of care the paramedic renders as part of the air transport team will be indicated by using (BLS), (ILS) or (ALS).

1.6.7.4 Patient

Critically ill or injured patients are transported via air ambulance. According to Nicol and Steyn (2004: 15), a critically ill or injured patient refers to a patient who exhibits altered vital signs which may include a decreased level of consciousness or signs of respiratory, cardiovascular or neurological compromise. This patient may be walking or on a stretcher due to his or her illness or injury.

In this study, the concept 'patient' will refer to a critically ill or injured patient who needs to be air lifted by means of a fixed wing aircraft to a speciality or more advanced level of care, and who is cared for during transportation by specifically trained competent professionals.

1.6.8 Planning the study

The research was planned thoroughly by means of the development of a proposal. The proposal was submitted for evaluation and ethical approval before the study was commenced.

A summary of the steps utilised to plan the study during the proposal development, as well as the criteria and application of the steps are provided in Table 1.4.

Table 1.4: Planning the study

Phase 1: Planning		
Steps	**Criteria**	**Application**
1. Problem identification	After developing the research problem, the research questions were formulated.	The research problem was identified after informal discussions with colleagues. (View section 1.2)
2. Literature review	A literature review was conducted to compile a preliminary questionnaire with the support and input of experts in the field of research.	A literature review was done in order to assimilate and become familiar with previous knowledge about the research question. (View Chapter 2)

Phase 1: Planning		
Steps	**Criteria**	**Application**
3. Determine design of research	The study design should interpret study findings correctly without bias.	A quantitative, non-experimental, explorative, descriptive, correlation design was applied to this study. (View section 3.2)
4. Design questionnaire	The preliminary questionnaire was amended after expert input.	The preliminary questionnaire was scrutinised by experts in the field of aviation medicine and tested by four independent health care professionals prior to finalisation. (View section 3.3.1.2)
5. Determine population	This represented a complete set of subjects in which the researcher was interested and wished to generalise the findings to.	All health care professionals involved in air ambulance transfers in sub-Saharan Africa were selected for participation in this study. (View section 3.3.1.3)
6. Develop sampling plan	Sampling was done so that it was representative of the whole population.	Purposive sampling was used in this study. All service providers in air medical transfers were purposefully selected to participate in this study. (View section3.3.1.3)
Phase 2: Empirical data		
7. Conduct a pre-test	This was conducted to determine whether any unforeseen problems would present in the study.	The questionnaire was sent to four experts in the field of air medical transfers to test before distributing it to the sample population. (View section 3.3.1.3)
8. Data collection	A pre-established plan was followed with the distribution and collection of the data.	Participants completed an electronic questionnaire which was sent back to an independent person to maintain anonymity. (View section 3.3.1.3)

Phase 3: Interpretation		
Steps	**Criteria**	**Application**
9. Data analysis	The data were summarised and then analysed and interpreted.	A statistician assisted the researcher with the analysis and interpretation of the data. (View section 3.3.1.3)
10. Data interpretation	The analysed data were interpreted by the researcher in conjunction with the statistician.	The data were interpreted in order to formulate the findings. (View section 3.3.1.3)
11. Interpret results	Results were interpreted in order to draw conclusions.	Answers with regard to the research question were formulated and discussed. (View Chapter 4)
Phase 4: Communication phase		
12. Communicate findings	A research report was written to communicate the findings.	The research report was set out in five chapters. (View Chapters 1 to 5)

The research method, including the design and methodology utilised in the study, is discussed in depth in Chapter 3.

1.7 SIGNIFICANCE OF THE STUDY

LoBiondo-Wood and Haber (2006: 51) state the significance of a study relates to its potential to contribute to the body of scientific knowledge.

By addressing the distinctive challenges concomitant with the transportation of critically ill or injured patients via air ambulance, it is the belief of the researcher that this study will:

- provide more insight into and understanding of the specific challenges health care professionals experience in this environment;
- increase the job satisfaction of these health care professionals;
- lead to improved collaboration between members of the air transport team;

- enhance the continuous professional development of the health care professionals; and
- contribute significantly towards positive patient outcomes.

1.8 SCOPE AND LIMITATIONS

The scope of this study was only applicable to air ambulance service providers in sub-Saharan Africa, and was therefore not representative of other fixed wing air ambulance services in other countries. Samples were not stratified for the purpose of investigating, for example, helicopter transportation.

In the view of Burns and Grove (2005: 39) limitations refer to problems or restrictions in a study that may limit the degree to which findings can be generalised to the study population.

A limitation was that not all of the invited air ambulance service providers in sub-Saharan Africa responded or agreed to participate in this study. This resulted in a relatively small sample size (N=58), which, in turn, led to limitations in predicting the statistical differences. Measures to minimise errors were implanted, but as respondents were required to complete a questionnaire, the assumption had to be made that they would answer truthfully.

1.9 LAYOUT OF THE STUDY

The layout of this study is as follows:

- Chapter 1 presents the outline and introduction to the study as well as a brief discussion of the research design and methods used.
- Chapter 2 covers the literature review regarding the air ambulance transport of patients globally, based on the input-throughput-output systems approach used in the study.
- Chapter 3 describes the research method in depth.

- Chapter 4 contains the results of the study and a literature control applicable to the research findings.
- Chapter 5 contains the conclusions, recommendations and limitations of the study.

1.10 CONCLUSION

In Chapter 1 the background to the research problem, the problem statement, research questions, aim and objectives, the researcher's frame of reference, and the research method were addressed. The limitations of the study and an overview of the layout of the study were also mentioned.

In Chapter 2 a comprehensive literature review on the history of air ambulance transport, rationale and modes of transport, air transport team and the systems approach and how it applies to air ambulance transport, is provided.

In Chapter 3 the research design, research methodology and ethical considerations for this study are discussed in depth.

Chapter 4 presents the results of the data analysis. This includes the research results as set out in the input-throughput-output model. It is further subdivided into sections A to F.

Chapter 5 entails the conclusions, limitations and recommendations. The aims and objectives are described followed by the conclusion. This is discussed within the input-output-throughput model. Recommendations are made based on the conclusion and future research is discussed. This chapter is concluded with the researcher's personal reflections and a summary.

2 LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 provided an orientation to the study. This chapter gives an overview of the history of ambulance services, focusing on air ambulance services in sub-Saharan Africa. In addition, it delineates the different modes of patient transport, the health care professionals involved in transporting patients via air ambulances and the equipment required for patient transport. The input-throughput-output systems approach utilised as conceptual framework for the study is utilised to guide the discussions.

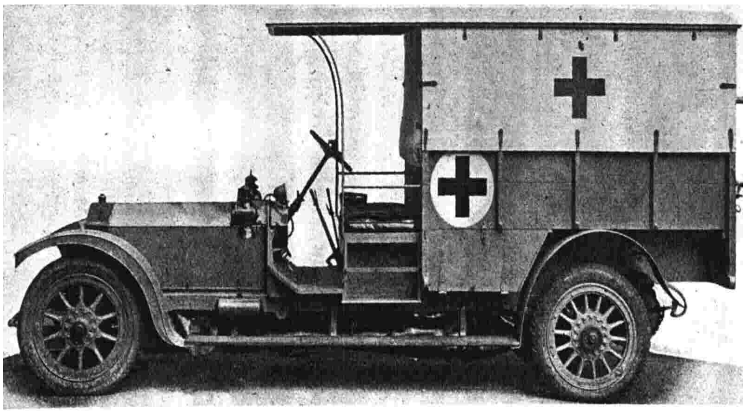
2.2 HISTORY OF THE USE OF AMBULANCES

Going back as far the 1400s, history regarding ambulance services is vague. However, it is mentioned by Holleran (2003: 1) that horse carts were used as road ambulances at the time (View Picture 2.1). During the France-Prussian War (1871) hot air balloons were used as ambulances to transport the wounded from the battlefield (Wheeler, Wong & Shanley 2007: 308). Automobiles of various kinds eventually replaced the horse carts while helicopters and airplanes replaced the hot air balloons (View Picture 2.2).

Picture 2.1: Horse-drawn ambulance *(Source: Firegeezer the Digital Day room: picture 1)*

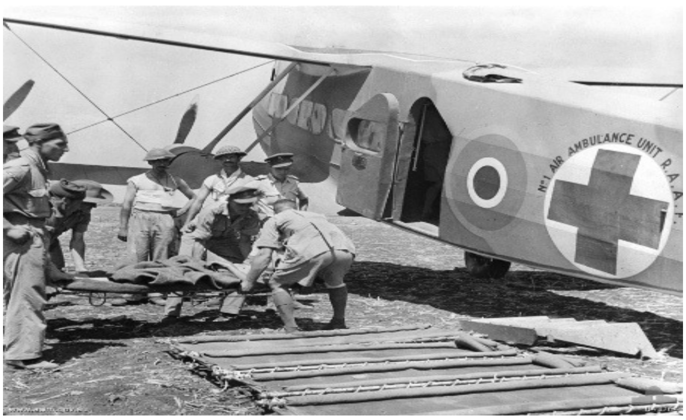
Similar developments were found regarding the health care professionals involved in the transportation of patients. Pre-hospital nursing care is considered to have originated in the work done by Florence Nightingale, worldwide regarded as the founder of the nursing practice, during the Crimean War (1854-1856) (Holleran 2003: 1). The earliest form of paramedic assistance can be traced back to World War I (WWI) between 1914 and 1918 when volunteers with only basic first aid training were used to transport the injured from the battlefield. Later, corpsmen were trained to do this work; they later became known as 'field medics' (Holleran 1). In the United States of America (USA) the first training course for 'paramedics' - as they are known today - was presented in the late 1960s (The Wisconsin EMS Association 2007).

During the American Civil War (1861-1865) a system for transporting the wounded and ill was devised which included transportation by road, steam boats as well as trains. In 1865, the first hospital-based road ambulance service provider was started in Cincinnati, Ohio (Holleran 2003: 1).



Picture 2.2: Example of first motorised ambulances *(Source: M. Homer 2006: picture 1)*

Although various attempts were made during WWI to find ways of transporting the wounded and ill **from** the battlefield, it was found to be easier to simply transport flight surgeons **to** the battlefield. However, according to Holleran (2003: 1) and Wheeler *et al.* (2007: 308), the French and Serbian Armies did manage to transport patients successfully from the battlefield by means of aircraft during this war (View Picture 2.3).



Picture 2.3: Fixed wing air ambulance *(Source: No.1 Air Ambulance Unit RAAF 2008-2011: picture 1)*

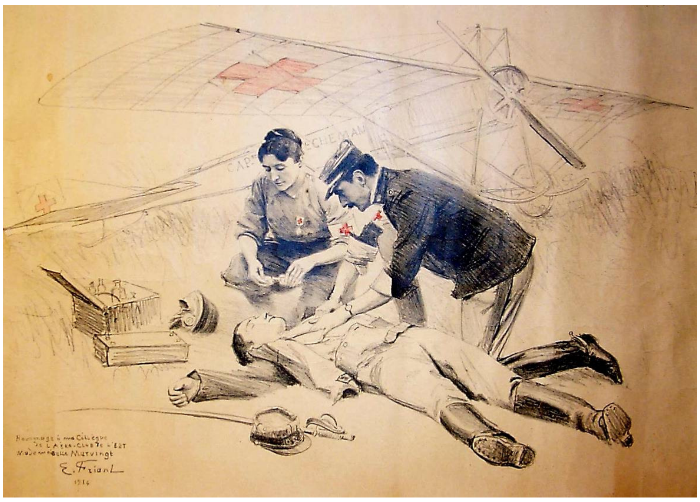
Beninati *et al.* (2008: s370) explain that, because of the many difficulties experienced with the evacuation of the wounded soldiers during WWI, the United States Army Air Corps developed an organised evacuation system in World War II (WWII) (1939-1945). This included wounded soldiers being transported from the battlefield to a designated care point. As a result of these systems implemented during WWII, air medical transport continued to develop after the war. It subsequently became more specialised with air ambulances and dedicated, trained medical personnel on board each aircraft, thus shaping air ambulance services into those currently in operation. The first flight nurses graduated from their 4-week training in Bowman, Kentucky, USA, in 1943. They were taught flight physiology, survival skills and aircraft loading skills (Air Ambulance Service Companies: History 2009).

The first helicopter evacuation was during WWII (1939-1945). British troops had fallen behind Japanese lines and no airplane could land to pick them up. They were evacuated by means of a small helicopter, the Sikorsky YR-4B (Wagner 2011: [2]). (View Picture 2.4).

Picture 2.4: First helicopter used as an air ambulance *(Source: Olive-drab.com 1998-2003: picture 3)*

During the Korean War (1950-1955), air evacuation specifically by helicopter became the preferred method of medical evacuation. Air evacuations became more specialised during the Vietnam War (1955-1975) and later the Gulf War (1991) with patients being rapidly evacuated from the battlefield to a pre-determined point of care (McGinnis, Judge & Nemitz 2007: 353; Air Ambulance Service Companies: History 2009). The first permanent civilian helicopter air ambulance service was started in Munich, Germany in 1970. Shortly afterwards, in 1972, the first hospital-based air ambulance service in the USA was started in Denver at the St. Anthony Central Hospital (Mercyflight New York 2010).

In 1910, Marie Marvingt, a flight doctor, advocated using fixed wing air ambulances but the suggestion was ignored by the French Government. It was only in 1934 that she was able to establish the first air ambulance service in Morocco, Africa. Morocco was the ideal location for an air ambulance service due to the remoteness of the area (Lam 2002). Marie Marvingt presented various seminars and conferences on aviation medicine. In 1929 she was one of the organisers behind the First International Congress on Medical Aviation (Lam 2002). View Picture 2.5 for a sketch of Marie Marvingt, depicting her as a flight doctor managing a patient.



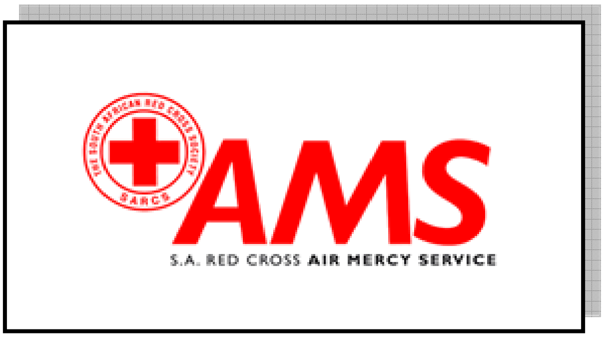
Picture 2.5: Sketch of Marie Marvingt, a flight doctor *(Source: Friant [n.d]: picture 1)*

In 1928 the Royal Flying Doctor Service was started in Australia; the first air ambulance service set into operation. The Royal Flying Doctor Service still provides medical care to people living in far and remote areas in Australia (The blog with a lot of topics 2009). View Picture 2.6 which provides an example of an airstrip used by the Royal Flying Doctor Service. From the picture it is evident that air ambulances flew to isolated areas using gravel roads which were not dedicated airstrips.

Picture 2.6: Royal Flying Doctor Service emergency airstrip (Source: Portal: Australia/Featured picture 2007: week 8)

Sir Michael Wood started the Flying Doctors of East Africa in 1957 which remains operational currently as part of the African Medical Research Foundation (AMREF). This service operates from Nairobi, Kenya and throughout Africa (Macnab 2006: 256).

The South African Red Cross Society was started in 1896. Seventy years later, in 1966, the South African Red Cross Society formed the Air Mercy Services (View Picture 2.7). Currently, the Air Mercy Services (AMS) collectively have eight branches, namely in the Northern Cape (1), Western Cape (2), Mpumalanga (1), Limpopo (1), Free State (1) and KwaZulu-Natal (2). These branches operate both fixed wing and rotor wing air ambulances (Exadaktylos *et al.* 2005: 106; Air Mercy Services: Bases 2010).



Picture 2.7: Air Mercy Services: SA Red Cross *(Source: Hazelden Design [n.d.])*

The Department of Health of the Northern Cape together with the South African Red Cross Society started the South African Red Cross Flying Doctor and Health Outreach Service in March 1996. This service transports specialists to local hospitals, thereby reducing the number of patient transfers by road with up to 90% (Flying Doctor outreach service launched in KwaZulu Natal 1998: 35). These specialists guide local doctors and nurses in an attempt to reduce referrals to higher level hospitals with more facilities. The South African Red Cross Flying Doctor and Health Outreach Service also manages an effective cold chain delivery system for vaccines to other hospitals, and transports patients to the higher level hospitals in emergency cases.

In KwaZulu-Natal the South African Red Cross Flying Doctor service was started on 8 June 1998 as a joint operation between the South African Red Cross and the Department of Health following the great success achieved in the Northern Cape. The South African Flying Doctor Service makes use of volunteer dentists, optometrists and specialists to provide a service (AMS: Services 2010). Quoted from their website, the AMS: Services (2010) state:

> *…in a land characterised by vast distances, the AMS has become a vital conduit for delivery of regular healthcare services to peripheral areas. We work closely with provincial departments of health and health workers in the community to assess need, identify backlogs and implement appropriate healthcare programmes.*

Subsequently, more air ambulance services have been established in South Africa, for example Air Rescue Africa and Netcare 911. These services provide air ambulance services within South Africa as well as in sub-Saharan Africa. Table 2.1 provides a summary of the history of ambulance transport.

Table 2.1: Summary of the history of ambulance transport

Year	**Ambulance services**		
	International ambulance services	**Africa air ambulance services**	**South Africa air ambulance services**
1400s	***Horse carts*** Ambulance transport		
1861-1865	***American Civil War*** Road, trains and boats		
1865	***Ohio, USA*** 1st hospital-based road ambulance service		
1910		Marie Marvingt advocated fixed wing air ambulance services, ignored by government	
1914-1918	***WWI*** Helicopter air ambulance used to transfer doctor to patient in the battlefield		
1928	***Australia*** 1st fixed wing air ambulance (Royal Flying Doctor Service)		
1929	1st International Congress on Medical Aviation		
1939-1945	***WWII*** Helicopter air ambulance used for organised medical air evacuations from battlefield		
1957		***Kenya*** Fixed wing air ambulances: Flying Doctors of East Africa	
1966			***Cape Town*** South African Red Cross Fixed wing
1970	***Munich, Germany*** 1st civilian helicopter air ambulance service started		
2010	Air ambulance services exist throughout ***sub-Saharan Africa*** and worldwide These are both fixed wing and helicopter air ambulances (civilian and military)		

2.3 TYPES OF PATIENT TRANSFERS

The transport of a patient means the physical movement of a patient from one facility to another, or from the scene of an accident to a treating facility irrespective of the mode of transport (Robinson 2007: 1012). According to Bristow and Toff (1992: 767) and Martin (2003: 131), there are three types of patient transfers, namely: *primary*, *secondary* and *tertiary* patient transfers.

Primary transfer is defined as transporting the patient from the scene of the accident or incident to an emergency facility or hospital. It further means taking emergency medical care to the site of an emergency (Bristow & Toff 1992: 767). The mode by which primary transport is rendered is usually by means of road ambulances, but it can also be by rotor wing air ambulances and, in remote areas, by fixed wing air ambulances (Davenport 2004: [1]). Various studies have been done without providing proof that helicopters decrease mortality and morbidity (Koppenberg & Taeger 2002: 213).

Secondary transfer is the transport of a patient between treating facilities. This, however, does not mean that interfacility transfers are not done in high-priority cases (Bristow & Toff 1992: 767). Gray *et al.* (2004: 281) state a secondary transfer should only be considered if it will improve the patient's outcome. Furthermore, it should be done in such a manner so as not to jeopardise the current level of necessary care being rendered according to the patient's condition (Lamb 2003: 101).

The reasons for interfacility transfers may differ. Common indications for such a transfer may include the lack of available resources, state or government protocols, or even family requests (Proehl 2009: 922). A coordinator from an insurance company will evaluate the patient's condition and base the decision to move the patient on company protocols and the condition of the patient. The patient may be moved to a facility capable of supplying additional or specialised care for his or her needs.

The transferring physician or person may also realise that the requirements of the patient's injury or illness exceeds what the facility can offer (Koppenberg & Taeger 2002: 211; Warren *et al*. 2004: 256). Grissom and Farmer (2005: s13) state the availability of beds in intensive care units are a scarce resource and patients may have to be transported to the nearest facility where a bed is available.

Tertiary transfer is the repatriation of a patient either for follow-up specialist care or transport to the country of origin (Bristow & Toff 1992: 767; Martin 2003: 131). The patient is usually transported by means of a fixed wing aircraft. This may be either an air ambulance or commercial airliner (Bristow & Toff 769; O'Shea 2005: 84.)

In primary, secondary and tertiary transfers the ultimate goal is to render definitive care to the patient as soon as possible in order to decrease the mortality and morbidity rate (Van Hoving *et al.* 2008: 136). Robinson (2007: 1015) adds an unstable critically ill or injured patient should be transported by the fastest means available and by a medical team able to render appropriate levels of care; Gunnarsson *et al.* (2007: 1) believe though that the longer it takes to reach appropriate care, the higher the level of skill is needed during transport of the patient.

2.4 MODES OF TRANSPORT

Different modes of transport are used during primary, secondary and tertiary transport of patients. These include road ambulance transport, helicopter air ambulances, fixed wing air ambulances, commercial air ambulances and boat ambulances. Each of these modes will be discussed in sections 2.4.1 to 2.4.5.

Koppenberg and Taeger (2002: 212) believe the decision about the mode of transport should be made in the best interest of the patient.

Listed below are the various factors which influence the choice with regards to the mode of transport.

- **The nature of the patient's illness**: All ambulances are equipped and staffed according to the type of patient that it transfers as noted by Koppenberg and Taeger (2002: 212). In patients with spinal injuries transfer by helicopter air ambulance is beneficial as this reduces the risk of secondary spinal injury (Black, Ward & Lockey 2004: 359).
- **Urgency of the transfer**: In some cases it takes longer to summon air transport than it would to transport the patient by road ambulance (Black *et al.* 2004: 355, 357). For example, if the ambulance has no health care professionals on board at the given time and they have to be sent for, it may take longer for them to assemble, prepare for the flight and then fly to collect the patient than just transferring the patient via a road ambulance.
- **Availability of the mode of transport**: Specialist teams may be needed for two transfers simultaneously (Gray *et al.* 2004: 282).
- **Mobilisation times**: Wallace and Ridley (1999: 319) explain the mobilisation of the transport team may delay the transfer times. Dickerson and Palmer (2005: 201) note that average activation to take-off time of fixed wing aircraft in South Africa is 1.6 hours.
- **Geographical factors**: In some cases the landing site is not at the emergency facility. This necessitates a further transfer via ground ambulance (Black *et al.* 2004: 355; Gray *et al. 2004:* 282). Of course, if inaccessible terrain can hamper road transfers then air transfer becomes the mode of choice (O'Shea 2005: 84). According to Rodig (Paper unpublished 1998: 5-1), air ambulances are the mode of choice during search and rescue operations. Martin (2003: 131) states a characteristic of helicopters that adds to the advantage of helicopter transport, is its ability to operate in confined spaces.
- **Traffic and weather conditions**: During road disruptions air transport is preferable to road transport (O'Shea 2005: 84). Although a certain choice of transport may be preferred, it is still subject to weather conditions (Pollak 2011: 12)

- **Cost**: Coats and Goode (1999: 1292) assess that the cost of an air ambulance is three times higher than that of a ground ambulance.

Only once all the factors influencing the mode of transport have been considered and assessed by all role players involved, can the appropriate mode of transport be decided on.

2.4.1 Road ambulance

A road ambulance is a ground vehicle dedicated to the transport of a patient. This could be used for primary, secondary or tertiary transfers (Pollak 2011: 9) (View Picture 2.8).

Picture 2.8: Example of a road ambulance *(Source: Oxyman 2007).*

According to Lamond (2004: 375), in South Africa a road ambulance can be used in a radius of up to 300 km, while Jones and Young (2004: 11) suggest the maximum radius should be 100 miles (± 160 km) after which an air ambulance should be used. Exadaktylos *et al.* (2005: 107) explain that the AMS suggests that road ambulances should only be used in a 50 km maximum radius.

Robinson (2007: 101) states in the Emergency Nursing Core Curriculum that, if a patient's condition is not life-threatening, road transport should be considered irrespective of the distance. A study conducted in the United Kingdom (UK) suggests that, if the patient transport should take longer than 45 minutes, an air ambulance should be used (Black *et al.* 2004: 355). This is shorter than the time recommendations made by Gray *et al.* (2004: 282) state air ambulances should only be used if transfers are estimated to take longer than 90 minutes – this would be approximately 80 km. Moreover, Gupta *et al.* (2004: 110) recommend in cases of patient transfers exceeding 150 km, air transport should be considered. Black *et al.* (355) furthermore advise that, should the patient be too unstable, road transport is preferable as medical interventions which cannot be performed in a helicopter may be needed.

It is evident that no standard applies with regard to the mode of transport used as an ambulance.

2.4.2 Helicopter air ambulance

A helicopter is an aircraft of which the ability to lift vertically is derived from aerodynamic forces acting due to one or more rotors turning (Merriam-Webster online dictionary). The helicopter is usually used for primary transport - meaning from the scene of an accident to the emergency department (Martin 2003: 132) (View Picture 2.9).

Picture 2.9: Helicopter air ambulance *(Source: Janders 2009)*

According to Pollak (2011: 43) and O'Shea (2005: 84), helicopters can be used for a variety of missions, including interfacility transfers and scene responses, as well as for numerous other purposes such as organ transport or search and rescue operations.

The patient's specific injuries can also determine the mode of air transport. Coats and Goode (1999: 1292) note in cases where the terrain does not permit road access, helicopters are deemed the best mode of transport. Black *et al.* (2004: 355) maintain it is exactly the critical condition of the patient that makes helicopter transfers hazardous. Wallace and Ridley (1999: 369) note it is important to consider that helicopters have a worse safety record than fixed wing aircrafts. They add a helicopter is also very expensive and most are not very comfortable or patient friendly.

Lamond (2004: 375) indicates that in South Africa the helicopter range should not exceed 300 km. This is similar to the statement of Exadaktylos *et al*. (2005: 107) that a helicopter will be used if the distance for transport of a patient ranges between 50 km and 200 km.

It remains vital to recognise that the benefit of an air ambulance lies in the speed with which definitive care is rendered to the patient as this can influence the patient's outcome (Naylor & McLellan 1996: 1348; Robinson 2007: 1014; Belway *et al*. 2008: 288).

2.4.3 Fixed wing air ambulance

A fixed wing aircraft is commonly known as an airplane or aeroplane in the vernacular (Concise Oxford dictionary). Lamond (2004: 375) suggests transfers further than 300 km away should be performed by fixed wing air ambulances, while Exadaktylos *et al.* (2005: 107) state in transfers exceeding 200 km a fixed wing air ambulance should be used. Uusaro *et al.* (2002: 1125) advise air ambulance transfer of a patient if the distance is more than 80 km.

Picture 2.10: Example of a dedicated fixed wing air ambulance *(Source: Boisaubert [n.d])*

A fixed wing air ambulance aircraft is permanently equipped with medical equipment which has been approved by the local national regulatory authority (Bristow & Toff 1992: 767) (View Picture 2.10). The aircraft has specialised equipment such as ventilators, incubators for infants and even machines for dialysis. Some of these aircraft have the ability to pressurise the cabin which enable them to fly at greater heights (Air Ambulance Service Companies: History 2009). Turbo prop planes or small business jets are examples of fix wing aircrafts that are generally used, but because they have limited cabin space, it could restrict access to equipment (Dewhurst *et al*. 2001: 883).

Dedicated air ambulance services are not uncommon, but staffing them with personnel who are available at short notice and who is familiar with the lengthy flights are hard to find (O'Shea 2005: 85). Air transport brings the resources needed for definitive critical care to the patient more swiftly, especially in Africa where tertiary care and facilities with definitive care are mostly inaccessible. Highly skilled and knowledgeable staff is brought to the patient and a high standard of care is maintained throughout the transfer (Rajah & Lasersohn 2000: 21; Beninati *et al.* 2008: s37). Stabilisation in the field is known to reduce the risk of morbidity and mortality; this is mainly because of the decrease in the risk of deterioration of the patient during the transfer (Rajah & Lasersohn 2000: 21)

Due to the high costs involved in the air ambulance transfer of a critically ill or injured patient, the benefits in transferring the patient must outweigh the risks (Koppenberg & Taeger 2002: 212; Warren *et al.* 2004: 256).

2.4.4 Commercial air ambulance

Teichman *et al.* (2007: 263) state larger, faster and cheaper aircraft can be used for the repatriation of travellers who have fallen ill away from their homes or countries. In such cases, a commercial aircraft is a cheaper alternative. Commercial aircrafts are also faster due to their long-range fuel tanks and limited technical stops (Teichman *et al.* 2007: 263). Although commercial air travel is more cost-effective than an air ambulance, it can only be used when a patient requires minimal medical intervention, and also if the patient's condition permits travelling on a commercial aircraft. O'Shea (2005: 85) mentions that privacy is unfortunately limited on a commercial aircraft.

Picture 2.11: Example of a customised and fully equipped patient transport compartment

(Source: Author)

Some commercial airliners have specialised areas in the aircraft dedicated to the transport of ill or injured patients on a commercial aircraft; for example, the Patient Transportation Compartment available on the German airline, Lufthansa (View Picture 2.11). This compartment offers the privacy lacking on other commercial aircraft. It is fitted out with specialised equipment for the transport of critically ill and injured patients (Japanese Society of Travel Medicine 2011).

2.4.5 Boat ambulance

Boat ambulances fit this description as it is used to transport casualties (Webster's online dictionary: Vehicle types [10]).

The first example of a boat ambulance is a boat ambulance in Venice, Italy. Due to the absence of any roads in and around Venice, all emergency services, including ambulance transport, are rendered via boat (Italy Heaven 2010). Picture 2.12 depicts a boat ambulance in Venice.

Another form of boat ambulances are hospital ships used by the military, for example, the US Navy. According to the Federation of American Scientists (2010), these ships perform two distinct functions:

- they provide emergency medical care to casualties of war outside of their home country; and
- assist other governmental organisations in relief projects in the case of disaster or humanitarian operations.

Due to the fact that 20% of the world's population resides next to waterways, a medical boat has been established on the Amazon River in Brazil. The medical boat provides medical services to 22 000 people, including 3 000 children and more than 500 pregnant women. More such boats might be implemented in Africa along the Orange, Zambezi and Congo rivers. These boats are made available because of donations from charity organisation (Global Charity Association 2011).

Rescue boats in South Africa are operated by the National Sea Rescue Institute (NSRI). The NSRI does not only partake in sea rescues, but also inland water rescues. They have 30 coastal and three inland bases from where they operate 72 boats. The service is run by over 900 unpaid volunteers (National Sea Rescue Institute 2011).

Picture 2.12: Example of a boat ambulance *(Source: Heyns 2009)*

2.5 TRANSPORT TEAM

It is important to understand that an air ambulance is a mobile critical care unit and should thus have qualified health care professionals on board (Lamb 2003: 101). According to Grissom and Farmer (2005: s15), the environment should be suitably staffed with personnel capable of working in specialised areas. Irrespective of the combination of the crew, they must be able to perform advanced cardiac life support should the patient's condition require it (Warren *et al.* 2004: 260).

Various sources (Koppenberg & Taeger 2002: 212; Warren *et al.* 2004: 257; Leggat & Fischer 2006: 143) describe various combinations of health care professionals on air ambulances. Grissom and Farmer (2005: s15) and Jones and Young (2004: 11) state the crew usually consists of two members, one of which is a critical care registered nurse. The second member of the team depends on the patient's condition or illness and can either be a doctor, a paramedic or a respiratory therapist. Koppenberg and Taeger (2002: 212) explain that, although both the paramedic and the respiratory therapist may be as skilled as physicians in intubating patients, the use of Intensive Care Unit (ICU) speciality nurses may reduce the "rate of mishaps dramatically"; therefore they advise that personnel trained and experienced in the critical care field should conduct these transfers. It is interesting to observe that The US Army almost always makes use of a three member team, namely, a doctor, a critical care nurse and a respiratory therapist (Beninati *et al*. 2008: s371).

Frakes and Lord (2004: 38) state nurses constitute 97% of the staff on both rotor and fixed wing transfers. In some cases no paramedics are allowed as they are specifically trained for the pre-hospital environment and are not familiar with the critical care environment (Koppenberg & Taeger 2002: 212).

The training of the transport teams are unfortunately not regulated by any governing body at present. Dewhurst *et al*. (2001: 887), Grissom and Farmer (s15) as well as Teichman *et al.* (2007: 264) concur that there is currently no international or federal standards for the training of transport crews in either the USA or the UK. Currently, the only accreditation available is either from the Commission on Accreditation of Medical Transport Systems (CAMTS) or from the European Medical Air Institute (EURAMI). CAMTS is an American based accreditation service focusing on all patient transport systems, while EURAMI focuses on the European air ambulance services. Accreditation from both these services can be obtained by air ambulance service providers outside the USA and Europe. The accreditation is voluntary and renewable every three years. (EURAMI 2010; CAMTS 2009). Both CAMTS and EURAMI require that the air ambulance company needs to comply to preset standards to obtain this accreditation. This, however, does not touch on the subject of training, but does set a standard of care to be provided by air ambulance services (Grissom & Farmer 2005: s16). Only one company in South Africa is currently CAMTS accredited, namely Air Rescue Africa (CAMTS 2009). Netcare 911 is EURAMI accredited (EURAMI 2010).

According to Jones and Young (2004: 12), the different states in the USA each have their own minimum requirements. The general requirements include that the flight registered nurse should have three to five years' experience in critical care nursing. They should also be current in Advanced Cardiac Life Support and Paediatric Advanced Life Support. Additional qualifications include: Neonatal Resuscitation Program, Pre-hospital Trauma Life Support, Basic Trauma Life Support, Trauma Nurse Core Course or Trauma Nurse Advanced Trauma Course. They must also be registered as a critical care registered nurse, emergency registered nurse, or certified flight nurse. Some states require the flight registered nurse to be trained as emergency medical technician or even emergency medical technician-paramedic. According to Wrobleski and Vukov (1996: 158), there is still an immense difference in skills and knowledge among registered nurses due to the lack of standardisation in training. This includes those registered nurses with a post-basic qualification in critical care or accident and emergency nursing.

Currently in the UK registered nurses wanting to join the military aero medical field undergo a five week training programme. In this time they undergo training in flight physiology, and then later go on to supervised flights before they are allowed to transport patients. It is important to note that these registered nurses then already have a post-basic specialist nursing qualification (Lamb 2003: 94). Doctors also have a specialisation qualification, usually in anaesthetics, with at least two years' postgraduate experienced in critical care (Wallace & Ridley 1999: 369).

Grissom and Farmer (2005: s15) explain in the USA paramedics can join the National Flight Paramedics Association. The minimum standards they set out entail that the health care provider should be a qualified emergency medical technician-paramedic; this is equivalent to being an ALS paramedic in South Africa. The flight paramedic in the USA should also be current in Basic Life Support, Advance Cardiac Life Support as well as aero medical courses. Lastly, these paramedics must have three years' experience of working as an emergency medical technician-paramedic. In South Africa crews should be trained in Advanced Cardiac Life Support, Paediatric Advanced Life Support, Advanced Trauma Life Support, Advanced Neonatal Life Support or Neonatal Resuscitation Program as well as the aero medical courses available (Dickerson & Palmer 2005: 201). The Civil Aviation Authority (CAA) compels crews to annually take part in CAT 138 training in South Africa. This entails some survival techniques and general aviation knowledge (Rajah & Lasersohn 2000: 22).

Although no international standard exists, it is still of the utmost importance that health care professionals should be adequately trained in the field of aero medical transport prior to transporting patients (Dewhurst *et al.* 2001: 882).

2.6 AIR TRANSPORT

For the purpose of the study specific attention was given to the air transport of patients by means of fixed wing aircrafts. The discussion will be led by the pre-flight (input), in-flight (throughput) and post-flight (output) considerations that are required during air transportation.

2.6.1 Pre-flight considerations (Input)

Specific pre-flight considerations are discussed, and include administrative duties, patient information, advanced emergency equipment, drugs and miscellaneous considerations.

2.6.1.1 Administrative

Administrative considerations include the availability of health care professionals, the medical condition of the patient, and the relevant funds available for the transport.

The mode of air ambulance service should also have health care professionals with adequate expert levels of skill and knowledge necessary to match the patient's current as well as potential needs. Proehl (2009: 923) states the patient's condition influences the equipment needed for the air transport. This statement is supported by Robinson (2007: 1014). The level of care required by the patient versus the level of care rendered within the different patient transport services also influences the mode of transport (Robinson 2007: 1013; Teichman *et al.* 2007: 262).

The availability of funds can alter the mode of transport chosen. Insurance companies often choose to go with the cheapest service provider (Teichman *et al.* 2007: 268). On the other hand, insurance cover could prefer the patient to be transferred to a centre of definitive care (Dewhurst *et al*. 2001: 883). According to Leggat and Fischer (2006: 135), insurance cover could be the patient's only safety net when travelling abroad and the importance of this should be stressed to international travellers.

2.6.1.2 Patient information

Gupta *et al.* (2004: 109) make an important statement by saying that the safest place for a critically ill or injured patient is in a critical care unit, connected to state-of-the-art equipment, monitored continuously by specialised nursing staff. On the occasion that they are moved or transported, adverse effects may occur. It is generally agreed that the critically ill and injured patients already have deranged physiology, and that transporting these patients increases their morbidity and mortality (Wallace & Ridley 1999: 368; Uusaro *et al*. 2002: 1122). In order to reduce the possibility of the patient becoming unstable, the transport team must be able to anticipate any problems and act accordingly to prevent these incidents or any other associated with aero medical transfers (Teichman *et al.* 2007: 264; Beninati *et al.* 2008: s374).

Uusaro *et al*. (2002: 1122) believe that inter-hospital transfers of the severely ill and injured patient can be done safely, on condition that proper pre-transport preparations are made by the transport team. Relevant equipment and medication must be packed according to the patient's condition or illness. By not adhering to this the transfer can turn into a possible disaster (Teichman *et al.* 2007: 264).

Pre-flight preparation starts by obtaining patient information from the transferring facility. Gondwe and Brysiewicz (2008: 62) and Dewhurst *et al.* (2001: 883) point out that, especially in Africa, the first challenge is the different languages spoken. This means that valuable time is spent interpreting instead of obtaining care for the patient. There has to be good communication regarding the history and findings to determine what equipment would be needed for the patient. The report should preferably include a primary and secondary survey to give as much detailed information as possible to the transport team (Leggat & Fischer 2006: 143). Many international companies employ a medical director to coordinate the transfer between the sending facility, transport team and the receiving facility (Teichman *et al.* 2007: 263). Only after the patient information has been obtained is a mode of transport chosen.

2.6.1.3 Advanced emergency equipment

Equipment is specifically packed for every patient being transported by air. The equipment will depend on the type of aircraft used for the transport, the patient's condition, predicted interventions the patient will require, as well as the distance the patient needs to be transported (Lamb 2003: 100; Pollak 2011: 19). Although the equipment may differ, there is minimum advanced equipment that should be used during the transport of patients.

The Intensive Care Society of the UK set up minimum levels of care regarding transporting the critically ill or injured patients. The levels include a minimum of advanced life support knowledge and skills. In order to attain and maintain an advanced level of care throughout the transfer of the patient, similar equipment as found in the critical care units of other facilities should be available during air transport (Lamb 2003: 101).

Rajah and Lasersohn (2000: 21) maintain that equipment must be specific to the type of patient transported. Because equipment used for adults and children differ, it is essential that the correct equipment is available. For example, if a paediatric patient needs to be transported, paediatric specific equipment such as a ventilator, monitoring or transport equipment will be needed.

Other specifications pertaining to air ambulance equipment also need to be considered. Depending on the type of aircraft being used, on-board power is not always available; equipment should therefore have sufficient battery power available for continuous monitoring. In many aircraft convertors should be implemented to provide power during flight. Battery packs may also be needed (Wallace & Ridley 1999: 369; Grissom & Farmer 2005: 16; Teichman *et al.* 2007: 264). Equipment must also be robust, as it is moved around during transfer and loading of the patient (Wallace & Ridley 1999: 369; Beninati *et al*. 2008: s373). The "shock, drop and topple test" is mentioned by Lamb (2003: 96). This is descriptive of the harsh conditions equipment is exposed to all the time and after which they must still be in working condition. Not only must equipment be durable, but also lightweight and manageable (Venticinque & Grathwohl 2008: s287).

Most aircraft operators request that equipment first be tested as it might interfere with the radio frequency of the aircraft. The changes in altitude and cabin pressure may also influence medical equipment (Beninati *et al. 2008:* s373; Grissom & Farmer 2005: s16; Lamb 2003: 96). Venticinque and Grathwohl (2008: s287) and Lamb (2003: 97) emphasise that other environmental factors, for example, temperature and humidity, should not have any influence on the equipment. Lamb (2003: 96) and Beninati *et al.* (2008: s374) explain that vibrations from both fixed wing and rotor wing aircrafts may influence the equipment and must be tested beforehand. It is unacceptable to have only auditory alarms in the air ambulance as the noise levels inside the aircraft as well as on the tarmac make it difficult to hear; this can critically delay reaction time to respond to a change in the patient's condition (Lamb 96; Teichman *et al.* 2007: 267).

2.6.1.4 Drugs

The air transfer team should have access to advance drugs when transferring a patient. Although various authors, including Rajah and Lasersohn (2000: 25), Dewhurst *et al.* (2001: 886), Warren *et al.* (2004: 260) and Beninati *et al. (2008:* s373) all suggest which lists of drugs that should be available during an air ambulance transfer, it is not always possible to stick to the recommended drugs. Firstly, it depends on the availability of that particular drug in the specific country and, secondly, the particular drug can only be administered if its administration is within the scope of practice of the health care professional on board (Robinson 2007: 1019).

A summary of the drugs prescribed by the Advanced Cardiac Life Support (2008), the Neonatal Resuscitation Program (2006), the Paediatric Advanced Life Support (2006), and the South African Advanced Life Support Practitioner Protocols (2006) is presented in Table 2.2.

Table 2.2: Drugs advocated for air transport of patients

Drug	Advanced Cardiac Life Support (2008)	Neonatal Resuscitation Program (2006)	Paediatric Advanced Life Support (2006)	South African Advanced Life Support Practitioner Protocols (2006)
Adenosine	√		√	√
Activated charcoal				√
Adrenaline	√	√	√	√
Albumin	√		√	√
Amiodarone	√		√	√
Anticholinergic inhalants	√		√	√
Antihistamines	√		√	√
Aspirin	√			√
Atropine	√	√	√	√
B-Blockers	√			

Drug	Advanced Cardiac Life Support (2008)	Neonatal Resuscitation Program (2006)	Paediatric Advanced Life Support (2006)	South African Advanced Life Support Practitioner Protocols (2006)
B2-stimulant inhalants	√		√	√
Calcium channel blocker	√			
Calcium		√	√	√
Clopidogrel	√			√
Corticosteroids	√		√	√
Diazepam				√
Digoxin	√			
Dobutamine			√	
Dopamine	√	√	√	
Fibrinolytics	√			
Flumazenil				√
Furosemide			√	√
Glucagon	√	√		√
Glucose 50%	√	√		√
Heparin	√			
Labetalol	√			
Lignocaine	√		√	√
Lorazepam				√
Magnesium sulphate	√		√	√
Medical oxygen	√	√	√	√
Metoclopramide				√
Midazolam				√
Morphine sulphate	√			√
Naloxone		√	√	√
Nitroglycerin	√		√	√

Drug	Advanced Cardiac Life Support (2008)	Neonatal Resuscitation Program (2006)	Paediatric Advanced Life Support (2006)	South African Advanced Life Support Practitioner Protocols (2006)
Nitrous oxide		√		√
Phenobarbital		√		
Potassium	√			
5% Sodium (5%Na)	√			
Sodium bicarbonate	√	√	√	√
Surfactant		√		
Thiamine				√

In a study done by Rashford and Myers (2004: 270) it was mentioned that health care professionals participating in air ambulance transport must be higher skilled than other health care professionals in order to justify the mode of transport. One such skill is rapid sequence induction. Pollak (2011: 194) states these health care professionals must be highly prepared to manage patients in air ambulances who could be receiving a wide variety of drugs.

2.6.1.5 Miscellaneous considerations

Miscellaneous considerations include environmental control, sleep deprivation and personal insurance. Wallace and Ridley (1999: 369) state warming devices will be advantageous. Grissom and Farmer (2005: s17) maintain that temperature monitoring can and should be done meticulously, although this can become very challenging depending on the environmental temperature. This factor can be detrimental to the patient's outcome (Smith 2008: s297).

It is crucial to recognise that a patient isolation unit is needed to transport a patient with an infectious disease (Teichman *et al.* 2007: 266). In the USA the military is called upon to transport highly infectious disease patients. In South

Africa patients with infectious diseases can be transported by Air Rescue Africa, an air ambulance provider, as they do have a patient isolation unit available (Air Rescue Africa 2010).

Frakes and Kelly (2007: 46) state fatigue and disruption in the circadian rhythm of health care professionals may have detrimental effects on both the patient and safety operations. According to them, even losing only two to three hours of sleep may decrease cognitive performance by 25%. The authors mention a few examples of poor performance: personnel working during the night have a 50% greater incidence of blood borne pathogen exposure than personnel working daytime shifts. Intubation times increase as found during mannequin intubation sessions, and a greater incidence of traffic violations was observed among night shift personnel. Gander *et al*. (1998: B9) found that during commercial flights where crew members were allowed to take turns sleeping, crew members recorded difficulty in falling asleep, and also sleeping lighter and for shorter times. It was also noted that crew members had a higher caffeine intake than usual in order to fight fatigue.

Adequate death or disability insurance cover for the crew is essential (Wallace & Ridley 1999: 370). A study in the UK within the National Health System showed that less than 30% of hospitals provide adequate cover for personnel transporting patients. They are subsequently urged to join an organisation that will provide them with the necessary death and disability cover while they are transporting a patient (Ahmed & Majeed 2008: 504).

2.6.2 In-flight considerations (Throughput)

On arrival at the transferring facility, appropriate assessment, management of life-threatening conditions and stabilisation of the patient is imperative as the risk of the patient deteriorating increases the moment the patient is moved (Proehl 2009: 4). Stabilising the patient prior to transfer may increase the flying time, but Koppenberg and Taeger (2002: 211) as well as Leggat and Fischer (2006: 144) believe this is the safest for the patient as the incidence of adverse effects are lowered drastically. Grissom and Farmer (2005: s13) add it is important to note that pre-flight preparation may require care beyond the resuscitation phase, thus supporting the view of Wallace and Ridley (1999: 370) and Beninati *et al.* (2008: s374-5) that stabilisation is needed prior to take-off to reduce adverse effects during flight. This means that procedures are performed in unfamiliar surroundings, for instance, the tarmac or transferring facility.

As noted by Dewhurst *et al.* (2001: 885-6), in many cases there is a language difference between the transferring staff and the air crew, which adds to the strenuous environment. O'Shea (2005: 82) refers to prior assessment as of cardinal importance because life-threatening emergencies should be handled immediately. This includes managing the airway and breathing requirements of the patient, adding intravenous lines as deemed necessary, and evaluating the cardiac function and vital signs. Spine and limb immobilisations are done as needed. Leggat and Fischer (2006: 144) further advocate that, if proper stabilisation was done prior to the flight and monitoring is continuous, the flight should be uneventful. Warren *et al.* (2004: 262) add flight physiology should be taken into consideration for further management during the flight.
Warren *et al.* (261) and Teichman *et al*. (2007: 264) indicate that "Scoop and run" without stabilising the patient may only be done in life-threatening situations.

2.6.2.1 Aviation physiology

Aviation physiology - also known as transport physiology - entails four major components. These are temperature, volume, pressure and the relative mass of a gas. For better understanding of the latter, a summary of the gas laws (adopted from Holleran [2003: 42-3]) is provided in Table 2.3.

Table 2.3: Summary of the gas laws

Gas law	Brief description
Boyle's law	If the temperature remains constant, the volume of a mass varies inversely to the **pressure.**
Dalton's law	The pressure of a mixture equals the sum of the individual pressures from the **gasses.**
Charles' law	If the pressure remains constant, the volume of a gas is directly proportional to the **temperature.**
Henry's law	The amount of gas dissolved in a liquid is dependent on that gas' **solubility.**
Gay-Lussac's law	Should the volume of gas stay consistent, the pressure is directly proportional to the **temperature.**
Graham's law	Gasses will flow through a liquid from a higher to a lower **density.**

Understanding the gas laws is vital because, during flight, the pressure within the cabin decreases. According to Boyle's law (View Table 2.3), this would imply an increase in volume. The volume of gas in the cuff of an endotracheal tube will thus expand, causing tracheal necrosis. Another example is a patient with a small pneumothorax. When on the ground, the pneumothorax might not be life-threatening, but once the patient is airborne, the pneumothorax will expand, having detrimental effects on the patient. In other words, a few extra procedures should be performed in order to ensure patient safety and well-being during the flight. All air-filled tubes, for example, the endotracheal tube cuff, should be re-inflated with normal saline or, if these tubes are still filled with air, continuous monitoring of the pressure must be done (Beninati *et al*. 2008: s374; Kaczala & Skippen 2008: 91).

An example of Henry's law (View Table 2.3) would be in the case of decompression illness. Due to the increase in pressure, all the gasses in the bloodstream dissolve. During a decrease in pressure, or ascending from a dive, the nitrogen diffuses from the blood and tissues and forms gas bubbles. If the ascend is slow enough, the nitrogen will be expelled by means of breathing, but in the case of a rapid ascend the bubbles accumulate in the tissues, causing a decrease in the patient's condition (Caroline 2008: 35.23).

Dalton's law is of importance as a patient who may not have needed supplemental oxygen prior to the flight, may show signs of hypoxia during flight, as the same percentage of oxygen (21%) is still available, but at a lower pressure (Rajah & Lasersohn 2000: 22; Holleran 2003: 42-3; Teichman *et al.* 2007: 264-5; Beninati *et al.* 2008: s374).

Charles and Gay-Lussac's laws (View Table 2.3) apply to oxygen cylinders. The volume remains the same, but should the temperature rise, for example, when left out in the sun, the pressure inside the cylinder increases which can lead to an explosive decompression of the cylinder (Beninati *et al*. 2008: s374).

The patient is not the only consideration when preparing for transport, but the environment the patient is transported in is equally important. Teichman *et al.* (2007: 266-7) and Holleran (2003: 44) explain that environmental control is essential. Not only should equipment be secured in the aircraft to prevent injury to the crew or patient, but noise, vibration, temperature changes, decrease in humidity, and gravitational changes should be taken into consideration. Acceleration and deceleration forces should also be considered as they can lead to deterioration in the patient's condition (Teichman *et al.* 2007: 263).

The orientated patient should give informed consent for air ambulance transport prior to the transport. The benefit and risks involved in air ambulance missions must be explained to the patient prior to signing the informed consent. This should preferably be done in writing. Should the patient be illiterate, the legally authorised person should act on behalf of the patient (Warren *et al.* 2004: 258; Beninati *et al.* 2008: s374). The family of a patient must be orientated as to the proceedings. Should someone, for example, a family member, accompany the patient on the aircraft, the aircraft safety procedures as well as their function during the flight should be explained to them (Robinson 2007: 1022).

2.6.3 Post-flight considerations (Output)

Record keeping and debriefing are regarded as the two most important components of post-flight considerations.

2.6.3.1 Record keeping and documentation

No flight is completed until the documentation is done. The crux of documentation comes down to "If it is not documented it is not done." (Geyer 2005: 32; Owen 2005: 48; Nursingtimes.net 2007: [4]). Record keeping is seen by many as the most basic part of good nursing practice (Nursingtimes.net 2007: [1]).

Patient documentation serves multiple purposes. These have been identified by Cheevakasemsook *et al.* (2006: 367) and are supported by various authors:

- **Legal evidence of care rendered:** Owen (2005: 49) states it is the duplication of actions that provide the necessary legal protection. Rajah and Lasersohn (2000: 24) stress that documentation is the only legal defence.
- **Continuous evaluation of quality, efficiency and effectiveness of patient care:** Record keeping is the only continuous form of exchanging information and evaluating the patient's condition (Geyer 2005: 40; Saranto & Kinnunen 2009: 465). Ireland *et al*. (2009: 6) and Caroline (2008: 14.16) explain that, while taking history from or of the patient and during examination, vital information is obtained. Although this information may not be of any value immediately, essential data may be lost due to poor record keeping when the medical team of the receiving hospital takes over from the transport team. All records regarding the patient and the history of her or his accident or illness must be kept to be handed over to the receiving facility (Wallace & Ridley 1999: 370; Emergency Nurses Association 2007: 1042).
- **Provide a database supporting development of nursing care and standards of clinical care:** Rajah and Lasersohn (2000: 24) state documentation is imperative for morbidity and mortality meetings and

training. This is of such a great concern that a committee was formed and a uniform design based on the Utstein concept. This system specifically targeted uniform reporting of data. In this case it was specifically for the trauma patient in order to be able to evaluate protocols and compare patent outcomes (Dick & Baskett 1999: 82).

- **Reimbursement:** Meticulous recording will assist in calculating the cost of nursing and appropriate reimbursement (Saranto & Kinnunen 2009: 465).
- **Planning future health care for the patient:** Identification of problems and the care plans implemented should be recorded as it could assist with future health care of the patient (Morales 2009: [11]).

Negative experiences regarding record keeping are also explained by Cheevakasemsook *et al*. (2006: 367-8). They state that proper record keeping is not being done by health care professionals due to various reasons. Numerous forms need to be filled in and data have to be duplicated, thus it is a time-consuming action (Owen 2005: 49). Many nurses perceive record keeping as a task separate from that of taking care of the patient. The aforementioned authors agree on minimal standards for record keeping because it is through documentation that a patient's condition and changes thereof are tracked. The minimal standards suggested includes: records should be written clearly without the possibility of being erased; notes should be chronological to understand the events as it occurred; it must not include any abbreviations except if it is allowed according to policy; problems must be identified, and decisions made and care delivered must be noted precisely (Nursingtimes.net 2007: [6]; Morales 2009: [11]).

2.6.3.2 Debriefing

There are two different forms of debriefing. The first concerns the well-being of the health care professionals and is especially critical during and after stressful situations. According to CAMTS, it is the responsibility of supervisors at air ambulance services to evaluate the quality of medical care provided by the crew (Mayer, Buchanan & Brunko 2009: 84). It is important to understand that quality of care does not only rely on knowledge and skills, but also on the emotional health of the crew members. This necessitates that time should be used to debrief the crew after a long or difficult mission (CAMTS 2010). Keene *et al*. (2010: 185) acknowledge the severe need for frequent debriefing, but state it happens less frequently than it should.

The second type of debriefing is explained by Brackenreg (2004: 265) who states experiential learning is of great value. According to the author, the visual stimulation overcomes the gap between theory and practice. This form of debriefing is done in order to facilitate scenarios and then to give the learner the opportunity to debrief or reflect on the situation.

2.7 CONCLUSION

In Chapter 2 the literature regarding the history of ambulance transport, and specifically pertaining to air ambulance patient transfers, was investigated. This was done according to the Systems Model. The literature was divided into three main categories, namely input, throughput and output. These three categories were compared to the pre-flight, in-flight and post-flight considerations and possible challenges that may be experienced by health care professionals during these three stages of air transport.

In Chapter 3 the research methodology used in the study is discussed.

3 RESEARCH METHOD

3.1 INTRODUCTION

Chapter 2 provided an in-depth discussion of the history of ambulance services, focusing on fixed wing air ambulance transportation. The input-throughput-output systems approach was used to guide the discussion. Chapter 3 focuses on the research method used in the study. Planning during the development of the proposal as summarised in Table 1.1 guided the content of the chapter.

According to Polit and Beck (2006: 4), the research method refers to the scientific procedures used to improve, refine and develop the knowledge base. Polit and Beck (2008: 758) further describe and define the research method as the steps, procedures and strategies for gathering and analysing data in a research investigation. Babbie and Mouton (2001: 72) define the research design as the planning of scientific inquiry, thus designing a strategy for finding out something. Polit and Beck (2008: 765) describe the research design as an overall plan for obtaining answers to the research question.

3.2 RESEARCH DESIGN

The research design serves as a guide to the researcher in planning and implementing the study in order to achieve the intended objectives (Burns & Grove 2005: 211). An appropriate research design should provide trustworthy answers to the research questions while at the same time avoiding or minimising bias (Polit & Beck 2004: 209). This study was conducted by means of utilising a quantitative, non-experimental, descriptive, exploratory, and correlation design.

3.2.1 Quantitative design

In this study a quantitative research design was used to explore and describe what challenges were experienced by health care professionals during air transportation of critically ill or injured patients in sub-Saharan Africa. This led to the question how management could contribute to limit these perceived challenges as experienced by health care professionals during air transportation of patients.

According to Creswell (2003: 17), quantitative design involves the process of collecting, analysing, interpreting and recording the results of the study in writing. In a quantitative design evidence is gathered according to a specified plan and using formal instruments, such as questionnaires, to collect the required information to address the research question. According to Burns and Grove (2005: 27), a quantitative design is the "formal, objective, systematic process in which numerical data is used to obtain information about the world". The authors add that this method is used to describe variables, examine relationships between variables and determine cause-effect interactions between variables (Burns & Grove 2005: 23). Polit and Beck (2004: 451) state the information gathered with a quantitative design has to be in the form of numeric information that can be analysed with statistical procedures. A formal instrument, namely a questionnaire, was used to collect information (view Annexure C) and data were analysed using the Statistical PSS Version 16 statistical computer programme as suggested by Polit and Beck (2004: 469).

Quantitative research was an appropriate design for this study as it provided quantifiable data from the health care professionals involved in transporting critically ill or injured patients via air ambulance throughout sub-Saharan Africa. The data were measured objectively to assist in exploring and describing the challenges they experienced during the pre-flight, in-flight and post-flight. The results of the collected data may contribute to the development of recommendations to address some of these challenges in future (view section 5.5).

3.2.2 Non-experimental design

Polit and Beck (2006: 52) describe the non-experimental research design as collecting data without making any changes or introducing treatment. According to Stommel and Wills (2004: 144, 358), in a non-experimental design the researcher cannot manipulate the research question in terms of both feasibility and ethical acceptability. The researcher only observes and collects data, and does not attempt to intervene in any way to alter the phenomena of interest.

This study lent itself to being non-experimental as reflected in the fact that there was no intervention planned during the phases of the research.

3.2.3 Exploratory design

Exploratory research is aimed at exploring the full nature of the phenomenon, the manner in which it is manifested and the underlying process (Babbie & Mouton 2001: 83). Exploratory studies are done to acquire a better understanding of the phenomenon and they can yield new insights into the research topic (Polit & Beck 2006: 500).

The exploratory design was used in this study to explore the perceived challenges as experienced by health care professionals during the transportation of critically ill or injured patients via air ambulance.

3.2.4 Descriptive design

According to Burns and Grove (2005: 44), a descriptive design helps to identify problems in current practice with the view to improve practice outcomes. Descriptive studies describe aspects of a situation as they naturally occur. A descriptive design involves the complete description of a single variable within a given population (Babbie & Mouton 2001: 81). A descriptive research is not aimed at determining the relationship between the independent and dependant variables and no hypothesis is therefore required (Polit & Hungler 1999: 195; Polit & Beck 2006: 498).

The researcher selected a descriptive design for this study in order to describe the perceived challenges experienced by health care professionals during the transportation of critically ill or injured patients via air ambulance.

3.2.5 Correlation design

According to Uys and Basson (2005: 130), correlation refers to the correlation between two or more variables. This can be divided into simple correlation where there is a correlation between only two variables, or multiple correlations in which case more than two variables are explored. Polit & Hungler (1999: 166) warn that correlation does not prove causality, meaning that although there is a correlation between two variables, it does not mean that one variable causes the other one, but merely that a relationship exists between variables. Thus, because of the statistical analysis used by the researcher, correlation between different variables can be made.

In this study a correlation was made between the gender of the different health care professionals (view section 4.2.1.2 and Figure 4.4); the distribution of health care professionals in the different countries (view Table 4.1 and Figure 4.3); correlation between the health care professions and the courses attended (view section 4.2.1.4); and compliance of the different countries with regard to additional courses attended (view Table 4.3 and Figure 4.7).

3.3 RESEARCH METHODOLOGY

Polit and Beck (2006: 223) state research methodology refers to the techniques used to structure a study, gather and analyse the data in the course of the research investigation in a systematic fashion; it consists of a set of orderly, disciplined procedures to acquire information.

Holloway and Wheeler (2002: 287) describe the research methodology as the framework of theories and principals on which design and method are based. The methodology thus includes drawing up the research design, defining the study variables, selecting the study population, and choosing various kinds of tools and procedures to use in gathering, analysing and interpreting the data. It also encompasses the choice of various methods that will be applied to guarantee the reliability, objectivity and validity of the study conclusions.

For the purpose of this study the research methodology is discussed in terms of the three phases in which the research was conducted, delineating the population, sample and data collection.

3.3.1 Phases of the study

This study was conducted in **three** phases

- **Phase I:** Planning
- **Phase II**: Pre-test
- **Phase III**: Execution

The three phases will be discussed separately.

3.3.1.1 Phase I: Planning

During Phase I a questionnaire was developed which was used in which the aim and objectives of the study were addressed. The conceptual framework (view Figure 1.1) was used to guide the development of the questionnaire (view Annexure C).

Phase I consisted of three steps, namely:

- Step 1: Compile a preliminary questionnaire
- Step 2: Consult experts
- Step 3: Compile the final questionnaire

The three steps as well as the actions taken during each step in Phase I are summarised in Table 3.1.

Table 3.1: Phase 1: Planning

Steps	Actions
Step 1 Compile a preliminary questionnaire	➲ Consulted and studied relevant literature ➲ Used researcher's own experience in the field ➲ Input from supervisors
Step 2 Consult experts	➲ Consulted health care professionals involved in the field of air ambulance transport of patients to provide feedback and inputs on the preliminary questionnaire ➲ A total of six health care professionals volunteered to participate in refining the questionnaire: two doctors, two registered nurses and two paramedics (ALS) ➲ The health care professionals were requested to provide written feedback and make suggestions regarding the preliminary questionnaire ➲ The questionnaire was refined based on the inputs from the health care professionals
Step 3 Compile the final questionnaire	➲ Consult a statistician ➲ Final questionnaire was developed and prepared to be pre-tested

Once the questionnaire had been developed according to the steps set out in Table 3.1, it was pre-tested during Phase II of the study.

3.3.1.2 Phase II: Pre-test

According Polit and Beck (2008: 762), a pre-test is a small-scale study conducted before the main study on a limited number of respondents from the same population as that intended for the study. In addition, Polit and Beck (2010: 345) indicate that newly constructed questionnaires should be pre-tested to ensure that proper words are used, that questions are clear and without bias and are structured in logical order.

The preliminary questionnaire (view Table 3.1) questionnaire was given to six health care professionals: two doctors, two registered nurses and two paramedics (ALS) involved in the air transport of patients. Suggestions were made with regard to the layout of the questionnaire and structure of the items. The suggestions were considered and corrections were made before the data collection process was initiated.

3.3.1.3 Phase III: Execution

Phase III involved the execution of the study as regards the population, sampling, sample size and data collection.

- **Population**

According to Burns and Grove (2005: 746) and Polit and Beck (2010: 306), the eligible population consists of all the members who meet the criteria and to whom the findings can be generalised. Brink, Van der Walt and Van Rensburg (2006: 123) describe the study population as a group of people with common characteristics related to the specific phenomenon the researcher wants to investigate. In this study the population included all the health care professionals involved in fixed wing air transport of patients.

The target population to which the researcher wished to generalise the research results and which complied with the inclusion criteria, included health care professionals who were working for air transport service providers in sub-Saharan Africa and who were involved in the air transport of patients. This was consistent with the view of Burns and Grove (2009: 344). The target population involved 11 air ambulance service providers in nine different countries in sub-Saharan Africa (view section 1.6.2).

The eligible criteria (also referred to as inclusion criteria) specify the characteristics of the target population (Burns & Grove 2009:344; Polit & Beck 2010: 396). The eligible criteria for participants in this study were:

- they had to be older than 18 years;
- had to be able to understand, read and write English;
- if medical doctors, they had to have successfully completed a MBChB degree and had to be registered with a governing body, for example the South African Health Professions Council, or with an equivalent body outside the South African borders;
- if a registered nurse, she or he had to be registered with the South African Nursing Council, or with an equivalent body outside the South African borders;
- if paramedics, they had to be registered as a basic, an intermediate or an advanced life support provider with the South African Health Professions Council, or with an equivalent body outside the South African borders;
- they had to be involved as health care professionals in the transportation of patients via fixed wing air ambulance services in sub-Saharan Africa; and
- participants had to take part willingly in the study.

Of the 11 air ambulance service providers, nine from six different countries agreed to participate and signed the information leaflet and informed consent document (view Annexure B). This was regarded as the accessible population, which is consistent with the view of Burns and Grove (2009: 344) and Polit and Beck (2010: 308). Due to the fact that the majority of countries, except South Africa, had only one air ambulance service provider, it would have been easy to identify these countries by name, anonymity and confidentiality. Therefore, the researcher and air ambulance service providers agreed to refer to the countries as Country A, Country B and so forth to protect anonymity and maintain confidentiality of all the air ambulance service providers. In Figure 3.1 the process followed for determining the accessible population and members is illustrated.

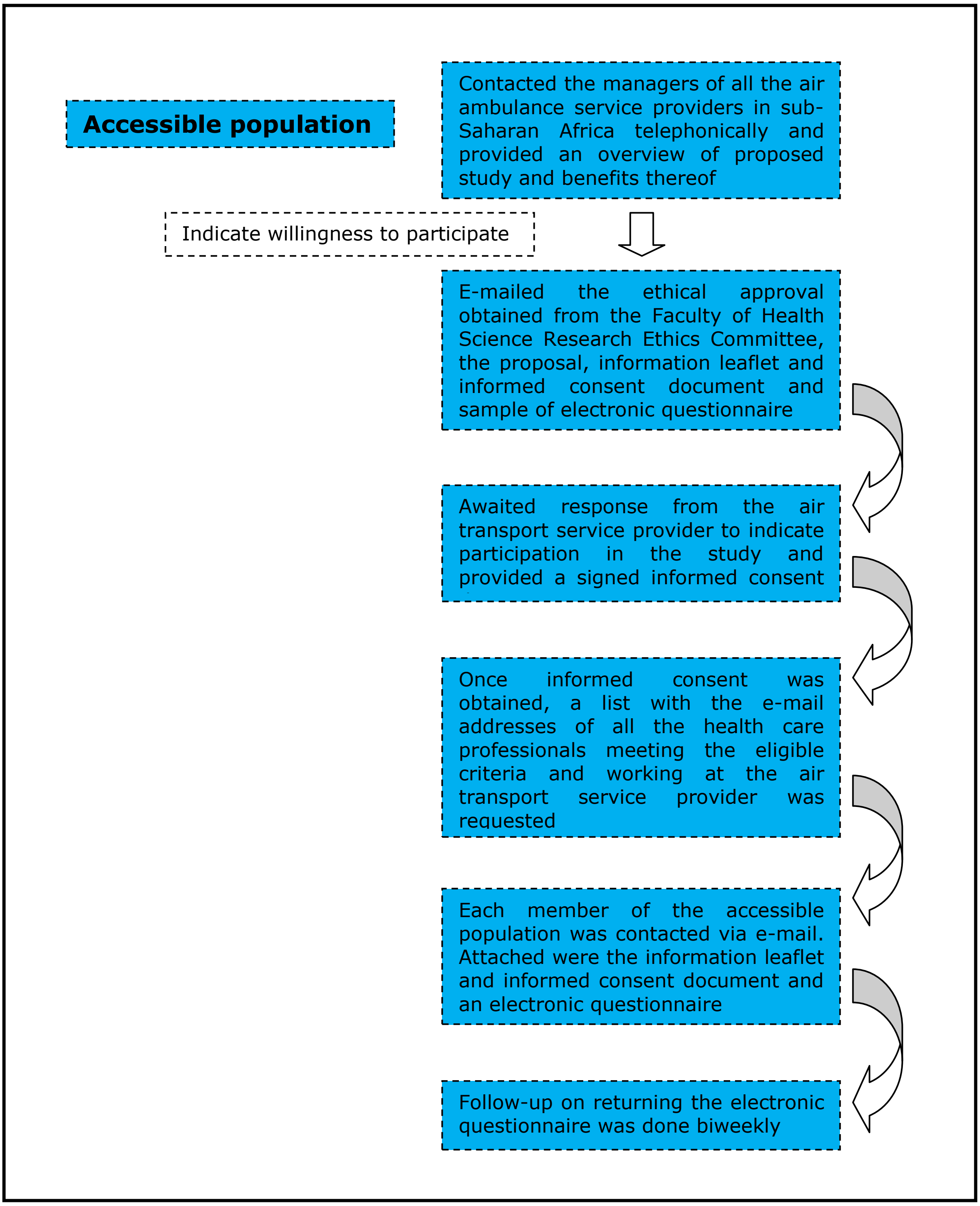


Figure 3.1: Process to determine the accessible population and number of members

Feedback from the nine ambulance providers regarding the number of health care professionals involved in air transport of patients in sub-Saharan Africa assisted the researcher to determine the size of the target population. The target population is the entire population in which the researcher is interested (Polit & Beck 2010: 307). A summary of the accessible population, which accumulated to a total of 117 health care professionals involved in six countries in sub-Saharan Africa, is provided in Table 3.2. The process described in Figure 3.1 was followed to determine the number of members of the accessible population.

Table 3.2: Summary of the accessible population

Country	Category	Number of members
Country A	Doctors	0
	Registered nurses	0
	Paramedics	2
Country B	Doctors	1
	Registered nurses	0
	Paramedics	4
Country C	Doctors	0
	Registered nurses	0
	Paramedics	5
Country D	Doctors	48
	Registered nurses	24
	Paramedics	15
Country E	Doctors	0
	Registered nurses	0
	Paramedics	6
Country F	Doctors	2
	Registered nurses	10
	Paramedics	0
Accessible population 117		

- **Sampling**

Two main sampling designs, non-probability and probability, are described by Polit and Beck (2010: 309). Non-probability sampling is conducted when the respondents are selected by non-random methods (Polit & Beck 2010: 309). Probability sampling involves the random selection of respondents, where each of the respondents has an equal chance to be selected (Polit & Beck 313). Acknowledging that non-probability sampling is less likely than probability sampling to produce representative samples as suggested by Polit and Beck (309), the researcher chose to use non-probability sampling based on the target population size.

Consecutive sampling, one of the methods used in non-probability sampling, was used. Consecutive sampling involves recruiting all the respondents from an accessible population who meet the eligible criteria over a specific timeframe (Polit & Beck 2010: 311). One of the advantages of using consecutive sampling is that, when all the members of the accessible population are invited to participate in the study over a specific time period, the risk for bias is greatly reduced. This is consistent with the view of Polit and Beck (2010: 312).

- **Sample size**

Brink (2003: 133), Burns and Grove (2009: 42), and Polit and Beck (2010: 307) agree that a sample is a smaller component of the population and sampling represents the process of selecting a sample. A key requirement of the positivist paradigm and quantitative design is that the findings should be generalised to the population, therefore the sample has to be representative of the population (Polit & Beck 2010: 307).

Due to the relative limited number of members (total number 117) available in the accessible population, the statistician recommended that purposive sampling (view section 3.3.2) should be used to increase the sample size. This is consistent with the view of Polit and Beck (2010: 316) who argue that the largest possible sample is strived for in quantitative research design; thus, the larger the sample size, the more representative it is likely to be.

- **Data collection**

The execution phase included data collection by means of the questionnaire developed during Phases I and II. Data collection refers to the method or technique used to gather the information as applicable to the research variables (LoBiondo-Wood & Haber 2006: 318). Of the three main data collection methods, namely self-report, observation and bio-physiologic measures, Polit and Beck (2010: 339) indicate self-reports are most commonly used in both quantitative and qualitative research studies.

In a quantitative research design, structured self-report data are gathered either verbally through interviewing, or otherwise through formal, written instruments called questionnaires (Polit & Beck 2010: 343). Questionnaires were used in this study as it was the most suitable method to gain access to the members of the accessible population. Furthermore, questionnaires enable data collection from larger samples (which increases representativeness), save time and money, provide numeric data, and make analysis easier as indicated by LoBiondo-Wood and Haber (2006: 325), Burns and Grove (2009: 406) and Polit and Beck (345).

Questionnaires provide written responses. Although the information may have less depth, they do allow for larger samples and consistency during data collection. Well-structured questions and response sets yield information with regard to person or subject facts, or situational facts, or level of knowledge, impressions and intentions of the subject (Burns & Grove 2009: 406). The advantages of questionnaires include that they are less costly and require less time and energy to administer than interviews (Polit & Beck 2004: 350.) These authors argue that, because complete anonymity is possible, respondents are more likely to provide honest answers. The format of the questionnaire is standard, therefore questions are consistent and there is less opportunity for interviewer's bias (Polit & Hungler 1999: 334).

The disadvantages of questionnaires include that the response rate may be low. To overcome this limitation in the current study, the researcher appointed a

designated person to each service provider. This person had to personally distribute the questionnaires and receive the completed ones from the health care professionals at the service provider (company). The response rate for each of the participating countries are provided in table format in Table 4.1.

Questions are designed as open-ended or closed-ended. Open-ended questions provide an opportunity to elaborate on responses and are generally not used, but can be in structured instruments (view Annexure C in items V8, V14, V15, V16, V131, V155). Closed-ended questions have fixed responses that range from simple ('Yes'/'No') to complex (scales) answers. These types of questions allow for ease during completion and analysis (LoBiondo-Wood & Haber 2006: 325; Polit & Beck 2010: 343).

The questionnaire was developed during Phase I of the research. The questionnaire (view Annexure C) consisted of 12 pages and was divided into six sections, namely:

Section A: Personal information
Section B: Pre-flight considerations
Section C: Advanced emergency equipment
Section D: In-flight considerations
Section E: Post-flight considerations
Section F: Feedback and control

The questionnaire consisted of a participant information leaflet, informed consent and a set of questions which had predetermined response alternatives. In addition, the researcher devised questions into sections as follows:

- **Section A: Personal information:** This section highlighted the demographic and personal information regarding age, gender, qualifications and other courses that the participants had completed. It also included which country their air ambulance operates from.

- **Section B: Pre-flight considerations:** This section focused on information regarding the patient's condition. The questionnaire included information regarding the history, primary survey, resuscitation phase and secondary survey. The location of the patient was also focused on.
- **Section C: Advanced emergency equipment:** In this section the availability of advanced emergency equipment and stock, including stock used to enhance personal and universal protection, had to be documented. Since different aircraft are used as air ambulances, space and weight limitations may have been regarded as being a problem to some health care professionals. Similarly, the administering of some of the drugs may have been limited to the specific health care professional's scope of practice.
- **Section D: In-flight considerations:** This section focused on the knowledge of flight physiology and the influence thereof as regards patient treatment.

  It was also essential to determine how successfully information pertaining to the handing over of a patient, the referral documentation, and data pertaining to diagnostic tests already done, was obtained in view of the language barriers encountered in the different countries in sub-Saharan Africa. The cooperation from the treating health care professionals is essential in obtaining optimal history and up-to-date treatment regimens Cheevakasemsook *et al.* (2006: 367).

  This section also addressed the treatment of the patient inside the air ambulance en route to the treating facility. Factors influencing care inside the aircraft include: privacy for the patient; monitoring of the patient's progress. The latter may be difficult due to limited monitoring capabilities as well as the ability to perform surgically clean procedures.
- **Section E: Post-flight considerations:** Handover at the receiving facility remains an important step in the patient transport to ensure continuation of patient care. Restocking the air ambulance is the final step in a flight. This is

of importance for the next group of health care professionals in order to be prepared for the next flight.

- **Section F: Feedback and control:** This section focused on the implementation of continuous professional development following air ambulance transportation of critically ill and injured patients. Debriefing of the health care professionals remains an important aspect in monitoring the overall well-being of the health care professionals (Mayer *et al.* 2009:84).

The electronic distribution of the questionnaire was to the entire ***accessible population.*** All the members were invited to participate in the study. A schematic representation of the method that was used to distribute the questionnaire is presented in Figure 3.1.

The steps followed during the data collection included:

- **Step 1:** The researcher telephonically contacted the managers of air ambulance services in sub-Saharan Africa and gave them a brief overview (including the topic, aim, objectives and research methodology) of the intended study.
- **Step 2:** The following documents were sent electronically to the managers who considered participation in order to obtain approval to conduct the study: the ethical approval provided by the Research Ethics Committee of the University of Pretoria (view Annexure A), a proposal, an information leaflet, an informed consent document (view Annexure B), and a questionnaire (view Annexure C).
- **Step 3:** Once approval had been obtained from the participating air transport service providers, the managers were contacted and requested to provide the name of a designated person whom the researcher could contact in order to obtain the personal information of health care professionals.
- **Step 5:** The questionnaires were distributed electronically to each of the health care professionals whose information had been provided to the researcher by the designated persons. The health care professionals were invited to participate in the study. Written consent were waived as participants gave consent to participate by merely completing the

questionnaire. They were requested to return the completed questionnaires to a predetermined e-mail address. An independent person accessed the questionnaires from the predetermined e-mail address to enhance the anonymity and confidentiality of the respondents.

- **Step 6:** The respondents were informed of a closing date for submission of the completed questionnaires. The researcher sent a reminder biweekly to all the members of the accessible population to remind them of the closing date.

- **Data analysis**

The data analysis consisted of basic descriptive statistics. In this study it also allowed for a Chi-Square test.

Descriptive statistics are utilised to observe, describe and document aspects of a situation as it naturally occurs (Polit & Beck 2008: 274). Frequency distribution and percentage distribution were used during the data analysis.

- Frequency distribution

This is a systematic array of numeric values as well as a count of the number of times a value was obtained (Polit & Beck 2004: 719).

- Percentage distribution

This indicates the percentage of a sample with scores within a certain group (Burns & Grove 2005: 426).

- **Validity and reliability**

Validity and reliability are the major criteria for assessing the instrument's quality and adequacy (Polit & Beck 2004: 416).

Validity: According to Saks and Allsop (2007: 180), validity involves the extent to which the operationalised indicator is really measuring the concept it is intended to measure and whether it is a valid empirical indicator of the theoretical concept. Polit and Beck (2004: 423) add that, by measuring the appropriateness of the instrument, face validity is achieved. The validity of an instrument is supported by a greater or lesser degree of evidence. The four types of validity generally used are content validity, face validity, criterion-related validity, and construct validity. For the purpose of this study only three types were applicable: content validity, criterion-related validity and face validity.

- According to Polit and Beck (2006: 329), **content validity** is concerned with the sampling adequacy of the content area being measured. Areas covered in the tool should represent a wide area of the topic under study. This is considered a subjective exercise because the researcher or people designing the tests determine the content to be included in the study. In addition, Polit and Beck (2004: 423) hold that content validity concerns the thorough conceptualisation of the content so that the degree to which an instrument has an appropriate sample of items is measured. This procedure enables experts in the clinical field as well as medical experts to assess the appropriateness and accuracy of the instrument (Burns & Grove 2005: 378).
- According to Stommel and Wills (2004: 222), **criterion-related validity** assesses a measurement instrument by using external criteria for validation. The requirement of this approach is the availability of a reliable and valid criterion with which measures on the instrument can be compared.
- **Face validity** verifies that the instrument appears to be valid, or gives the appearance of measuring the content that is useful (Burns & Grove 2005: 379). According to Saks and Allsop (2007: 180), face validity refers to how a measure appears on the surface and whether all the required questions are framed in the appropriate language.

During the development phase of the questionnaire (see Phase I) in this study several steps were taken to ensure that only relevant information was collected. The researcher consulted literature and obtained critique from experts (view Table 3.1).

Reliability: Polit and Beck (2010: 305) describe reliability as "the consistency with which an instrument measures an attribute". An instrument is said to be reliable if it measures accurately and reflects the true score of the attribute under investigation. Reliability in this study was enhanced by pre-testing the questionnaire on six health care professionals that did not participate in the main study. According to Polit and Beck (2004: 416), a questionnaire is reliable to the extent that its measures reflect true scores under investigation. In addition, Burns and Grove (2005: 374) state reliability focuses on three aspects: stability, equivalence, and homogeneity.

3.4 ETHICAL CONSIDERATIONS

Research ethics involve protecting the rights of the respondents and the institutions in which the research was done, and maintaining scientific integrity (Babbie & Mouton 2001: 531; Burns & Grove 2005: 181).

According to de Vos *et al*. (2002: 63), ethics refer to a set of moral principles that are suggested by an individual or group and which are widely accepted. It lays down rules and behavioural expectations about the correct conduct towards experimental subjects and respondents, sponsors and other researchers. A number of key phrases describe the system of ethical protection that has been created in an effort to protect the rights of research respondents.

Burns and Grove (2005: 196) maintain the principle of voluntary participation requires that people should not be coerced into participating in research. Closely related to the notion of voluntary participation, is the requirement of informed consent. Essentially, this means that prospective research respondents must be fully informed about the procedures and risks involved in the research and must give their consent to participate (view Annexure B).

Ethical standards also require that researchers should not put respondents in situations where they might be at risk of harm as a result of their participation. Harm can be defined as both physical and psychological (de Vos *et al*. 2002: 64). The privacy of research respondents should be ensured during the research process. According to Burns and Grove (2005: 188), the two standards applied in order to help protect the privacy of research respondents.

- Firstly, the researcher should guarantee confidentiality by assuring respondents that their identifying information will not be made available to anyone who is not directly involved in the study.
- The second standard is the principle of anonymity, which essentially means that the participant will remain anonymous throughout the study.

Conducting research ethically begins with the identification of the topic and continues through to the end when the findings are published. The conduct of the researcher requires not only expertise and diligence, but honesty and integrity (Burns & Grove 2001: 1991; De Vos 2001:24).

According to Newell and Burnard (2006: 38), research ethics are based on the principles as described by the 10 provisions of the Nuremberg Code. The Nuremberg Code provided the basis for the Declaration of Helsinki in 1964, which was subsequently adopted by many countries engaged in health care research. In Table 3.4 the principles of the Nuremberg Code (adopted from Newell & Burnard [2006: 38]) is presented.

Table 3.3: Summary of the application of the principles of the Nuremberg Code as applied in this study

Principles of the Nuremberg Code	Application to this study
Voluntary consent is essential	Returning a completed questionnaire via e-mail or mail to the researcher will imply informed consent.
Study should yield fruitful results for the good of society	The results of the study will be used to compile recommendations as to how the challenges facing the health care providers transporting critically ill and injured patients via air ambulance can be reduced. The researcher regards this as a positive move towards improving the health and well-being of health care providers and the patient.
Previous results should justify the study	The researcher conducted an in-depth literature review about the topic for validity and reliability
Study should avoid all unnecessary physical and mental suffering and injury	In this study, there were no risk for physical or mental suffering or injury to the respondents as no physical activities or testing was involved, nor psychological intervention of any form

	whatsoever
No study should be conducted if it is believed death or disabling injury will occur	The objectives and content of the questionnaire will discussed with each participant by means of an information leaflet. This study involved no harmful activities which could lead to disabling or death
Principles of the Nuremberg Code	**Application to this study**
The degree of risk should never exceed potential benefits of the study	In this study there will be no risks for the respondents involved in the data collection process.
The study should only be conducted by qualified persons	The researcher is a qualified registered nurse and has successfully completed a research methodology module. In addition, the supervisors are both recognised researchers.
Respondents should be free to withdraw at any time	It will be explicitly explained to respondents that they have the opportunity to uphold consent or to withdraw at any time during the data collection of the study without being victimised
The persons undertaking the study must be prepared to stop the study if a continuation is likely to cause harm	Continuous communication with the study leaders of this study as well as the managers of the air ambulance services will be maintained and approval will provided by the Research and Ethics Committee of the University of Pretoria

The Nuremberg Code reflects the three notions most appropriate for this study and to which this study strictly adhered. These included the principles of autonomy, beneficence and justice (Newell & Burnard 2006: 38).

The principle of autonomy refers to the recognition that people, including the research participant, have the right to decide on a particular course of action and follow it (de Vos 2001: 24; Newell & Burnard 2006: 39). In this study, the focus was only on the perceived challenges experienced by health care professionals involved in the air transportation of critically ill and injured patients. The researcher did not at any time during this study deviate from this intended theme. The scope and benefits of the study were explained to all the respondents via an information leaflet. The respondents were also assured of anonymity and confidentiality as described by Green and Thorogood (2004: 57). Anonymity was maintained by not recording the respondents' names on the questionnaire, and the data collected was kept in the researcher's possession in a safe place to ensure confidentiality.

The principle of beneficence refers to the requirement that the researcher should maximise the benefits to respondents whilst minimising harm (Newell & Burnard

2006: 41; Polit & Beck 2006: 147). In this study, this principle was strictly adhered to as no harm was done to the respondents. The research process and instruments used in the data selection was approved by the Research Ethics Committee of the University of Pretoria as well as the management of each of the air ambulance services. The risk of harm was minimal because the study was non-invasive.

The principle of justice is described as an essential requirement that a person be treated fairly (Burns & Grove 2005:180). In this study, the principle of justice was adhered to as all individuals had an equal chance to participate in the study without excluding them on the basis of race, language, colour, gender, sexual orientation or age.

3.5 CONCLUSION

Chapter 3 discussed the research method in depth. The chapter covered all the aspects relating to the research design and methodology used during the study. The validity and reliability of the study was discussed and the chapter concluded with the ethical considerations adhere to in this study.

In Chapter 4 the research results and discussions are presented.

4 RESEARCH RESULTS AND DISCUSSION

4.1 INTRODUCTION

Chapter 3 provided an overview of the research method. Chapter 4 presents the results followed by a data analysis and a discussion in terms of the related literature. These are guided by the sections as grouped together in the questionnaire.

4.2 RESEARCH RESULTS

The data was obtained by means of an electronic questionnaire completed by the respondents (view Annexure C). This questionnaire was designed by the researcher following a comprehensive literature review and in conjunction with the statistician and experts in the field of air transport of critically ill or injured patients. (View section 3.3.1.1; Annexure C).

The questionnaire consisted of six sections which were guided by the Systems Model approach (view Figure 1.1) whereby the input-throughput-output systems approach were applied to the topic researched.

- **Input**
  - **Section A:** Personal information
  - **Section B:** Pre-flight considerations
  - **Section C:** Advanced emergency equipment

- ○ **Throughput**
  - **Section D:** In-flight considerations
- ○ **Output**
  - **Section E:** Post-flight considerations
  - **Section F:** Feedback and control

Input

4.2.1 Section A: Personal information [V2 – V17]

Section A included data such as the gender, age and distribution of the respondents in the six participating countries in sub-Saharan Africa. It also focused on the respondent's basic qualification and/or field of speciality as well as additional courses attended.

4.2.1.1 Gender (N = 58): [V2]

A total of 58 (N = 58) respondents from the six participating countries in sub-Saharan Africa completed the questionnaire. Figure 4.1 depicts that the data analysis showed that 36 (62.07%) of the respondents were female and 22 (37.93%) were male.

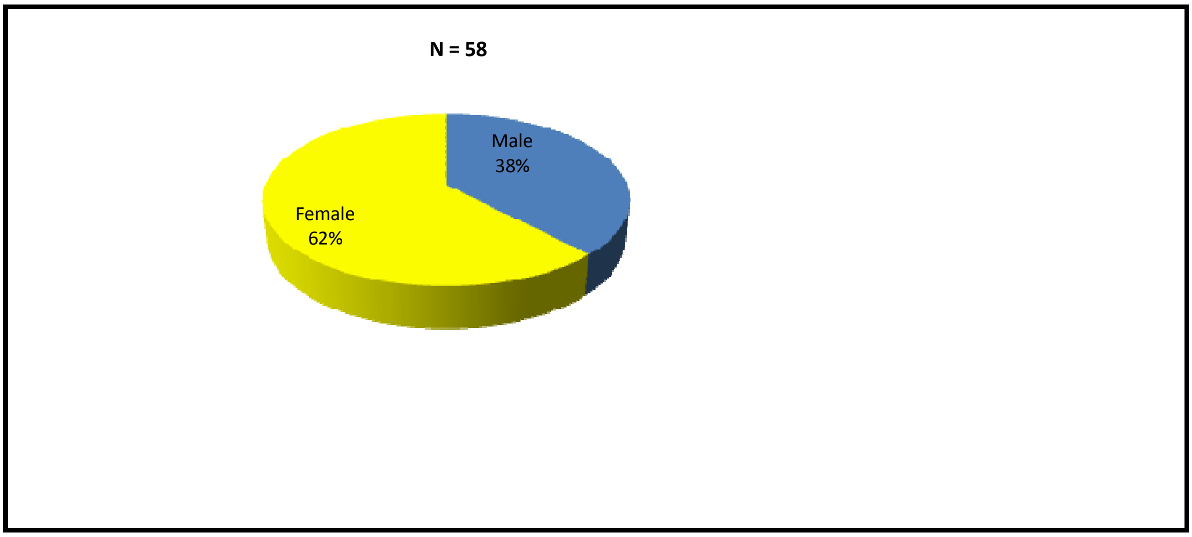


Figure 4.1: Gender distribution of respondents (N=58)

4.2.1.2 Health profession speciality in the team (N = 58): [V3]

The profession distribution of the respondents was explored. All respondents (N = 58) were health care professionals involved in the air transport of critically ill or injured patients in a fixed wing aircraft. A total of 16 (27.59%) were doctors, 20 (34.48%) were registered nurses, 19 (32.76%) were paramedics (ALS) and three (5.17%) were paramedics (ILS). As noted, no paramedics (BLS) participated in the study. This is illustrated in Figure4.2

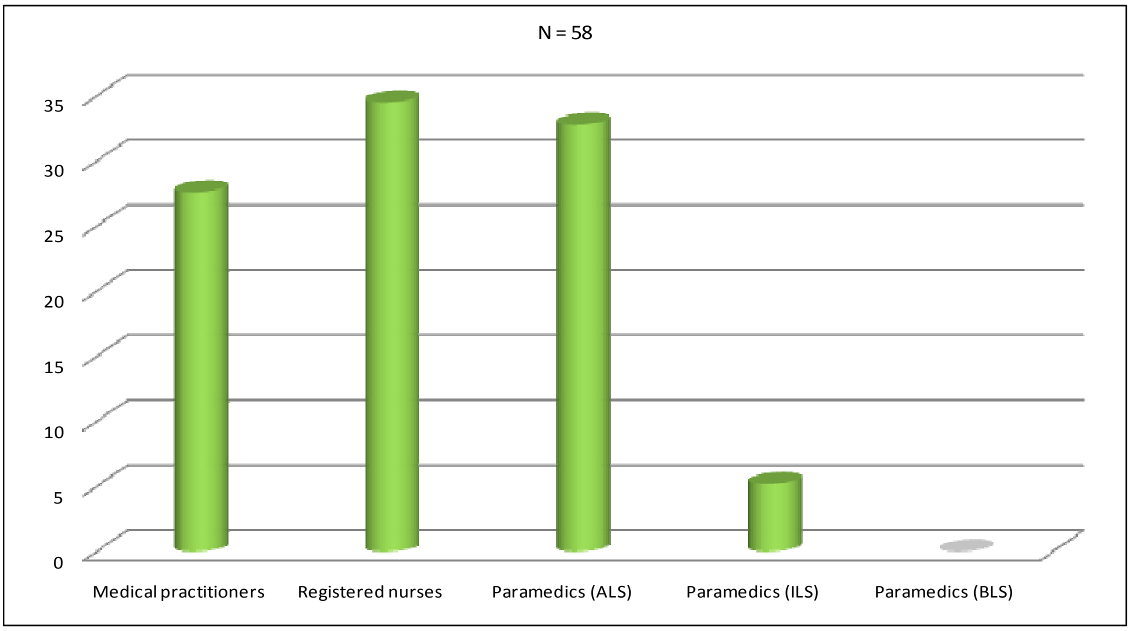


Figure 4.2: Profession distribution of the health care professionals

The distribution of the number of health care professionals from the six participating countries was also explored. For more clarity the status of the respondents and the number of professionals representing each status in the six participating countries, are tabled in Table 4.1. This is followed by a graphic depiction of the status distribution of the respondents in the six participating countries as displayed in Figure 4.3.

Table 4.1: Summary of the professions of the respondents in each in of the six participating sub-Saharan countries

Respondents N = 58	Participating Countries					
	Country A	Country B	Country C	Country D	Country E	Country F
Doctors	0	1 (25%)	0	15 (36.59%)	0	0
Registered Nurses	0	0	0	18 (43.90%)	0	2 (100%)
Paramedics (ALS)	2 (100%)	2 (50%)	2 (66.67%)	7 (17.07%)	6 (100%)	0
Paramedics (ILS)	0	1 (25%)	1 (33.33%)	1 (2.44%)	0	0
Total respondents per country	**2**	**4**	**3**	**41**	**6**	**2**

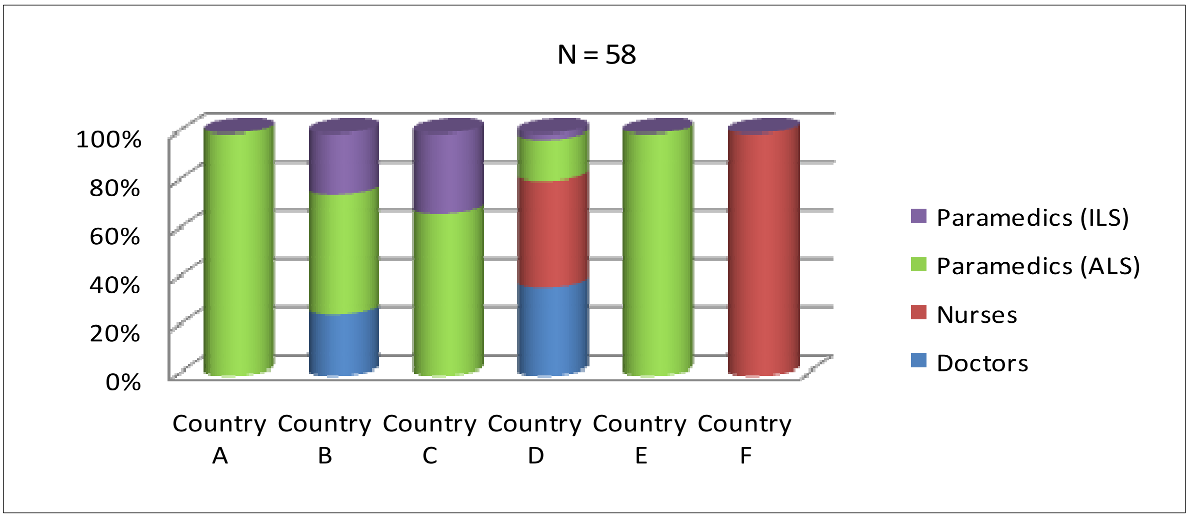


Figure 4.3: Distribution of health care professionals in the six participating countries (N=58)

As seen in Table 4.1 and Figure 4.3 respondents from six different countries in sub-Saharan Africa completed questionnaires. Since the study involved health care professionals who accompanied critically ill or injured patients, their professional status as well as the number of those of the same status working in each of the six participating countries are presented. Figure 4.4 depicts the professional distribution of the participants within their gender.

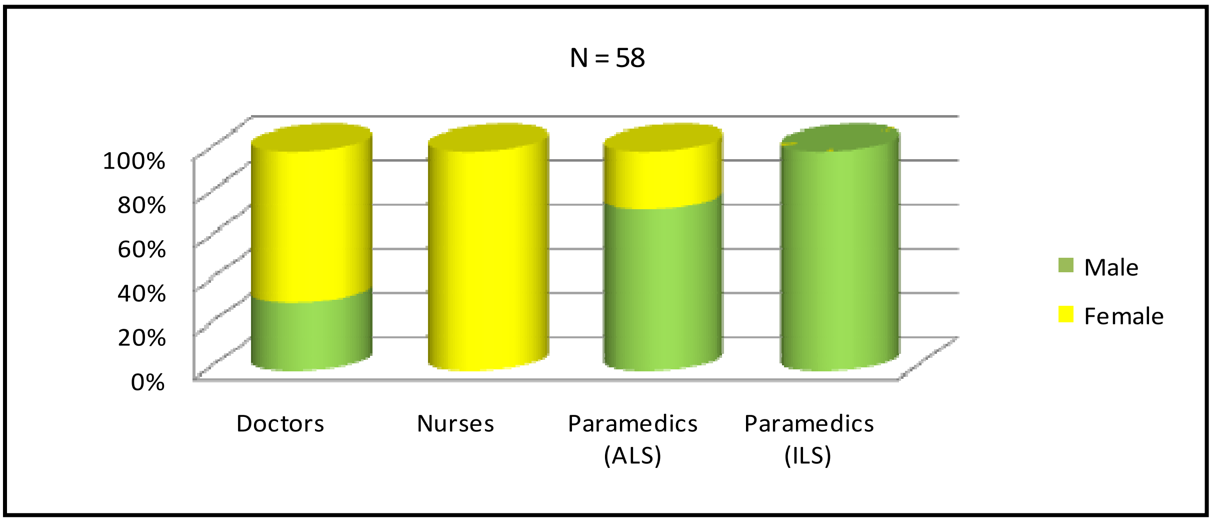


Figure 4.4: Professional distribution of the health care professionals within their gender (N=58)

Discussion: As shown in Figure 4.1, 36 (62.07%), of the health care professionals (N = 58) who participated in this study were female. This is consistent with the results in Figure 4.2. Frakes and Lord (2004: 38) state that nurses constitute 97% of staff on both rotor and fixed wing transfers. In Country F (view Figure 4.3) 100% of the respondents were identified as nurses, but it was also observed that only two (100%) respondents from this country participated. Similarly, the health care professional team from Country A consisted of only two (100%) paramedics (ALS). According to Warren *et al*. (2004: 257), a transport team should consist of two health care professionals of which one should be a critical care trained nurse. The other team member can be a registered nurse, emergency medical technician paramedic, respiratory therapist, or doctor. Koppenberg and Taeger (2002: 212) state pre-hospital personnel are not adequately prepared to accompany critically ill or injured patients during air transport. In South Africa the health care professionals on board a South African air ambulance should consist of a doctor and either a registered nurse or an ALS trained paramedic (Dickerson & Palmer 2005: 201).

The profession speciality of the respondents with reference to their gender as derived from the results is graphically illustrated in Figure 4.4. Eleven (30.56%) of the 36 female health care professionals were doctors, 20 (55.56%) were female registered nurses and five (13.58%) were female paramedics (ALS). Of the 22 male health care professionals, five (22.72%) were doctors. Of the total of 19 paramedics (ALS) who completed the questionnaire, 14 (63.64%) were male. All three (13.63%) of the ILS paramedics were male. According to the results, no paramedics (BLS) participated in the study.

4.2.1.3 Areas of speciality (n = 55): [V4 - V8]

Out of the total of 58 respondents, 55 (94.82%) respondents answered this question. Three (5.45%) had a diploma in Anaesthesiology; 11 (20%) had a diploma in Primary Emergency Care; 11 (20%) were trained as Critical Care nurses and 12 (21.82%) indicated they were Trauma and Emergency trained nurses. Of the respondents, 18 (32.73%) indicated to have "Other" qualifications. The "Other" courses were not significantly supported by the literature as necessary for health care professionals providing fixed wing air ambulance transfers for the critically ill and injured patients. These courses were noted to be as follow:

- Advanced Airway management
- Advanced Medical Life Support
- Advanced Midwifery
- Advanced Rescue Course
- Burns Management Course
- Diploma in Mountain Medicine
- Neonatal Intensive Nursing
- Ultrasound Course

These findings are illustrated in Figure 4.5.

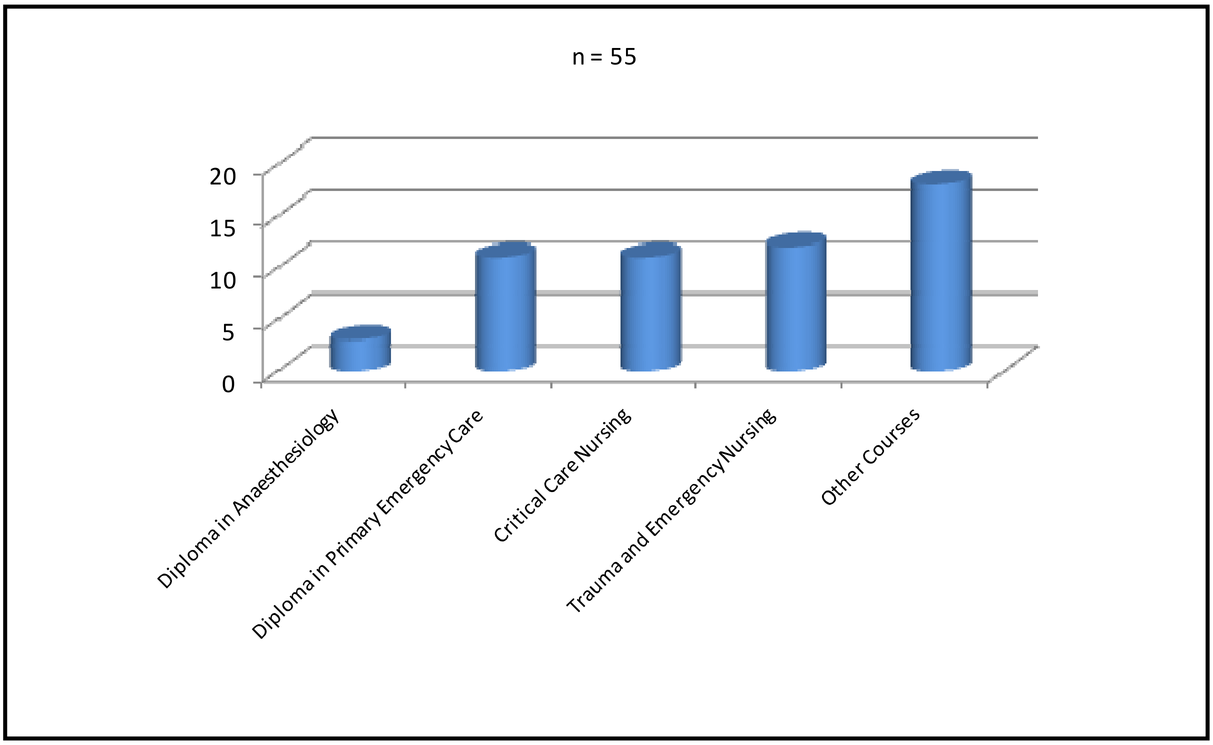


Figure 4.5: Areas of speciality (n=55)

Discussion: Grissom and Farmer (2005: s15) and Wrobleski and Vukov (1996: 158) acknowledge that there is no current standard for minimum qualifications required for health care professionals to be involved in the air transport of patients. They advocate that health care professionals should at least have additional training in flight physiology and pre-hospital patient management skills. Grissom and Farmer (2005: s15) state that a standard for nurses has been set by the National Flight Nurses Association whereby they can become registered as flight nurses. Standards for qualifying as a flight paramedic have also been set in the USA. Warren *et al*. (2004: 257) and Gray *et al.* (2004: 282) are in agreement that the medical doctor, as part of the transport team, should at least be trained in critical care medicine or anaesthesiology while the nurse should have a critical care or equivalent qualification. The Paediatric Intensive Care Society of the UK recommends that a speciality team, namely a paediatric transfer team, should be used when transferring paediatric patients as this has shown to be of benefit for the patient (Gray *et al.* 282).

4.2.1.4 Additional courses (N = 58): [V9 - V14]

During the data analysis it was found that 41 (81.03%) of all the respondents (N = 58) indicated they had attended a Paediatric Advanced Life Support course; 53 (91.38%) had attended an Advanced Cardiac Life Support course while 31 (53.45%) respondent attended the Advanced Trauma Life Support course. Nineteen (32.76%) of the respondents attended the Neonatal Resuscitation Program and 14 (24.14%) attended the Advanced Neonatal Life Support course. These findings are illustrated in Figure 4.6.

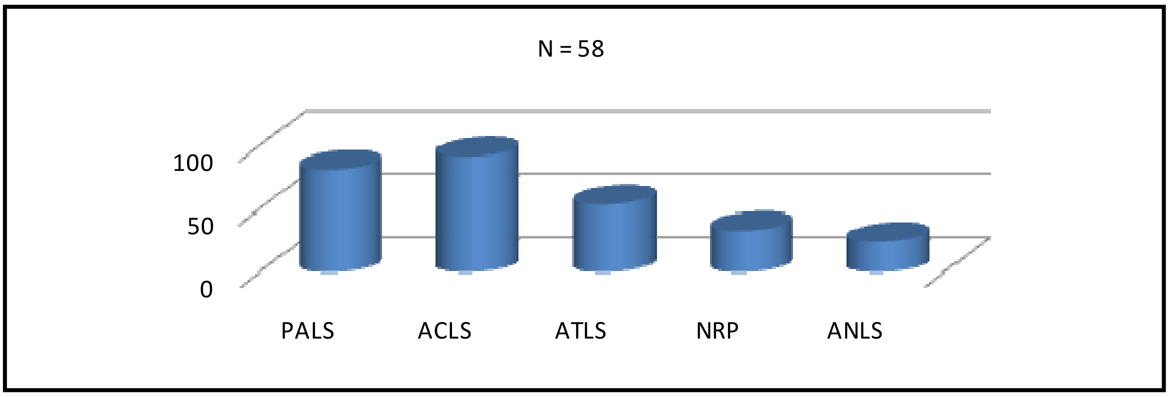


Figure 4.6: Attendance of Advanced Life Support courses (N=58)

Respondents from all six participating countries indicated that they had successfully completed various additional ALS courses. For easy referencing and understanding, these results from the six countries are first presented in table format (view Table 4.3), followed by a graphic presentation (view Figure 4.7).

Table 4.2: Legend for abbreviations used in Table 4.3 and Table 4.4

Advanced Life Support Courses	
PALS	Paediatric Advanced Life Support
ACLS	Advanced Cardiac Life Support
ATLS	Advanced Trauma life Support
NRP	Neonatal Resuscitation Program
ANLS	Advanced Neonatal life Support

Table 4.3: Summary of respondents who had completed ALS courses (N=58)

Country	(PALS)	(ACLS)	(ATLS)	(NRP)	(ANLS)
A (n = 2)	2 (100%)	2 (100%)	1 (50%)	0	0
B (n = 4)	2 (50%)	3 (75%)	1 (25%)	0	0
C (n = 3)	0	1 (33.33%)	0	0	0
D (n = 41)	38 (92.68%)	39 (95.12%)	2 (4.87%)	19 (46.34%)	14 (34.15%)
E (n = 6)	5 (83.33%)	6 (100%)	1 (16.67%)	0	0
F (n = 2)	0	2 (100%)	1 (50%)	0	0

The distribution of courses successfully completed by respondents from the six participating countries is depicted in Figure 4.7.

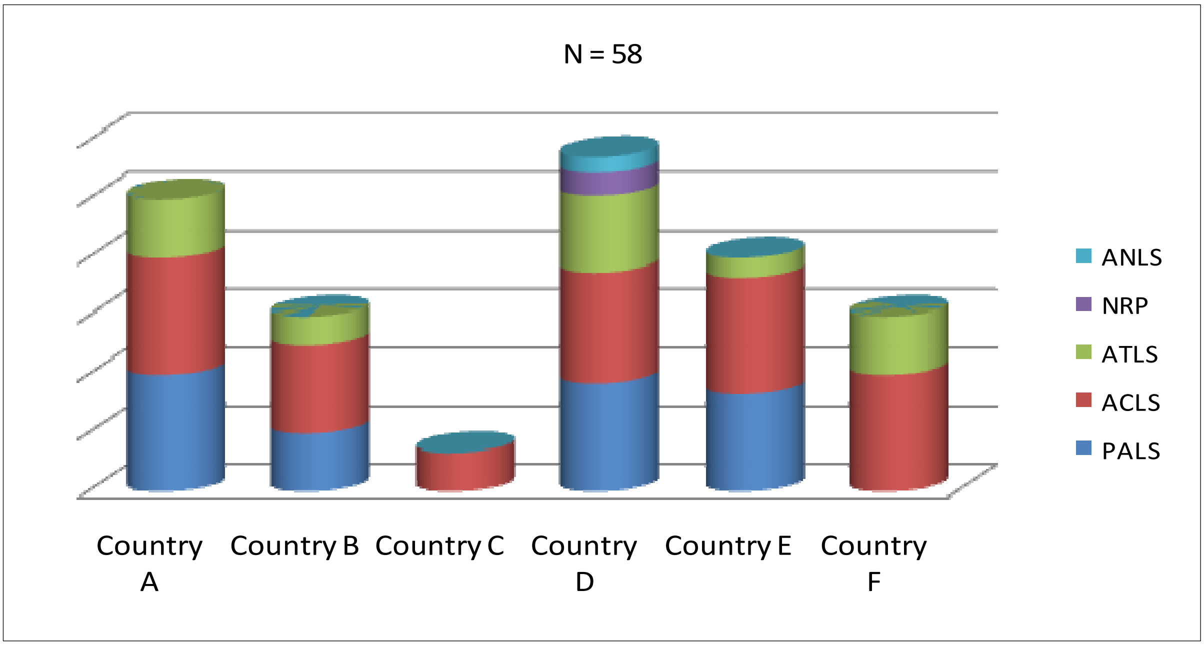


Figure 4.7: Distribution of additional courses completed by respondents from the six participating countries

The data were sub-categorised to indicate the health care providers' compliance with attending additional courses. Table 4.4 shows a summary of the numbers and percentages of the respondents who complied with attending additional courses and in Figure 4.8 the results are graphically illustrated.

Table 4.4: Summary of health care providers' compliance with attending additional courses

Respondents	Advanced Life Support Courses				
	(PALS)	(ACLS)	(ATLS)	(NRP)	(ANLS)
Doctors (n = 16)	16 (100%)	16 (100%)	14 (87.50%)	7 (43.75%)	8 (50%)
Registered nurses (n = 20)	17 (85%)	19 (95%)	12 (60%)	10 (50%)	5 (25%)
Paramedics (ALS) (n = 19)	14 (73.69%)	17 (89.47%)	4 (21.05%)	2 (10.53%)	1 (5.26%)
Paramedics (ILS) (n = 3)	0	1 (33.33%)	1 (33.33%)	0	0

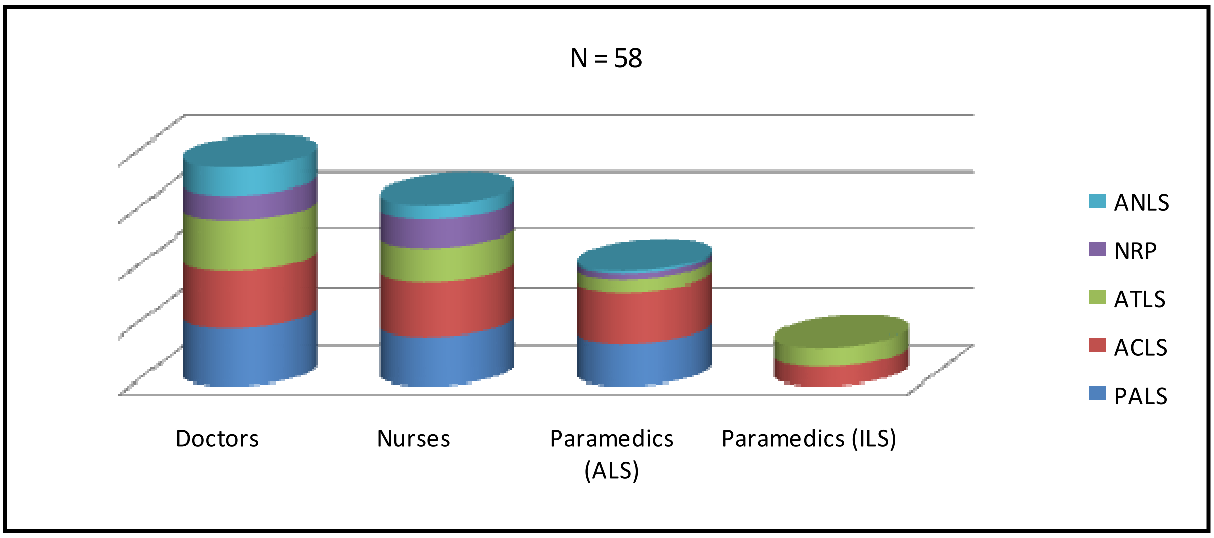


Figure 4.8: Health care professionals attending ALS courses (N=58)

Discussion: Jones and Young (2004: 12) state the following additional courses would be adventitious to the transport team member: Paediatric Advanced Life Support, Advanced Cardiac Life Support, Neonatal Resuscitation Program and Basic Trauma Life Support. According to Dickerson and Palmer (2005: 201), in South Africa crews should be trained in Advanced Cardiac Life Support, Paediatric Advanced Life Support, Advanced Trauma Life Support, Advanced Neonatal Life Support or Neonatal Resuscitation Program as well as the aero medical courses available. Due to the fact that no minimum standards exists for health care professionals involved in air ambulance transport, the Air and Surface Transport Nurses Association (ASTNA) states that certification in flight nursing, as recognised by ASTNA, would suffice for registered nurses to function in the air transportation of critically ill or injured patients, but then only when in conjunction with the Advanced Life Support Courses (ASTNA 2008: 1).

4.2.1.5 Age (n= 57): [V15]

The data were regrouped into six age groups of 5 years each. This gave a relatively good idea of the age group distribution among health care professionals. This is set out in Figure 4.9. The age group <25 years yielded one (1.75%) response when the respondent indicated an age of 24 years old at the last birthday. For the year group 30-34 years, 12 (21.05%) respondents indicated their age within this group. For the year group 35-39 years, 17 (29.83%) respondents indicated their age within this group. Five (8.76%) respondents conveyed that they fell within the 40-44 year group while three (5.26%) were >45 years old. The oldest respondent was 52 years old at the last birthday.

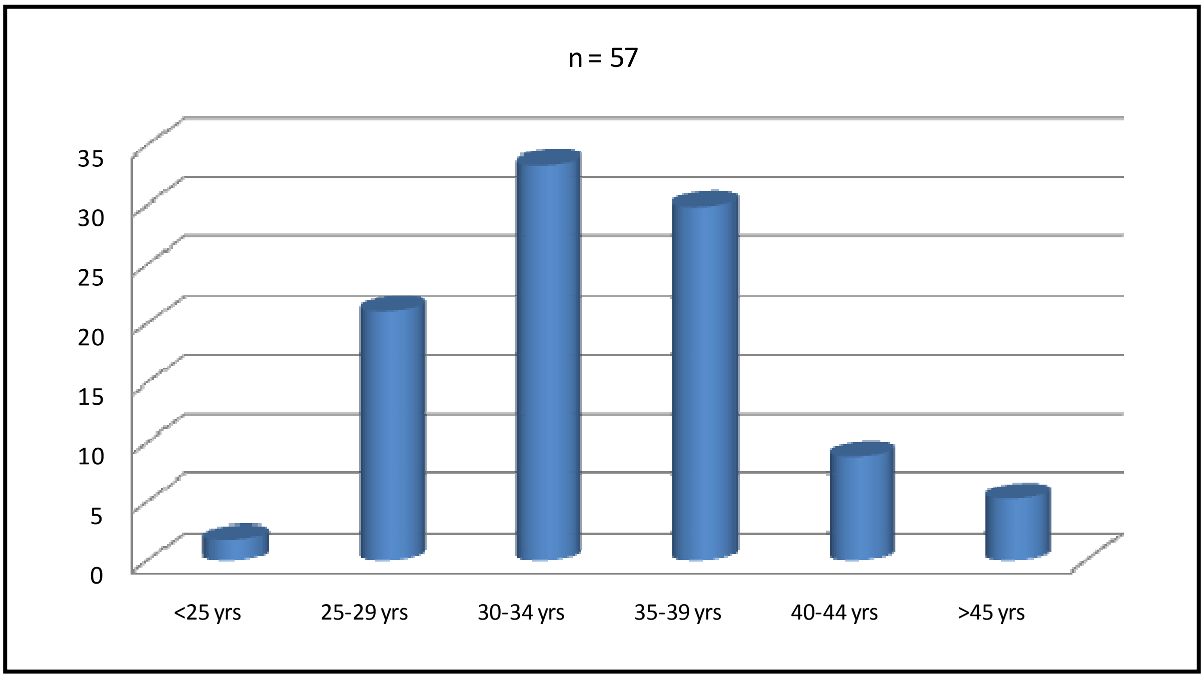


Figure 4.9: Age distribution among health care professionals (n=57)

Discussion: Wrobleski and Vukov (1996: 159) initiated a study among health care professionals involved in fixed wing air ambulance transport. They found that 87% of health care professionals were between 30-39 years old. In the current study of the 57 who responded to this question, the majority, namely 17 (29.83%) were in the same age group (Figure 4.9). A review of the literature yielded limited information about the age of air ambulance crew members; however, Whitley *et al.* (1990: [1]) theorise that, because older flight nurses have more experience, they can utilise their experience to render emotional support to a less experienced health care professional.

4.2.1.6 Years of experience (N = 58): [V16]

Respondents were asked to indicate their years of experience as health care professionals within an air transport team. The years of experience was regrouped to provide better insight into a specific age group. In the group one to four years 27 (46.55%) (N = 58) indicated their years of experience within these limits; 21 (36.21%) indicated 5-9 years; five (8.62%) indicated the 10-14 year group; two each (3.45%) indicated their years of experience in the 15-19 and 20-24 years groups respectively and one (1.72%) was in the >25 year group.

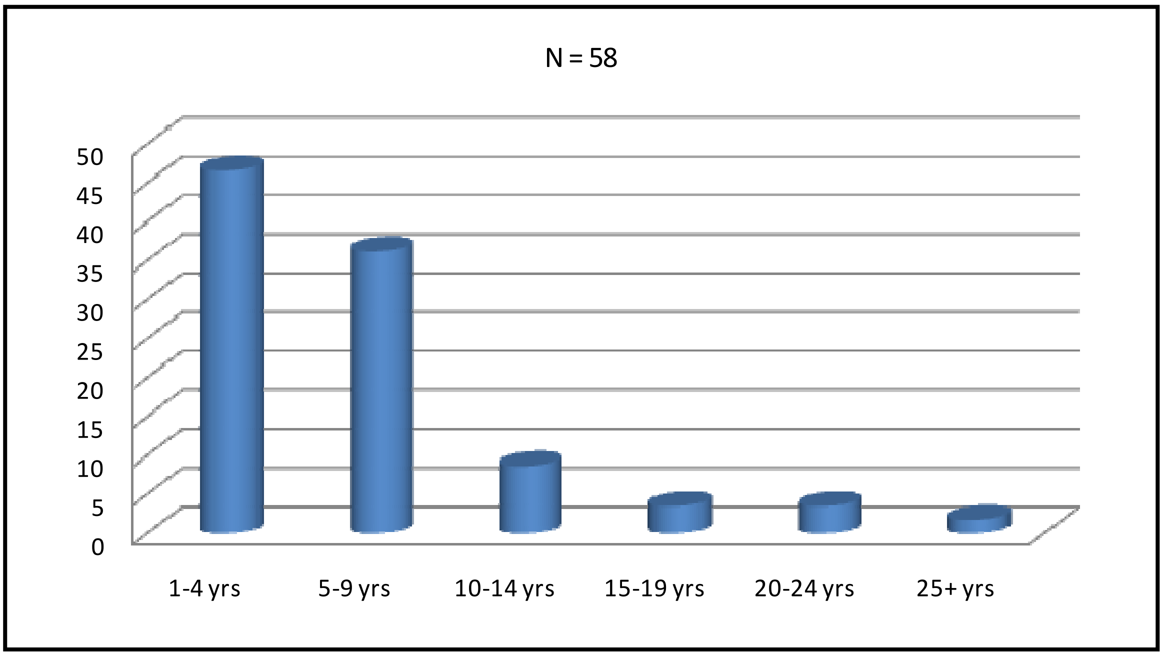


Figure 4.10: Years' experience as health care professional in fixed wing air transport team (N=58)

Discussion: According to Figure 4.10, the majority (27 [46.55%]) of the respondents had between one to four years' experience with the second highest group (21 [36.21%]) between 5-9 years. The African Medical and Research Foundation (AMREF) in Kenya requires that for registered nurses who wants to work on air transportation services, need four years' experience of which two have to be in critical care are required. Doctors must have emergency, critical care and air medical experience (Macnab 2006: 257). Marquand (2008: Getting your career of the ground [1]) on the Minority nurse.com website states that depending on the air ambulance service, nurses in the USA are required to have two to three years of critical care nursing experience before they are considered to participate in the air transportation of patients. Jones and Young (2004: 12) state experience of three to five years could be required by some air transport services.

4.2.1.7 Country of operation (n = 58): [V17]

Figure 4.11 indicates the distribution of respondents (N = 58) throughout the sub-Saharan countries. Two (3.45%) of the respondents were from Country A; four (6.90%) were from Country B three (5.17%) were from country C, and Country D constituted 41(70.69%) of the sample. From Country E there were six (10.34%) respondents, and from Country F there were two (3.45%) respondents.

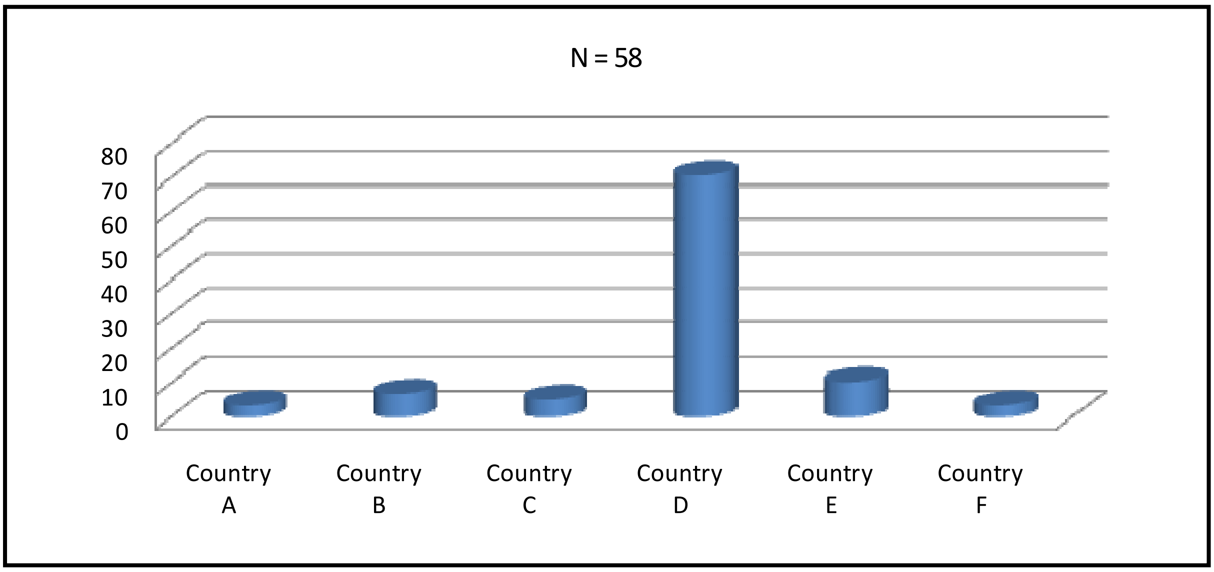


Figure 4.11: Distribution of respondents within participating countries (N=58)

Discussion: Figure 4.11 shows the highest distribution of the respondents (n =41) were in Country D (41[70.69%]) and the lowest in Country A (two [3.45%]). Macnab (2006: 257) and Exadaktylos *et al*. (2005: 107) state that, due to an uneven distribution of health care services in Saharan Africa, fixed wing air ambulances carrying medical crews on board are used to reach many of the remote regions and isolated communities in these areas. Rajah and Lasersohn (2000: 2) and Beninati *et al.* (2008: s37) concede that air transport brings the resources needed for definitive critical care to the patient more swiftly, especially in Africa where tertiary care and facilities with definitive care are mostly inaccessible. Highly skilled and knowledgeable staff is brought to the patient who contribute towards the maintaining of a high standard of care throughout the transfer as well as making a positive contribution to the outcome of the transfer.

4.2.2 Section B: Pre-flight patient information [V18 - V43]

Respondents were requested to mark the appropriate box on a four point Likert scale for Question 8 to Question 25 ([V18 – V163]) which addressed pre-flight information.

The scale was divided into the following numerical values:

(1)	Less than 25%	(<25%)
(2)	25% to less than 50%	(25%- <50%)
(3)	50% to less than 75%	(50%- <75%)
(4)	75% and more	(≥75%)

In order to discuss the degree of importance of each item, consensus between the researcher, the statistician and supervisors was reached to use ***75% and less*** as inclusion criteria for discussion.

To orientate the reader, a short summary is given of the meaning of pre-flight information as discussed in this study. The pre-flight information as intended in this study highlights the information obtained by the air crew personnel regarding the patient's history, the primary survey, the resuscitation phase, the secondary survey and the location of the patient. It is emphasised that the medical team of the transferring facility has to do a primary survey of the patients and inform the health care personnel of the air ambulance about health status of the patient.

As described by Pollack (2011: 10), competent staff in the call centre is the first link in the transport of the critically ill or injured patient. The pre-flight information is given by the transferring facility to a staff member in the call centre. This information should include the history, the patient's age, signs and symptoms leading to a diagnosis, and current treatment, for example, infusions and ventilation needs. The need for any cardiac assist devices should also be highlighted at this stage. In the case of an interfacility transport, the following information is also important: admission notes, peri-operative notes, laboratory results as well as nursing flow charts and notes. This information is essential to prepare for the transport of the critically ill or injured patient (Pollack 2011: 103). The data that needed to be obtained from the respondents in this pre-flight section focused on the patient information they had received from the transferring facility.

4.2.2.1 SAMPLE history [V18 - 25]

SAMPLE history is a useful mnemonic used when obtaining the history from patient with regards to the illness or injury sustained. The research findings pertaining to each of the components are discussed separately and summarised in Figure 4.12.

- **Signs and symptoms or seatbelt (n = 56):**

Two (3.57%) of the respondents indicated information regarding this category was received ≥75% of times; 10 (17.86%) indicated they received information 50- <75% of times; nine (16.07%) indicated 25- <50% and 35 (62.50%) indicated that it was given <25% of times.

- **Allergies (n = 55):**

Of the 55 respondents who answered this question, 16 (29.09%) indicated they were informed ≥75% of times of the patient's allergies; 14 (25.45%) noted this information was included 50- <75% of times and five (9.09%) indicated this information was received in 25- <50% of the cases before flights. Twenty (36.36%) indicated that in <25% of the cases information was given.

- **Medical history (n = 57):**

Of the 57 respondents who answered this question, 25 (43.86%) indicated it was given in ≥75% of cases and 17 (29.82%) respondents relayed that it given was in 50- <75% of the cases. Ten (17.54%) indicated the patient's medical history was given in 25- <50% of cases, while <25% of all cases was indicated by five (8.77%) of the respondents.

- **Past illnesses (n = 57):**

Only 57 of the respondents answered this question. Thirteen (22.81%) respondents indicated they received information on the patient's past illness in ≥75% of cases; 21 (36.84%) noted they were informed in 50- <75% of cases while 14 (24.56%) indicated a response of 25- <50%. Nine (15.79%) showed a response of <25%.

- **Last meal (n = 56):**

Of the 56 respondents who asked information regarding the last meal the patient had, only three (5.36%) respondents relayed that in ≥75% of the cases they received the information; one (1.79%) respondent indicated 50- <75%; nine (16.07%) indicated information about the patient's last meal was received 25- <50% before flights while the majority, 43 (76.79%), said in <25% of the cases they did receive the information about the last meal the patient had before flights.

- **Events (mechanism of injury; progression of illness) (n = 56):**

Fifty six of the respondents answered this question. As indicated by 21 (37.50%) of the respondents, in ≥75% of flights information was given. Twenty-three (41.07%) respondents indicated information was supplied 50- <75% of times prior to flights; nine (16.07%) marked the box 25- <50% of flights and three (5.36%) marked the box indicating <25% of flights.

- **Age of the patient (n = 56):**

Of the 56 respondents who answered this question, 46 (79.31%) noted they were informed of the patient's age ≥75% of times while ten (17.24%) indicated this information was only received in 50- <75% of cases. One (1.72%) responded with a 25- <50% answer and another one (1.72%) indicated information was received in <25% cases.

- **Diagnoses of patient (n = 57):**

Fifty-seven of the respondents answered this question. With regard to the diagnosis of the patient, 41 (71.93%) respondents revealed the diagnosis of the patient was received in ≥75% prior to flights; 14 (24.56%) indicated this information was received in 50- <75% of cases; one (1.75%) indicated a response of 25- <50% of cases and one (1.75%) noted that the diagnosis was received in <25% of cases.

Figure 4.12 indicates the frequency with which respondents were informed about the history, age and diagnosis of the patient prior to flights.

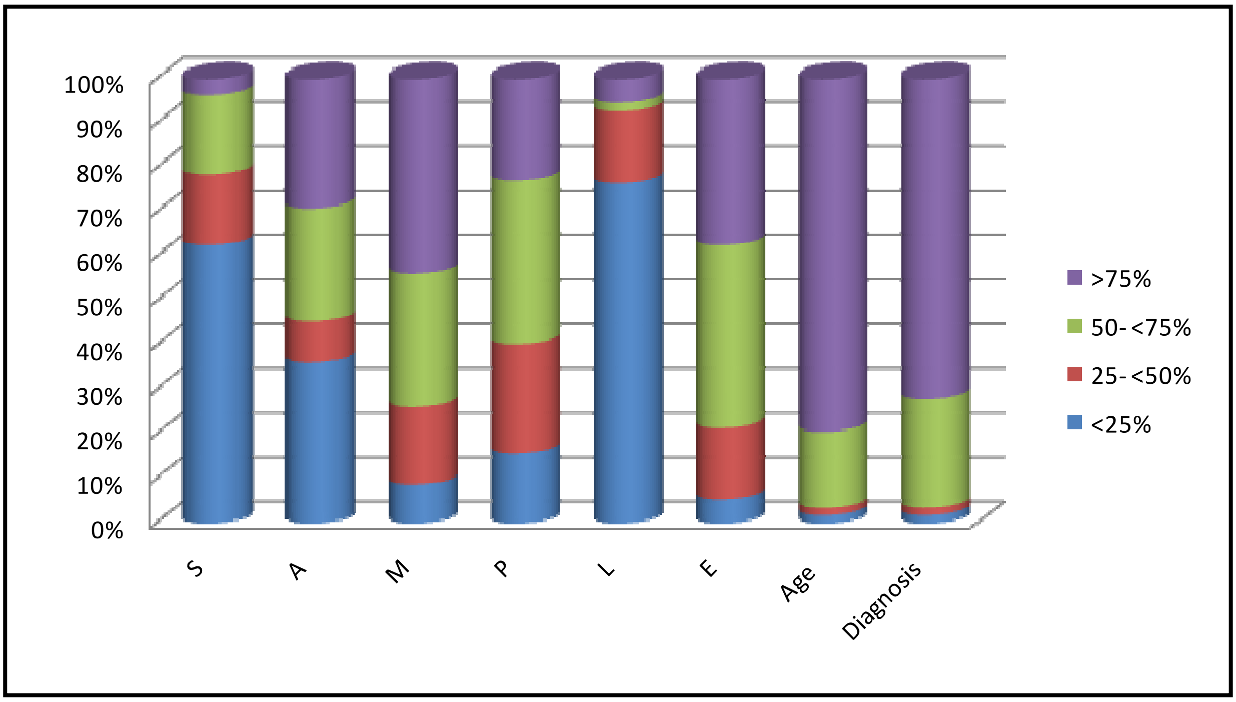


Figure 4.12: Distribution of prior notification of history of patient

Discussion: In summarising the information given in Figure 4.12, it can be deduced that critical information regarding patients' physical status was not supplied to the respondents prior to flights. The following sub-categories yielded distressing results regarding the absence of prior knowledge: *Signs and symptoms* (n = 56): 54 (96.43%); *Past illnesses* (n = 55): 44 (77.19%); *Last meal* (n = 56): 53 (94.64%).

Caroline (2008: 11) endorses the principles of the Advanced Trauma Life Support (ATLS 2008:11) which stipulates that a thorough history regarding the patient's current physiological status must be obtained prior to a flight. The mnemonic 'SAMPLE' is frequently used, also in South Africa (Heyns 2003: 94), to acquire this information:

S - **S**igns and **s**ymptoms/**S**eatbelt
A - **A**llergies
M - **M**edications currently used
P - **P**ast illness**/P**regnancy
L - **L**ast meal
E - **E**vents/**E**nvironment leading to the injury or illness

It is often not possible for the patient to provide this pre-flight information him- or herself; however, since it is critical to the survival of the patient, it is imperative that the necessary information is obtained from either the transferring facility personnel or family members or from both (ATLS 2008:11). In the view of Uusaro *et al*. (2002: 1122) an interfacility transfer of the severely ill or injured patient depends on the proper pre-transport preparations made by the transport team. Since patients vary widely in the type and scope of care needed, equipment and medication must be packed according to the patient's condition (Teichman *et al*. 2007: 264), therefore, pre-flight preparation starts by obtaining patient information from the transferring facility.

4.2.2.2 Primary survey [V26 - V31]:

It is crucial for patient management that air transport health professionals receive the data of the primary survey from the transferring team before the flight. This enables the air ambulance health care professionals to prepare for the immediate medical needs of the patient. In the questionnaire used for the purpose of this study, the primary survey data was sub-categorised to include the following: cervical spine control, airway management, breathing status, haemodynamic status, disability and environmental control.

- **Cervical spine control (n = 56):**

Regarding cervical spine control, 14 (25.00%) of the respondents indicated they were informed in ≥75% cases of this category prior to flights. Seventeen (30.36%) responded that it occurred in 50- <75% of flights and 11 (19.64%) indicated it occurred in 25- <50% of flights. Fourteen (25.00%) respondents relayed that they were informed in <25% of the flights. Each of these components are discussed separately and a summary can be viewed in Figure 4.13.

- **Airway management (N = 58):**

Thirty-six (62.07%) of the respondents noted they were informed about airway management of the patient in ≥75% of the cases. Thirteen (22.41%) respondents noted it to be in 50- <75% of cases; five (8.62%) indicated it was in 25- <50% of cases while four (6.90%) indicated information was supplied in <25% of cases.

- **Breathing status (N = 58):**

Of the respondents, 30 (51.72%) relayed that the breathing status of the patient was given ≥75% of times; 18 (31.03%) said it was provided 50- <75% of times, while eight (13.79%) indicated it was provided 25- <50% of times. The <25% box was marked by 2(3.45%) of the respondents.

- **Haemodynamic status (N = 58):**

More than half of the respondents, (35 [60.34%]), indicated they were informed about the haemodynamic status of the patients in ≥75% of the cases. Of the remaining 23 respondents, 17 (29.31%) indicated they were informed 50- <75% of times, five (8.62%) indicated information was received 25- <50% of times and only one (1.72%) revealed that the haemodynamic status of patients was received <25% of times.

- **Disability (n = 56):**

This category was measured by applying the principles of the Glascow Coma Scale. Of the respondents, 31 (55.36%) indicated they were informed of a patient's disability in ≥75% of cases. Fifteen (26.79%) were made aware in 50- <75% of cases while nine (16.07%) noted they were informed about it 25- <50% of times. The <25% box indicated only one (1.79%) response.

- **Environmental control (n = 57):**

With regard to the information received by the respondents on environmental conditions from the transferring team, five (8.77%) of the respondents revealed that they were given information ≥75% of times and seven (12.28%) indicated they were informed of the situation 50- <75% of time. Thirteen (22.81%) responded with 25- <50% of times while the majority, 32 (56.14%), indicated they were informed of environmental conditions <25% of times.

The results of the information received by the air ambulance health providers from the transferring team after the latter's primary survey are reflected in Figure 4.13.

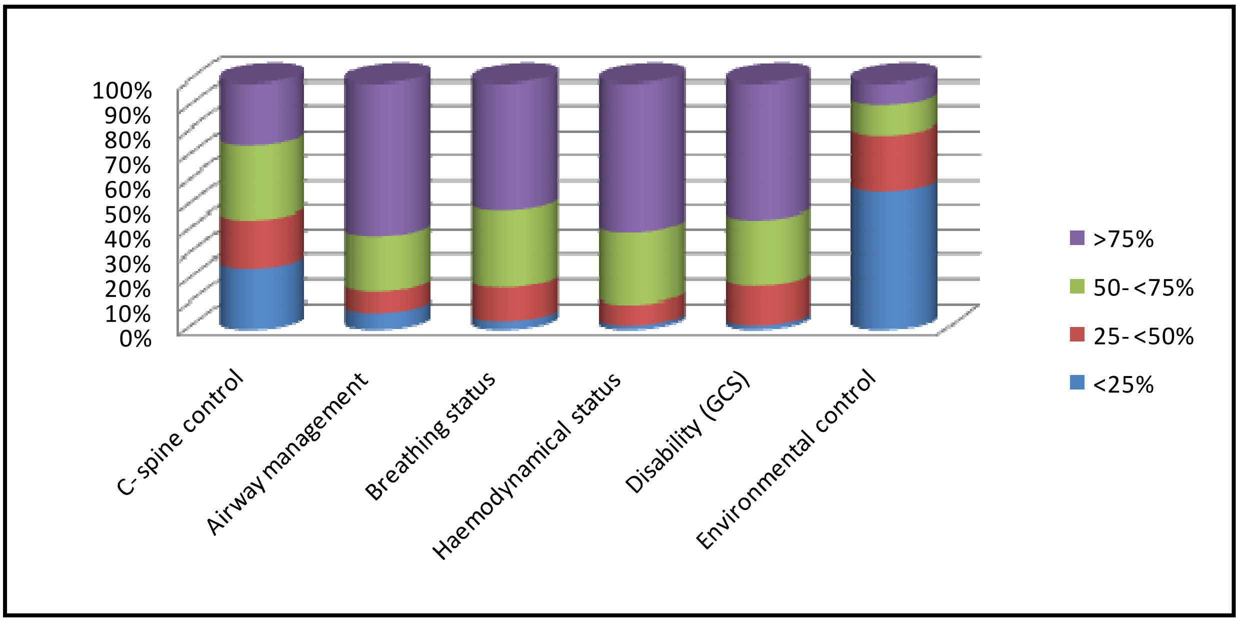


Figure 4.13: Incidence of prior knowledge with regards to primary survey

Discussion: The primary survey should be a quick assessment of the patient's current condition and must include identification of life-threatening emergencies that need urgent attention (ATLS 2008:4). Proehl (2009: 2) emphasises that the five steps in patient assessment as provided by the ATLS are essential to rapidly assess the patient and manage life-threatening emergencies. These are also referred to as the A, B, C, D, E's:

Airway management and cervical spine control. The airway is assessed for patency while the cervical spine is protected (ATLS 2008:5).

Breathing or ventilation is necessary to facilitate gas exchange. Injuries that can impair this vital function should be eliminated immediately (ATLS 2008:6).

Circulatory issues that are of importance include blood volume and cardiac output. The patient's level of consciousness can be an indication of decreased cardiac output as well as pulse rate, quality and regularity. Haemorrhage control is just as important in the trauma patient (ATLS 2008:7).

Disability relates to the patient's neurological status. A Glascow Coma Scale is a quick assessment of the patient's cerebral function (ATLS 2008:7). In accordance with the ATLS (2008: 7) this category specifically assessed whether respondents utilised the Glascow Coma Scale.

Exposure or **E**nvironmental control. The patient's body temperature may be influenced by ambient temperature in the cabin as well as weather conditions (Leggat & Fischer 2005:145). Not only is patient comfort of importance, but strict management of a patient's body temperature can make a difference with regards to the patient's outcome (Grissom & Farmer 2005:s17).

The results as depicted in Figure 4.13 shows that 42 (75%) of respondents (n = 56) did not receive information for at least 75% of the time pertaining to *cervical spine control;* 52 (91.23%) of the respondents (n = 57) indicated they were not given information about *environmental conditions*. This is troublesome because to avoid the loss of lives, minimise health hazards and provide the best care possible for the patient, relevant and precise information regarding all aspects of the patient's condition must be received by the air transporting medical team.

According to Wallace and Ridley (1999: 371), a complete handover includes the patient's history records, relevant statistics and any other data that will ensure correct and appropriate medical treatment of the particular patient. Also, this will ensure that the documentation about the patient's illness or injury is complete and available for future use or reference.

4.2.2.3 Resuscitation phase [V32 - V38]

The resuscitation phase follows the primary survey. In the data analysis, the following aspects were focused on: Additional intravenous lines, additional drugs, continuous medications, blood results, total fluid resuscitation, blood products and results of diagnostic procedures. These are set out in Figure 4.14.

- **Additional lines (N = 58)**

All the respondents answered this question. Thirteen (22.41%) of the respondents answered that they were informed ≥75% of times before flights of the additional intravenous lines of the patient; 17 (29.31%) indicated they were informed 50- <75% times prior to flights and 15 (25.86%) indicated to be informed in 25- <50% of cases before flights. The lowest number, namely 13 (22.41%), revealed that they were informed <25% of times of that additional intravenous lines would be needed.

- **Additional tubes (n= 56)**

Only 56 of the respondents answered this question. According to 16 (28.57%) they were informed ≥75% of times that additional tubes would be needed, while 18 (32.14%) indicated they were informed in 50- <75% of cases. Twelve of the respondents (21.43%) indicated they were made aware of additional tubes 25- <50% of times prior to flights while ten (17.86%) indicated to be informed <25% of times.

- **Continuous drug treatment (n = 55)**

Fifty-five of the respondents answered this question. Regarding continuous drug treatment, eight (32.73%) of the respondents relayed they were informed in ≥75% cases before flights that the patient was on continuous drugs; 24

(43.64%) indicated they were made aware in 50- <75% cases; nine (16.36%) indicated to be informed 25- <50% prior to flights, and four (7.27%) were informed in <25% of cases before flights.

- **Blood results (N = 58)**

All the respondents answered this question, indicating that four (6.90%) were informed in ≥75% of cases before flights of the patient's blood results; 24 (41.38%) were informed in 50- <75% of cases; 21 (36.21%) were informed in 25- <50% cases and nine (15.52%) were informed in <25% of cases.

- **Total amount of fluid administered (N = 58)**

One hundred percent of the respondents answered this question. Two (3.45%) said they were made aware of total amount of fluid administered prior to the arrival of the air ambulance transport team ≥75% of times and eight (13.79%) were informed 50- <75% of times. Twenty-two (37.93%) were informed in 25- <50% of times and 26 (44.83%) were informed <25% of times before flights.

- **Number of blood products administered (N = 58)**

All the respondents (N=58) answered this question. Nine (15.52%) respondents indicated to be informed ≥75% of times and 21 (36.21%) indicated to be informed 50- <75% of times. The 25- <50% box yielded a result of 16 (27.59%) respondents and the 25- <50% box a result of 12 (20.69%) respondents.

- **Results from diagnostic procedures (N = 58)**

All the respondents (N=58) responded to this question. Nine respondents indicated they were informed in ≥75% of cases before flights of the diagnostic procedures; 23 (39.66%) were informed in 50- <75% of cases; 19 (32.76%) indicated they were informed in 25- <50% of cases and seven (12.07%) indicated they were informed in <25% of cases.

The results of the resuscitation phase are set out in Figure 4.14.

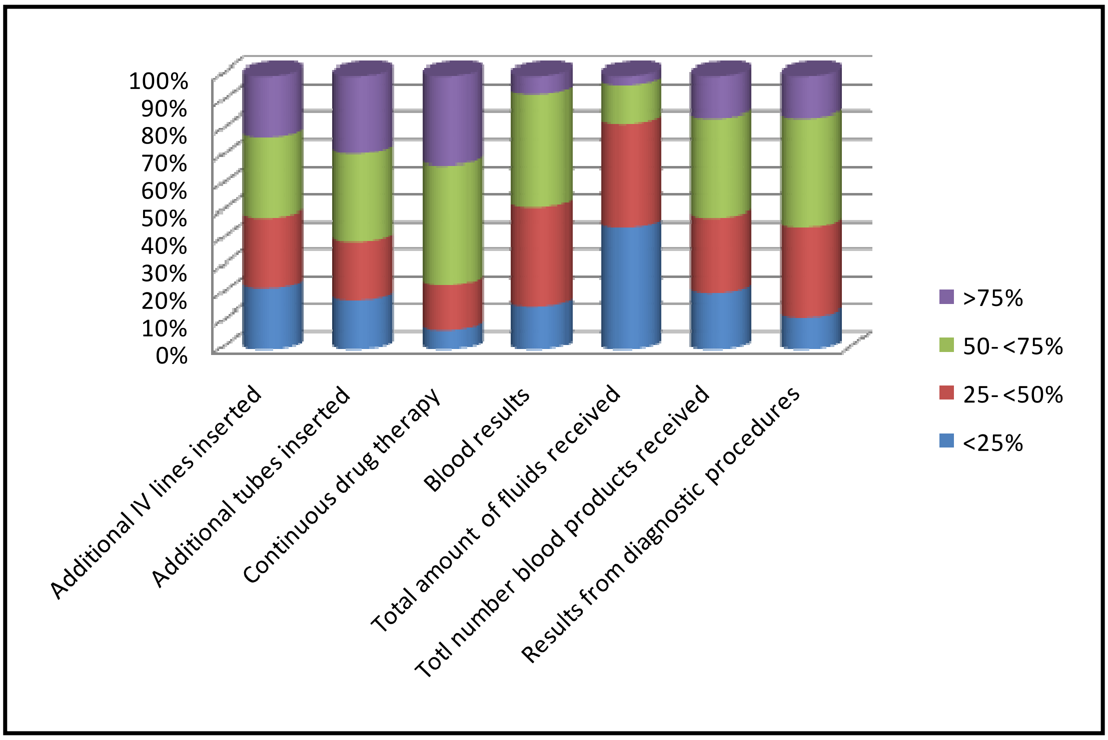


Figure 4.14: Information distribution regarding the resuscitation phase

Discussion: During the resuscitation phase actions are taken after primary assessment in order to correct life-threatening emergencies (ATLS 2008:8). This phase may also include adjuncts to the primary survey, for example, electrocardiogram analysis, urinary and gastric catheters, as well as X-ray examinations and complete vital signs monitoring (ATLS 2008: 9). Wallace and Ridley (1999: 371) state that all radiographic procedures should be documented and results handed over to ensure that the transport medical team have full knowledge of the patient's condition and also to ensure complete documentation.

The results from this sub-category as observed in Figure 4.14 are very disconcerting. Six of the seven sub-categories yielded negative results in that high percentages of respondents did not receive the necessary information: *Additional lines* (N = 58): 45 (77.59%); *Continuous drug treatment* (n = 55): 48 (87.27%); *Blood results* (N = 58): 54 (93.10%); *Total amount of fluid administered* (N 58): 56 (96.55%); *Number of blood products administered* (N = 58): 51 (87.93%); *Results from diagnostic procedures* (N = 58): 49 (84.48%).

4.2.2.4 Secondary survey [V39 - V40]

The secondary survey was sub-categorised in the several groups of questions as indicated below. The respondents could indicate the level of information received prior to a flight. The results were based on a head-to-toe examination and current patient management. A summary can be viewed in Figure 4.15.

- **Head–to–toe examination (N = 58)**

Ten (17.24%) of the respondents revealed that they received informed about the head-to-toe examination conducted on the patient in ≥75% of flights; 27 (46.55%) respondents indicated they were informed in 50- <75% of flights; 11 (18.97%) were informed in 25- <50% of cases prior to flights while ten (17.24%) marked that they were informed in <25% of the cases.

- **Patient management (n =57)**

One respondent did not answer this question. Twenty-four (42.11%) of the respondents indicated that they are informed of the patient management principles in ≥75% of flights; 19 (33.33%) respondents were informed in 50- <75% of flights; nine (15.79%) were informed in 25- <50% of flights and five (8.77%) indicated that they were informed in <25% of flights. Figure 4.15 depicts these components.

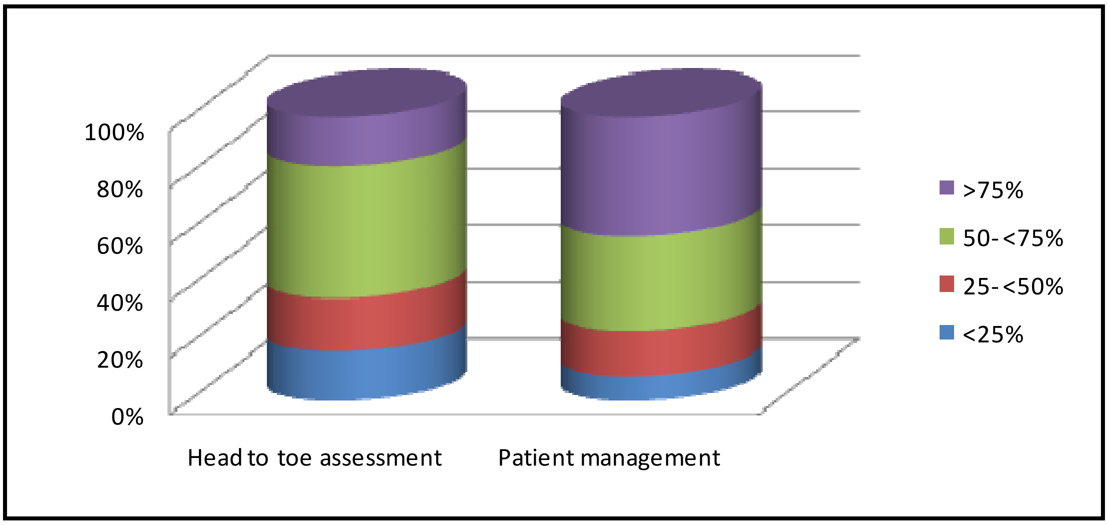


Figure 4.15: Information distribution with regards to secondary survey

Discussion: The secondary survey follows the primary survey and is only performed after all resuscitative interventions have been completed. This is a head-to-toe examination in which all systems and secondary factors which did not require immediate intervention are assessed. As shown in Table 4.15, the responses pertaining to the findings of *head-to-toe examination* (N = 58) is of concern as 48 (82.76%) respondents did not receive information about the findings of the secondary survey. The secondary survey is a rapid and systematic assessment of the patient to clarify illness or aetiology (Proehl 2009: 5; Rajah & Lasersohn 2000: 23). This phase includes palpation, auscultation, percussion and examination of the following areas: head and neck, chest, abdomen as well as perineum, rectum and/or vagina. This is followed by the musculoskeletal system and both sensory and motor function is observed for any injury or damage (ATLS 15:2010). In addition, Proehl (2009: 5) states that the secondary survey should not be performed until the primary survey and resuscitative procedures have been completed.

4.2.2.5 Patient location [V41 - V43]

In this study, it was regarded as necessary by the researcher to assess whether information regarding the location of the patient reached the respondents prior to the flight. Figure 4.16 depicts a summary of this section.

- **Exact location of the patient (N = 58)**

Forty-two (72.41%) of the respondents indicated that they were informed ≥75% before flights about the exact location of the patient; 14 (24.14%) indicated to be informed 50- <75% prior to flights; one (1.72%) was informed in 25- <50% of flights and one (1.72%) indicated to be informed <25% of the times about the patient's location before flights.

- **Expected flight duration (n = 57)**

One respondent did not answer this question, therefore (n = 57). Of the respondents, 48 (84.21%) of the respondents noted they were informed of the expected flight duration of the flight in ≥75% of cases. Seven (12.28%) indicated they were informed in 50- <75% of the cases and one (1.75%) was informed in 25- <50% of cases. One (1.75%) indicated to be informed <25% of the flight duration in advance.

- **Distance of the patient from the airport (n = 56)**

Of the 56 participants who responded to the question about information disclosed about the distance of the patient form the airport, 33 (58.93%) indicated they were informed ≥75% of the time before flights 11 (19.64%) respondents indicated they were informed 50- <75% of times and six (10.71%) were informed 25- <50% of times. Six (10.71%) of the respondents indicated they had knowledge about the patient's distance from the airport in <25% of flights.

These results are illustrated in Figure 4.16.

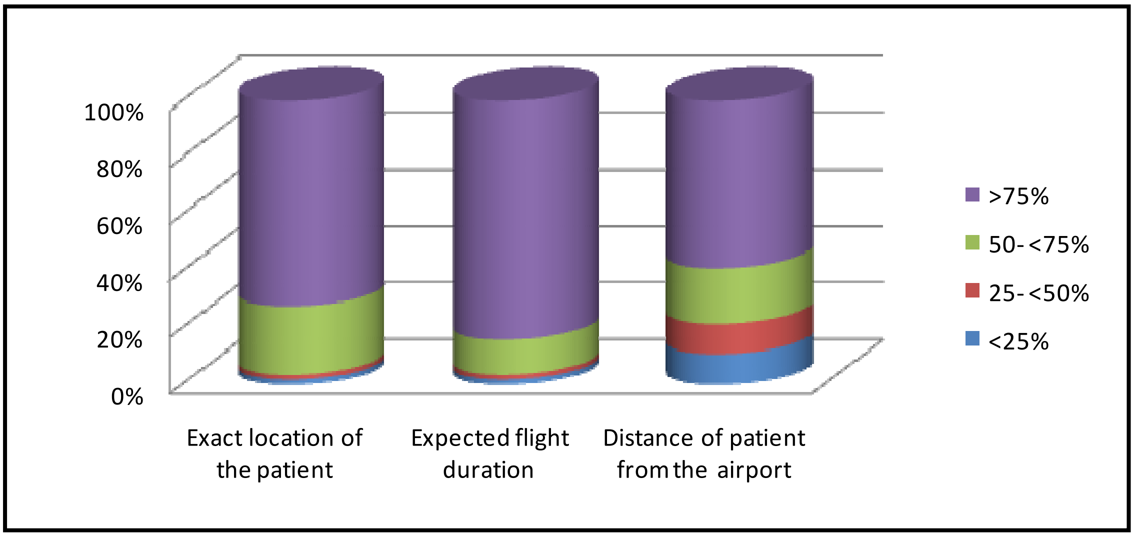


Figure 4.16: Details with regard to the patient location

Discussion: Although these factors are not discussed in literature these factors are important when transporting the critically ill or injured patient. Fluid and drug calculations need to be made pre-flight to last until handover at the receiving facility. Should the patient be intubated, oxygen requirements increase and health care professionals should be taking the distance of the patient with relation to the airport into consideration when preparing for a flight. From the research findings can be concluded that this information is available in ≥75% of flights.

4.2.3 Section C: Advanced emergency equipment [V44 – V131]

In this section the emergency equipment and stock on board an air ambulance which may be needed to administer to a patient as part of the emergency critical care en route to a medical facility, are discussed in detail. It is based on information obtained from the transferring team prior to a mission. The section is sub-divided into airway and spinal control, breathing and ventilation, circulation and haemorrhage control, defibrillation and drugs, environmental control and personal protective equipment. The minimum safe resting periods for health care professionals between missions is also discussed.

4.2.3.1 Airway and cervical spine [V44 - V52]

The emergency airway adjuncts and spinal control equipment was sub-categorised so that the respondents were able to distinguish which was available to them. For more clarity a summary of the results are depicted in table format in Table 4.5 and Figure 4.17 for a graphic summary.

Table 4.5: Summary of the results with regards to emergency airway adjuncts and spinal control equipment

Airway and cervical spine emergency equipment	<25%	25% - <50%	50% - <75%	≥75%
Laryngoscope with curved blades (N = 58)	1 (1.72%)	0	1 (1.72%)	56 (96.55%)
Laryngoscope with straight blades (n = 56)	6 (10.71%)	0	3 (5.36%)	47 (83.93%)
Endotracheal tubes (n = 58)	1 (1.72%)	0	4 (6.90%)	53 (91.83%)
Surgical cricothyroidotomy set (n = 58)	6 (10.34%)	2 (3.45%)	3 (5.17%)	47 (81.03)
Various sizes cervical collars (n =57)	1 (1.75%)	0	0	56 (98.25%)

Airway and cervical spine emergency equipment	<25%	25% - <50%	50% - <75%	≥75%
Head immobilising devices (n = 57)	0	0	0	57 (100%)
Scoop stretcher or spine board (n = 57)	0	0	0	57 (100%)
Vacuum mattress (n = 57)	1 (1.75%)	0	1 (1.75%)	55 (96.49%)
Kendrick extrication device (n = 57)	0	2 (3.51%)	3 (5.26%)	52 (91.23%)

Figure 4.17 presents a graphic illustration of the results from Table 4.5.

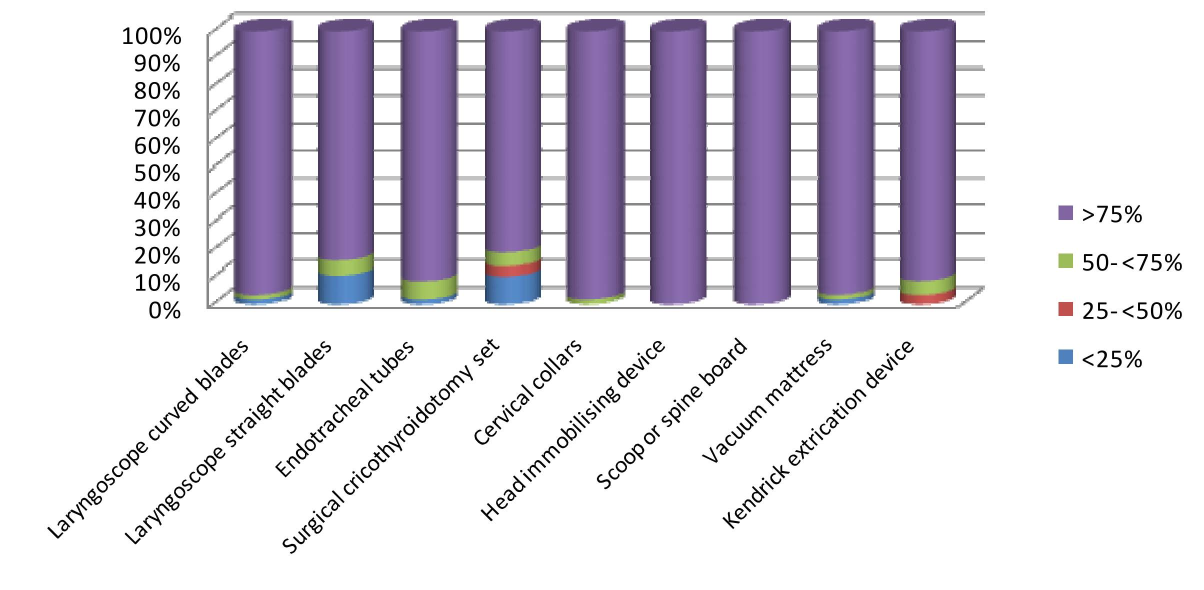


Figure 4.17: Availability of emergency airway and cervical spine management equipment

Discussion: As shown in Figure 4.17 the majority of respondents revealed that the required advanced emergency equipment for *airway and cervical spine control* was at hand in the aircraft ≥75%. Various authors as summarised in table format provide evidence that, to attain and maintain an advanced level of care throughout the transfer of the patient, advanced emergency equipment must be available during all emergency flights. Table 4.6 presents a summary of the literature verifying the equipment relating to airway and cervical spine control management with references to each sub-category.

Table 4.6: Summary of the literature with regards to airway and cervical spine control and references to each

	Equipment	Reference
Airway and cervical spine	Laryngoscope with curved and straight blades	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Teichman *et al.* (2007: 265) Pollak (2011: 147)
	Endotracheal tubes	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Teichman *et al.* (2007: 265) Pollak (2011: 147)
	Surgical cricothyrodotomy set	Warren *et al.* (2004: 259) Caroline (2008: 11.98) Proehl (2009: 58)
	Endotracheal tube stylet	Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Beninati *et al.* (2008: s373) Pollak (2011: 147)
	Magill forceps	Warren *et al.* (2004: 259) Beninati *et al.* (2008: s373) Pollak (2011: 147)

	Equipment	Reference
Airway and cervical spine	Nasogastric tubes	Rajah & Lasersohn (2000: 25) Teichman *et al.* (2007: 265) Pollak (2011: 679)
	Suctioning devices	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Lamb (2003: 97) Leggat & Fisher (2005: 144) Teichman *et al.* (2007: 265) Beninati *et al.* (2008: s373) Venticinque & Grathwohl (2008: s288) Pollak (2011: 147)
	Wire cutter	Teichman *et al.* (2007: 265) Beninati *et al.* (2008: s373)
	Nasopharyngeal airway	Warren *et al.* (2004: 259) Beninati *et al.* (2008: s373) Pollak (2010: 143)
	Oropharyngeal airway	Warren *et al.* (2004: 259) Teichman *et al.* (2007: 265) Beninati *et al.* (2008:s373) Pollak (2011: 143)
	C-spine control	Warren *et al.* (2004: 259) Teichman *et al.* (2007: 265) Beninati *et al.* (2008: s373)

4.2.3.2 Breathing and ventilation [V53 - V66]

Results regarding the available breathing and ventilatory emergency equipment on flights are presented in Table 4.7 and graphically illustrated in Figure 4.18.

Table 4.7: Summary of the results with regards to breathing and ventilatory equipment

Breathing and ventilation	<25%	25% - <50%	50% - <75%	≥75%
Pre-filled oxygen bottles (N =58)	0	1 (1.72%)	0	57 (98.28%)
Neonate bag-valve-mask devices (n = 57)	2 (3.51%)	4 (7.02%)	1 (1.75%)	50 (87.72%)
Paediatric bag-valve-mask devices (n = 57)	0	3 (5.26%)	0	54 (94.72%)
Adult bag-valve-mask devices (n = 57)	0	0	0	57 (100%)
Peripheral saturation monitoring devices (N = 58)	0	0	0	58 (100%)
Arterial blood gas monitoring (n = 54)	24 (44.44%)	2 (3.70%)	0	28 (51.85)
Capnography (N=58)	8 (13.79%)	3 (5.17%)	3 (5.17%)	44 (75.86%)
Peak expiratory flow meters (n = 57)	17 (29.82%)	8 (14.04%)	0	32 (56.14%)
Non-invasive mechanical ventilators (N = 58)	17 (29.31%)	0	4 (6.90%)	37 (63.79%)
Volume control operated mechanical ventilators (N = 58)	8 (13.79%)	0	1 (1.72%)	49 (84.48%)
Pressure control operated mechanical operators (N = 58)	8 (13.79%)	0	1 (1.72%)	49 (84.48%)

Breathing and ventilation	<25%	25% - <50%	50% - <75%	≥75%
Intercostal drain sets (N = 58)	11 (18.97%)	0	1 (1.72%)	46 (79.31)
Intercostal drain tubes (n = 57)	10 (17.54%)	1 (1.75%)	1 (1.75%)	45 (78.95)
Heimlich valves (N = 58)	4 (6.90%)	1 (1.72%)	2 (3.45%)	51 (87.93%)

The summarised results in Table 4.7 are graphically illustrated in Figure 4:18.

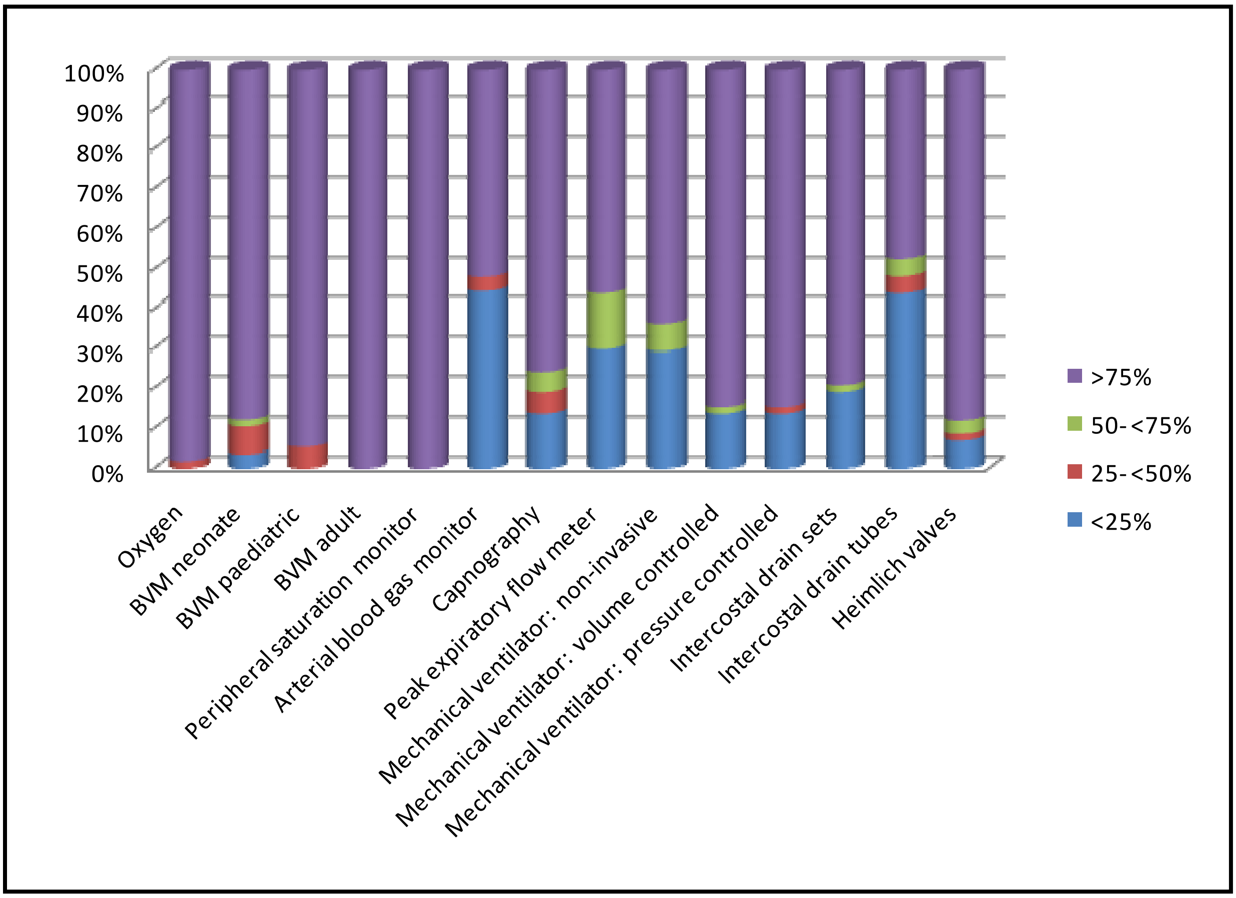


Figure 4.18: Availability of emergency equipment with regard to breathing and ventilation

Discussion: The highest response with regards to breathing and ventilatory equipment was for oxygen, bag-valve-mask devices and peripheral saturation monitors. These are basic equipment needed on any ambulance and can be used by any level of health care provider (view Figure 4.18 and Table 4.7). The recommended advanced emergency equipment that should be available for use during the transport of patients by air ambulance is mentioned by numerous authors as indicated below. Table 4.8 presents a summary of the literature verifying the equipment relating to breathing and ventilation with references to each sub-category.

Table 4.8: Summary of the literature with regards to breathing and ventilatory equipment and references to each

	Equipment	References
Breathing and ventilation	Oxygen	Wallace and Ridley (1999: 369) Leggat and Fisher (2005: 144) Teichman *et al.* (2007: 265) Pollak (2011: 144)
	Bag valve mask	Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Teichman *et al.* (2007: 265) Pollak (2011: 147)
	Pulse oximetry	Rajah & Lasersohn (2000: 25) Lamb (2003: 97) Warren *et al.* (2004: 259) Grissom & Farmer (2005: s16) Leggat & Fisher (2005: 144) Beninati *et al.* (2008: s373)
	Arterial blood gas	Lamb (2003: 97) Grissom & Farmer (2005: s19) Beninati *et al.* (2008: s373) Venticinque & Grathwohl (2008: s288)

	Equipment	References
Breathing and ventilation	Capnography	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Warren *et al*. (2004: 259) Grissom & Farmer (2005: s17) Leggat & Fisher (2005: 144) Teichman *et al.* (2007: 265) Beninati *et al.* (2008: s373) Venticinque & Grathwohl (2008: s288)
	Mechanical ventilator	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Lamb (2003: 97) Warren *et al.* (2004: 259) Teichman *et al.* (2007: 265) Beninati *et al.* (2008: s373) Venticinque & Grathwohl (2008: s288)
	Intercostal drainage tubes	Rajah & Lasersohn (2000: 25) Pollak (2011: 147)
	Heimlich valves	Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259)
	Peep valve	Warren *et al.* (2004: 259)

4.2.3.3 Circulation with haemorrhage control [V67 - V85]

For clarification the results with regard to circulation and haemorrhage control emergency equipment at hand as indicated by respondents in the sub-categories are given in Table 4.8 and graphically illustrated in Figure 4.19.

Table 4.9: Summarised results of circulation and haemorrhage control equipment at hand in fixed wing air ambulance

Circulation and haemorrhage control	<25%	25% - <50%	50% - <75%	≥75%
3-lead ECG monitors (N = 58)	0	0	0	58 (100%)
12-lead ECG monitors (n = 56)	11 (19.64%)	0	2 (3.57%)	43 (76.79%)
Rapid laboratory tests (n = 54)	23 (42.59%)	2 (3.70)	6 (11.11%)	23 (42.59)
Infusion pumps (N = 58)	8 (13.79%)	3 (5.17%)	6 (10.34%)	41 (70.69%)
High flow venous access lines (N = 58)	4 (6.90%)	1 (1.72%)	4 (6.90%)	49 (84.48%)
Peripheral venous access lines (N = 58)	1 (1.72%)	0	0	57 (98.28%)
Jugular venous access lines (n = 56)	10 (17.86%)	2 (3.57%)	0	44 (78.57%)
Femoral venous access lines (n = 56)	11 (19.64%)	3 (5.36%)	0	42 (75%)
Umbilical venous access lines (n = 56)	17 (30.36%)	2 (3.57%)	0	37 (66.07%)
Umbilical arterial access lines (n = 56)	19 (33.93%)	5 (8.93%)	0	32 (57.14%)
Central access lines (n = 57)	20 (35.09%)	1 (1.75%)	0	36 (63.16%)
Adult intraosseous needles (n = 56)	14 (25%)	4 (7.14%)	1 (1.79%)	37 (66.07%)
Paediatric intraosseous needles (n = 56)	12 (21.43%)	3 (5.36%)	1 (1.79%)	40 (71.34%)
Neonatal intraosseous needles (n = 57)	17 (29.82%)	4 (7.02%)	2 (3.51%)	34 (59.65%)
Rigid limb splints (n = 57)	2 (3.51%)	1 (1.75%)	2 (3.51%)	52 (91.23%)

Circulation and haemorrhage control	<25%	25% - <50%	50% - <75%	≥75%
Air filled limb splints (n = 53)	25 (47.17%)	3 (5.66%)	2 (3.77%)	23 (43.40%)
Traction splints (n = 57)	2 (3.51%)	1 (1.75%)	2 (3.51%)	52 (91.23%)
Availability of blood (n = 57)	20 (35.09%)	2 (3.51%)	11 (19.31%)	24 (42.11%)
Availability of other blood products (n = 56)	25 (44.64%)	2 (3.57%)	7 (12.50%)	22 (39.29%)

The results from Table 4.8 are graphically illustrated in Figure 4.19.

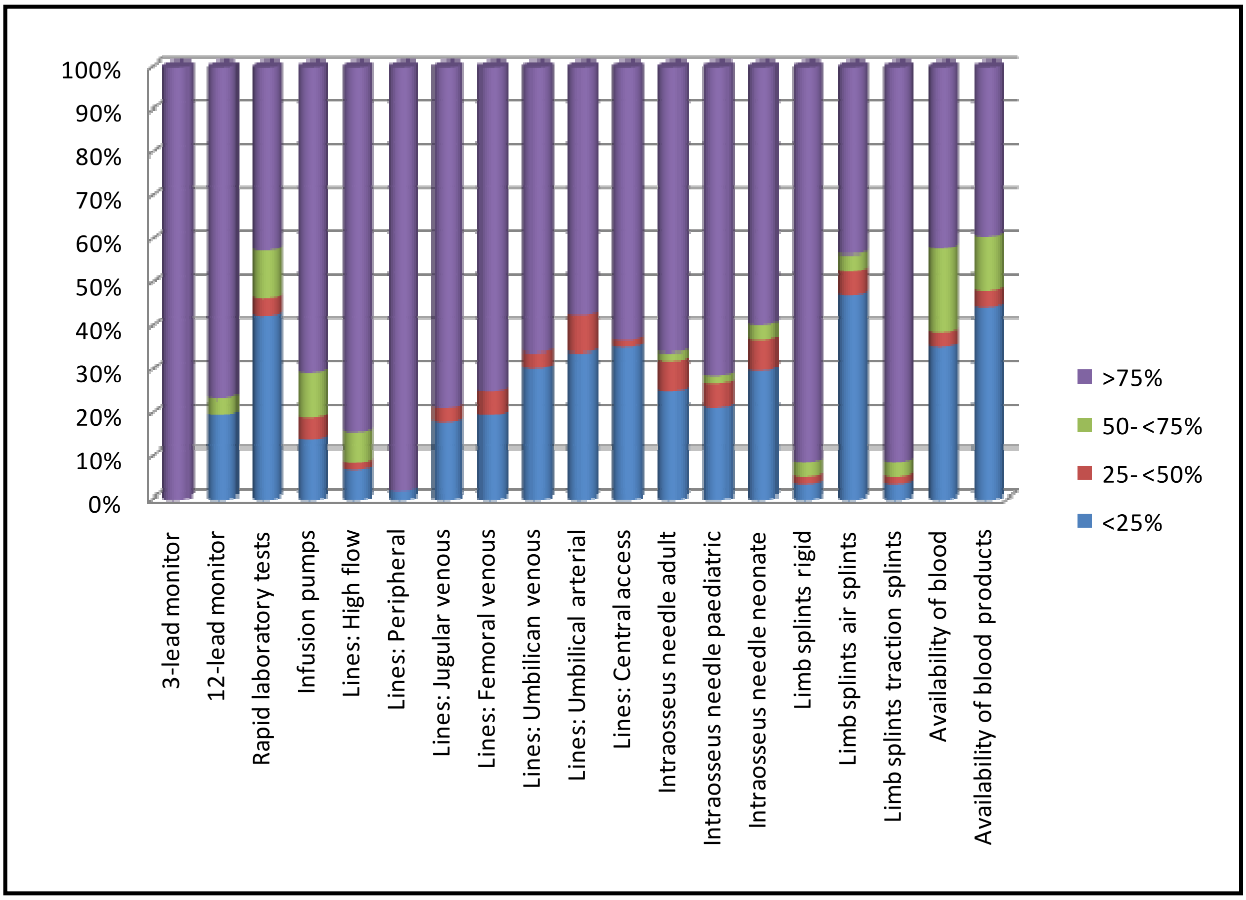


Figure 4.19: Availability of circulatory and haemorrhage control devices

Discussion: To administer the appropriate emergency treatment to patients – and sometimes to ensure their survival – equipment must be available. In fact, Lamb's (2003: 101) interpretation of 'availability' is that similar equipment as found in the critical care units of health facilities should be available during air transport of patients.

Figure 4.19 indicates that the following two sub-categories could raise some concern: *Rapid laboratory tests* (31 [57%] of respondents (n = 54) indicated it was not available; *Availability of blood* (34 [60.71%] of the respondents [n = 56] revealed that blood was not available). As set out in Table 4.10, different authors agree that it is essential to have emergency equipment for circulation with haemorrhage control available on air ambulances.

Table 4.10: Summary of the literature with regards to circulation and haemorrhage control and references to each

	Equipment	References
Circulation and haemorrhage control	Cardiac monitor	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Grissom & Farmer (2005: s17) Leggat & Fisher (2005: 144) Teichman *et al.* (2007: 265) Beninati *et al.* (2008: s373)
	Invasive blood pressure/ non- invasive blood pressure	Wallace & Ridley (1999: 369) Lamb (2003: 97) Warren *et al.* (2004: 259) Grissom & Farmer (2005: s17) Leggat & Fisher (2005: 144) Teichman et al. (2007: 265) Beninati *et al.* (2008: s373) Venticinque & Grathwohl (2008: s288)
	12-lead ECG	Teichman *et al.* (2007: 265)

	Equipment	References
Circulation and haemorrhage control	Infusion pumps	Wallace & Ridley (1999: 369) Lamb (2003: 97) Warren *et al.* (2004: 259) Grissom & Farmer (2005: s18) Beninati *et al.* (2008: s373) Venticinque & Grathwohl (2008: s288)
	Central lines (venous/arterial)	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Beninati *et al.* (2008: s373) Venticinque & Grathwohl (2008: s288)
	Intraosseous device	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Teichman *et al.* (2007: 267) Beninati *et al.* (2008: s373)
	Intravenous fluids	Wallace & Ridley (1999: 369) Warren et al. (2004: 259) Leggat & Fisher (2005: 144) Teichman *et al.* (2007: 265)
	Various splints	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Teichman *et al.* (2007: 265)
	Blood products	Dhingra (2006: 3)

4.2.3.4 Disability, defibrillation and drugs [V86 - V116]

For clarity sub-divisions responded to in this question are also summarised in a table format (view Table 4.10) followed by a graphic representation of the results (view Figure 4.20).

Table 4.11: Summarised results of disability, defibrillation and drugs at hand on fixed wing air ambulances

Disability, defibrillation and drugs	25%	25% to less than 50%	50% to less than 75%	75% and more
Blood glucose monitoring (N = 58)	3 (5.17%)	0	0	55 94.83%)
Defibrillator (N = 58)	0	0	0	58 (100%)
External pacer (N = 58)	0	0	0	58 (100%)
Adrenalin (N= 58)	0	0	0	58 (100%)
Atropine sulphate (N = 58)	0	0	0	58 (100%)
Amiodarone (N = 58)	0	1 (1.72%)	1 (1.72%)	56 (96.55%)
Adenosine (n = 57)	2 (3.51%)	1 (1.75%)	1 (1.75%)	53 (92.98%)
Aspirin (n = 57)	0	0	0	57 (100%)
Calcium chloride (N = 58)	0	1 (1.75%)	0	57 (98.28%)
Clopidogrel (n = 55)	16 (29.09)	1 (1.82%)	2 (3.64)	36 (65.45%)
Dextrose (N = 58)	0	0	0	58 (100%)
Diazepam (N = 58)	0	1 (1.75%)	0	57 (98.28%)

Disability, defibrillation and drugs	**Less than 25%**	**25% to less than 50%**	**50% to less than 75%**	**75% and more**
Dobutamine (n = 57)	15 (26.32%)	2 (3.51%)	0	40 (70.18%)
Dopamine (n = 56)	14 (25%)	1 (1.79%)	0	41 (73.21%)
Flumazinal (N = 58)	0	1 (1.72%)	0	57 (98.28%)
Furosemide (N = 58)	0	1 (1.72%)	0	57 (98.28%)
Glucagon (n = 54)	18 (33.33%)	1 (1.85%)	4 (7.41%)	31 (57.41%)
Heparin (n = 57)	16 (28.07%)	3 (5.26%)	1 (1.75%)	37 (64.91%)
Lignocaine (N = 58)	2 (3.45%)	0	0	56 (96.55%)
Magnesium sulphate (N = 58)	1 (1.75%)	0	0	57 (98.25%)
Mannitol (n = 56)	18 (32.14%)	1 (1.79%)	0	37 (66.07%)
Midazolam (N = 58)	0	0	0	58 (100%)
Morphine sulphate (N = 58)	0	0	0	58 (100%)
Naloxone (N = 58)	0	0	2 (3.45%)	56 (96.55%)
Intravenous nitroglycerine (n = 54)	19 (35.19%)	4 (7.41%)	1 (1.85%)	30 (55.56%)
Sublingual nitroglycerine (n = 56)	17 (30.36%)	3 (5.36%)	0	36 (64.29%)
Nitroglycerine spray (n = 55)	3 (5.45%)	2 (3.64%)	1 (1.82%)	49 (89.09%)
Oxygen (N = 58)	0	1 (1.72%)	0	57 (98.12%)

Disability, defibrillation and drugs	<25%	25% - <50%	50% - <75%	≥75%
Sodium bicarbonate (n =57)	0	1 (1.75%)	0	56 (98.25%)
Skeletal muscle relaxants (N = 58)	13 (22.41%)	1 (1.72%)	2 (3.45%)	42 (72.41)
Streptokinase (n = 55)	26 (47.27%)	4 (7.27%)	4 (7.27%)	21 (38.18%)

The results from Table 4.10 are set out in Figure 4.20.

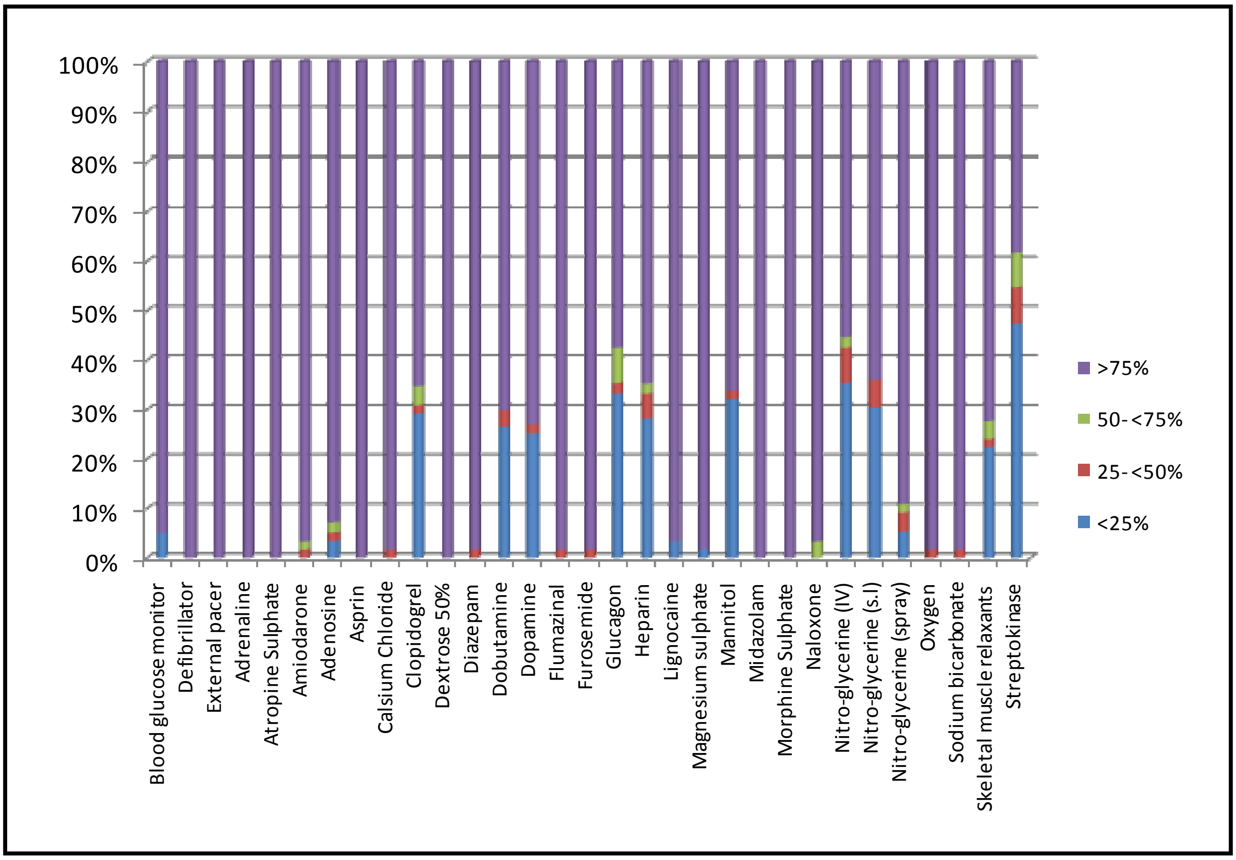


Figure 4.20: Availability of defibrillators and drugs

Discussion: It is interpreted from the results presented in Figure 4.20 that the availability of this equipment and drugs was in-line with those prescribed by ALS principles. This is a positive finding considering that some authors, for example, Robinson (2007: 1019) state that the availability of drugs on an emergency aircraft sometimes depends on the availability of that particular drug in the specific country.

Evidence is provided in Table 4.12 that numerous authors concede that the following emergency equipment regarding disability, defibrillation and drugs must be available when transporting patients:

Table 4.12: Summary of the literature with regards to disability, defibrillation and drug with reference to each

	Equipment	References
Disability, defibrillation and drugs	Blood glucose monitoring	Rajah & Lasersohn (2000: 25) Warren *et al*. (2004: 259) Venticinque & Grathwohl (2008: s288)
	Defibrillator	Wallace & Ridley (1999: 369) Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Leggat & Fisher (2005: 144) Teichman *et al.* (2007: 265) Beninati *et al.* (2008: s373)
	External pacing	Lamb (2003: 97) Warren *et al.* (2004: 259) Teichman *et al.* (2007: 265)
	Various medication	Rajah & Lasersohn (2000: 25) Warren *et al.* (2004: 259) Grissom & Farmer (2005: s19) Leggat & Fisher (2005: 144) Beninati *et al.* (2008: s373)

	Equipment	References
Universal/ protective equipment	Precautions towards contagious diseases	Rajah & Lasersohn (2000: 25) Pollack (2011: 779)
	Doppler/ Ultrasound	Grissom & Farmer (2005: s17) Venticinque & Grathwohl (2008: s288) Pollak (2011: 321)

Table 2.2 indicates the literature supported recommended drugs that should be available on an air ambulance when transporting the critically ill or injured patient.

4.2.3.5 Environmental control [V117 - V118]

Two sub-categories were included, namely, *Patient warmer* and *Incubator.* A patient warmer is advantageous as ambient temperature inside aircraft can become cool due to weather conditions outside the aircraft. These temperature changes can be detrimental to the critically ill or injured patient. With regards to an incubator, a baby has much less control of temperature changes, and thus should the ambient temperature be better controlled. This is done by means of an incubator.

- **Patient warmer (n = 55)**

Fifty five of the respondents answered this question. Seventeen (30.91%) of the respondents indicated that patient warmers were available on ≥75% of flights; six (10.91%) indicated it was available on 50- <75% of flights; two (3.64%) showed it to have been available on 25- <50% of flights and 30 (54.55%) respondents indicated it was available on <25% of flights.

- **Incubator (n = 57)**

Of the 57 respondents who answered this question, 44 (77.19%) indicated that an incubator was available on ≥75% of flights; three (5.26%) revealed it was available on 50- <75% of flights while two (3.51) respondents indicated it was available on 25- <50% of flights. According to eight (14.04%) respondents, an incubator was available on <25% of flights.

The results are indicated in Figure 4.21.

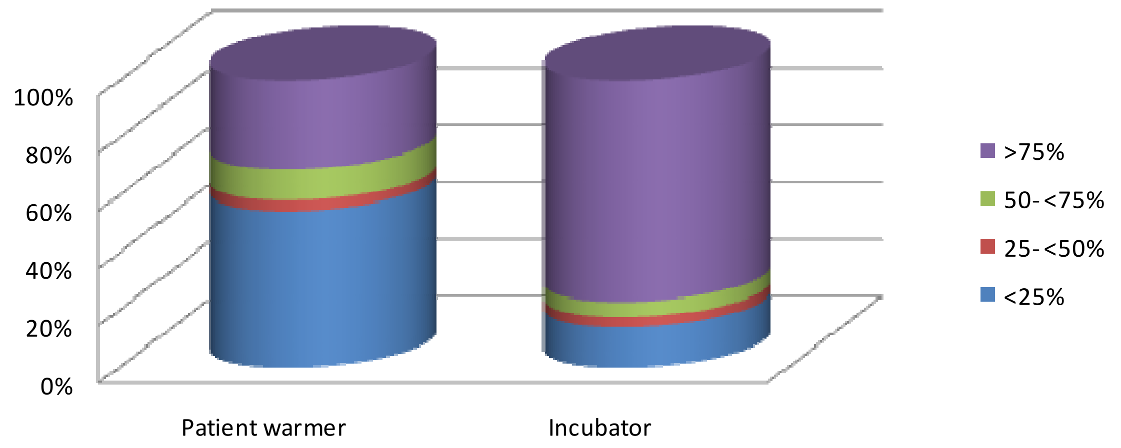


Figure 4.21: Availability of warming devices

Discussion: Table 4.12 indicates that various authors advise that warming devices should be considered part of the advanced emergency equipment and, as such, should be available on all air ambulances. Considering that, in some instances, a *patient warmer* can be the only way to control a patient's temperature effectively, the result of this sub-category (as reflected in Figure 4.21) is unacceptably high: the majority (38 [69.09%]) indicated it was not available on flights. As indicated in the same figure, the response to having an *incubator* on board the emergency aircraft was more positive: (44 [77.19%]) of the respondents (n = 57) indicated an incubator was on board in ≥75% of flights.

Table 4.13 presents a summary of literature regarding environmental control and references.

Table 4.13: Summarised literature and references regarding environmental control

	Equipment	References
Environmental control	Patient warmer and noise reduction	Wallace & Ridley (1999: 369) Lamb (2003: 97) Grissom & Farmer (2005: s17) Leggat & Fisher (2005: 144) Teichman *et al.* (2007: 267) Beninati *et al.* (2008: s373) Smith (2008: s298)

4.2.3.6 Personal protective equipment [V119 - V130]

It needed to be assessed whether the respondents were provided with personal protective equipment. To obtain the correct data, this question was also sub-categorised. In Table 4.14 the results of this question are presented.

Table 4.14: Summary of the results regarding personal protective equipment provided on fixed wing air ambulances

Personal protective equipment	25%	25% - <50%	50% - <75%	≥75%
Cover all or overall suits (n = 57)	9 (15.79%)	1 (1.75%)	4 (7.02%)	43 (75.44)
Various immunisations (n = 57)	13 (22.81%)	3 (5.26%)	5 (8.77%)	36 (63.16%)

Eye protection (n = 57)	1 (1.75%)	3 (5.26%)	5 (8.77%)	48 (84.21%)
Personal protective equipment	**<25%**	**25% - <50%**	**50% - <75%**	**≥75%**
Gloves (N = 58)	0	0	1 (1.75%)	57 (98.28%)
Face masks (N = 58)	3 (5.17%)	3 (5.17%)	1 (1.72%)	51 (87.93%)
Apron (n = 57)	14 (24.46%)	4 (7.02%)	1 (1.75%)	38 (66.67%)
Alcohol-based hand wash (n = 57)	4 (7.02%)	1 (1.75%)	7 (12.28%)	45 (78.95%)
HIV post-exposure packs (n = 57)	15 (26.32%)	1 (1.75%)	4 (7.02%)	37 (64.91%)
N1H1 post-exposure packs (n = 55)	26 (47.27%)	3 (5.45%)	2 (3.64%)	24 (43.64%)
Meningitis post-exposure packs (n = 56)	21 (37.50%)	3 (5.36%)	1 (1.79%)	31 (55.36%)
Annual medical checks (n = 56)	27 (48.21%)	3 (5.36%)	3 (5.36%)	23 (41.07%)
Medical insurance (N = 58)	11 (18.97%)	1 (1.72%)	1 (1.72%)	45 (75.59%)

In Figure 4.22 the respondents' feedback on whether they were provided with protective gear is depicted.

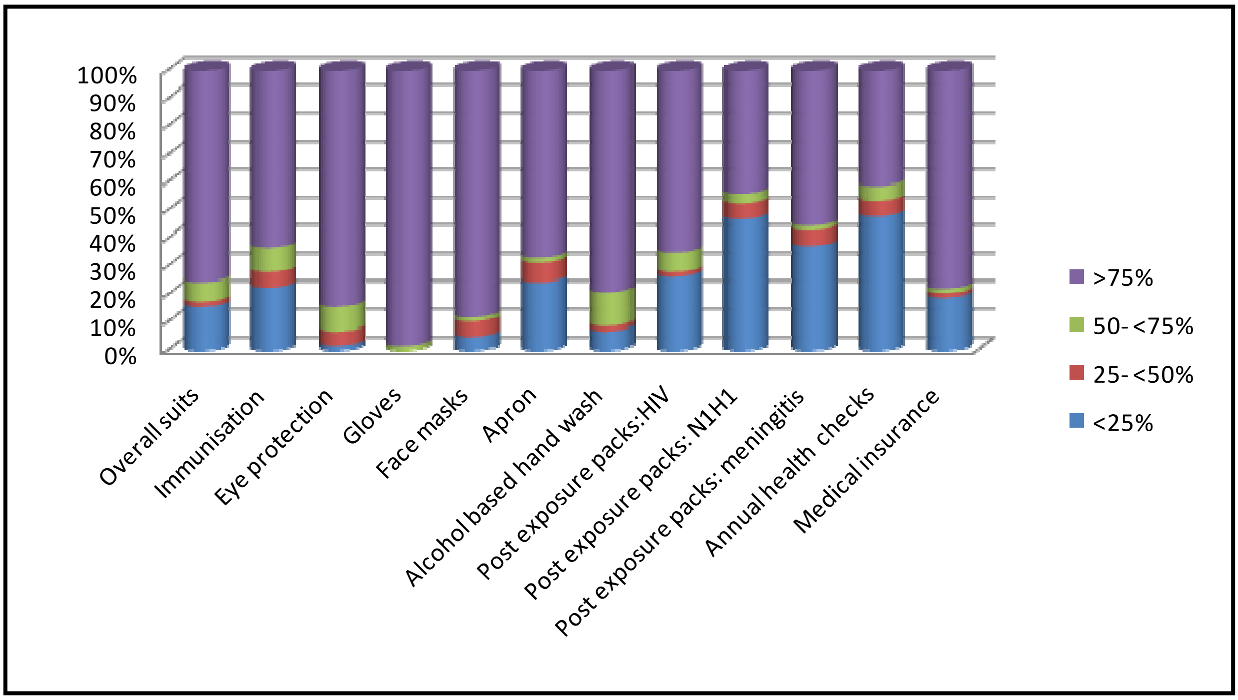


Figure 4.22 Availability of personal protective equipment

Discussion: As set out in Figure 4.22 the degree and availability of personal protective equipment varies considerably. Taking into account that health care professionals accompanying patients on emergency aircraft are vulnerable, not being provided with protective gear can increase their exposure to unknown or contagious diseases. In order to prevent contamination, it is recommended by Pollak (2011: 769) that personal protective equipment must always be available and utilised.

- In the case of airborne diseases, negative pressure transport as well as N95, masks are recommended.
- To prevent droplet contamination the following is mandatory: surgical masks, gloves and gowns, as well as facemasks or protective eye wear.

The protective gear should be worn at all times, especially when in contact with blood, body fluids or faeces. These guidelines have been set due to the fact that, during the resuscitation of a patient, the medical team members are in contact with bodily fluids 31% of the time; while treating a trauma patient, contact increases to 80%. Furthermore, contact is usually in an uncontrolled setting which increases the risk of contamination (Pollak2011: 769).

Other prophylactic measures, according to Pollak (2011: 776), include immunisations for as many as possible of the following:

- measles
- mumps
- rubella
- varicella
- hepatitis B
- influenza
- pertussis
- tetanus
- polio
- diphtheria
- yellow fever

Medical insurance should be adequate in the case of illness, injury or death while on duty (Bristow & Toff 1992: 768). Wallace and Ridley (1999: 370) believe adequate death or disability insurance cover for the crew is essential. In a study conducted in the UK, Stevenson *et al.* (2005: 798) determined that a limited number of emergency air transport personnel have sufficient insurance cover. The authors emphasise that it is imperative for emergency air transport personnel to acquire additional personal insurance. Ahmed and Majeed (2008: 504) also urge health care professionals to join an organisation that will provide them with the necessary death and disability cover while they are transporting a patient.

In this study it was found that 44 (75.59%) of the respondents had additional risk coverage, however 13(22.41%) indicated a lack of additional medical cover.

4.2.3.7 Rest periods between flights [V131]

There were only 47 (n = 47) responses to this question. Twelve (25.53%) of the respondents indicated that no rest time was allowed between flights; five (10.64%) indicated that one hour rest period was allowed between flights; 20 (42.55%) respondents indicated the period allocated to rest between flights was eight hours; eight (17.02%) of the respondents indicated a 12-hour rest period between flights and two (4.26%) indicated that a period of 24 hours for rest was allowed between flights. As set out in Figure 4.23 the rest periods between flights differed, but most respondents indicated it to be eight hours**.**

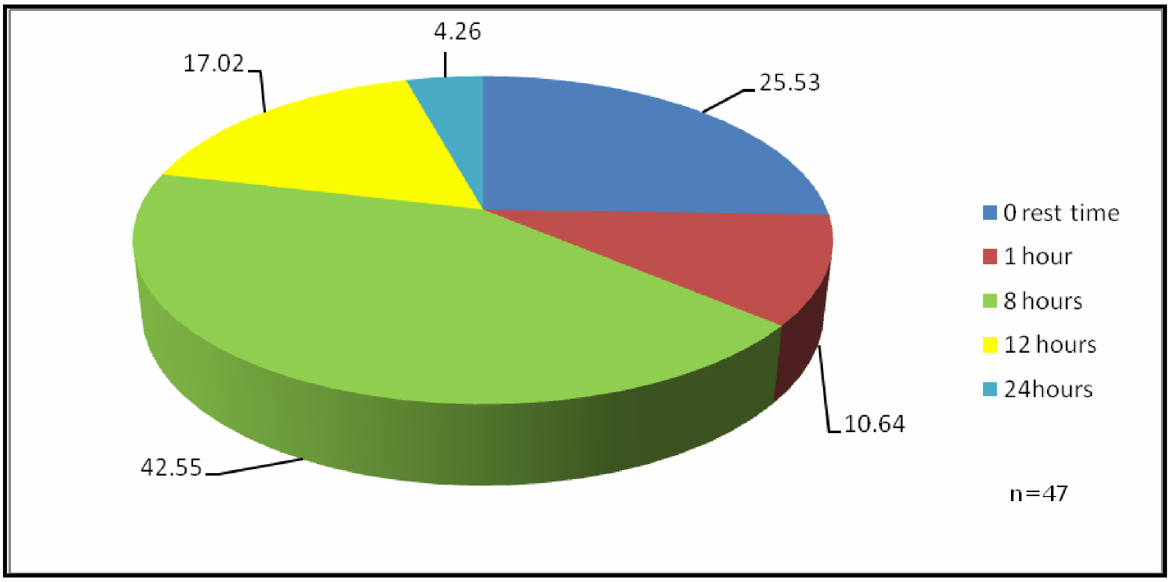


Figure 4.23: Rest periods between flights (n=47)

Discussion: Frakes and Kelly (2007: 48) opine that many health care professionals involved in air transport have other employment, and may start a shift already deprived of sleep who claims even losing only two to three hours of sleep may decrease cognitive performance by 25%. This is supported by Manacci *et al*. (1999: 24) who found that health care professionals working 24-hour shifts showed poorer cognitive performance in comparison to others, such as health care professionals working 12-hour shifts. According to Frazer (2009: 54), CAMTS do not provide guidelines concerning rest periods between shifts since their current view are that health care professionals arrive at work rested;

therefore, when in the workplace they are obligated to work and not rest. CAMTS's interpretation is thus that it is the responsibility of health care professionals themselves to make sure they have at least an eight-hour rest before a shift.

In this study, the distribution of rest periods between flights varied between 0 and 24 hours. Considering the limited information available which pertain specifically to shift lengths makes it difficult to set up a guideline for rest periods for health care professionals working in air transport. However, as can be seen in Figure 4.23, the majority (20 [42.55%]) of the respondents (n = 47) attempted to get at least an eight-hour rest between flights as recommended by CAMTS (Frazer 2009:54). Unfortunately, 18.97% of the respondents did not respond to this question.

Throughput

4.2.4 Section D: In-flight considerations [V132 - V148]

This section discusses patient management during flights. Flight physiology – the way one's body reacts during flight – is considered in management during the flight. It addresses the ability of the respondents' ability to perform ALS procedures and work under surgically clean circumstances. This section was also sub-categorised to acquire the relevant data.

4.2.4.1 First contact [V132-V138]

Respondents were asked to rate the first contact they had with patients.

- **Flight physiology (N = 58)**

Fifty-two (89.66%) participants relayed that they considered flight physiology in ≥75% of cases on first contact with the patient; five (8.62%) of the respondents said they considered flight physiology in 50- <75% of cases. One (1.72%

respondent indicated it was considered 25- <50% and one (1.72%) indicated it was considered in <25% of cases.

- **Ability to perform surgically clean procedures (N = 58)**

Twenty-six (44.83%) respondents revealed they were able to perform surgically clean procedures in ≥75% of flights; 19 (32.76%) indicated this to be 50- <75% of flights; two (3.45%) indicated it was 25- <50% and 11 (18.97%) respondents indicated they were able to perform surgically clean procedures in <25% of flights.

- **Use of ALS skills when managing the patient (n = 57)**

One of the respondents did not answer this question. Of the respondents, 46 (80.70%) indicated they were knowledgeable and competent in using ALS skills ≥75% of times; six (10.53%) could apply these skills in 50- <75% of times; five (8.77%) indicated this to be 25- <50%. None of the respondents marked the <25% box.

- **Ability to maintain patient privacy (N = 58)**

As evident by the results, in most cases respondents were able to manage the patient in privacy. Twenty three 23 (39.66%) of the respondents indicated a ≥75% degree of patient privacy and another 23 (39.66%) indicated it to be 50- <75%. Eleven (18.97%) noted they were only able to maintain patient privacy in 25- <50% of cases and one (1.72%) stated maintaining it was possible in <25% of cases.

- **Incidence of 'Scoop and run' (N = 58)**

One (1.72%) respondent indicated that "scoop and run" occurred ≥75% of times; seven (12.07%) respondents marked the 50- <75% box while 15 (25.86%) noted "scoop and run" occurred in <50% of times. The majority, 35 (60.34%), indicated it occurred <25% of times.

- **Incidence of 'Stay and play' (n = 57)**

One respondent did not respond to this question. Fifteen (26.32%) respondents noted this occurred ≥75% of times and 27 (47.37%) relayed it to occur 50-

<75% of times. According to 11 (19.30%) it occurred 25- <50% of times and four (7.02%) noted it occurred <25% of times.

- **Time limit while managing the patient (N = 58)**

This point yielded various results: 22 (37.93%) respondents indicated they were subjected to a time limit ≥75% of times; 12 (20.69%) indicated the time limit to be applicable 50- <75% of times; nine (15.52%) indicated it to be 25- <50% and 15 (25.86%) of the respondents noted it was <25% of times.

The individual results pertaining to the respondents' feedback with respect to their first contact with the patient are reflected in Figure 4.24.

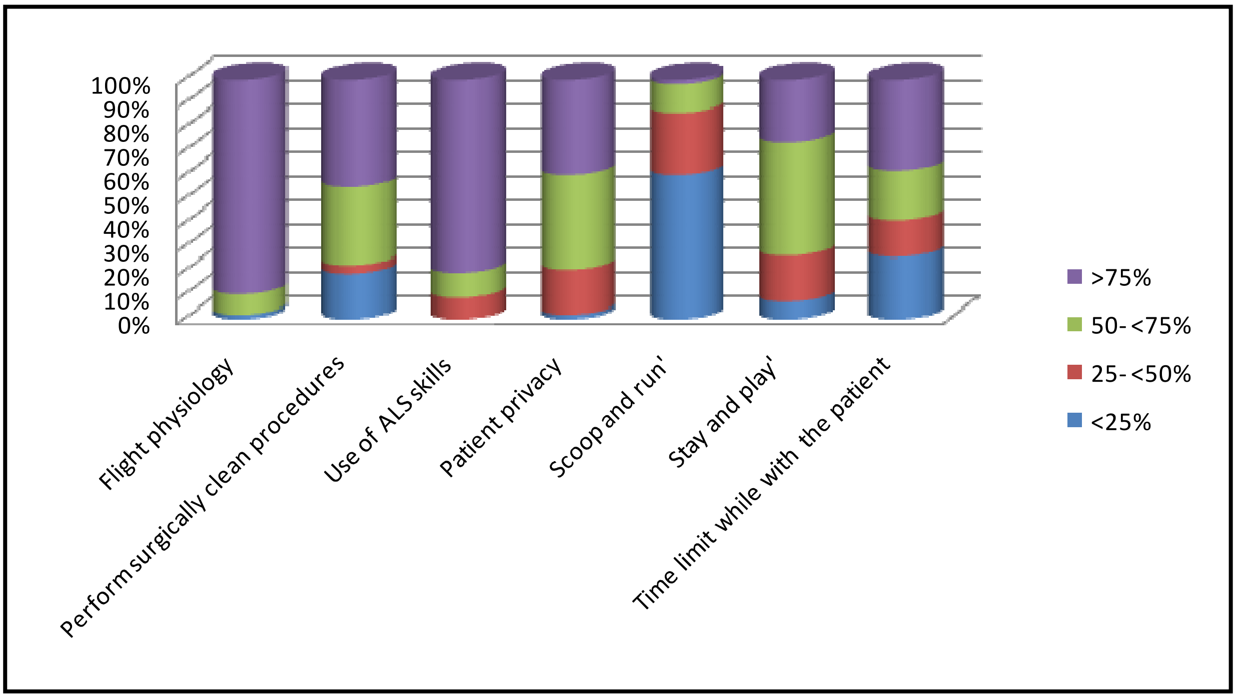


Figure 4.24: With regard to first contact with the patient

Discussion: Understanding and being knowledgeable about gas laws (view Table 2.2) are pivotal in air ambulance transport. The reason for this is that atmospheric pressure is directly related to altitude and temperature (view section 2.5.2.1 for details on gas laws). Therefore, various precautionary actions have to be considered regarding patient care (Pollak 2011: 74; Teichman *et al.* 2007: 265). Since the pressure in the cabin is directly influenced, it has considerable effect on maintaining the patient's temperature. In addition to temperature changes, the noise, vibration, decrease in humidity, gravitational changes and acceleration and deceleration forces can influence the patient's condition and care (Holleran 2003: 44; Teichman *et al.* 263). It is gratifying to know that 52 (89.66%) of respondents (N = 58) were capable, experienced and knowledgeable to keep the critically ill or injured patient safe in these conditions (view Figure 4.24).

Unfortunately, the results also reveal that the majority, 32 (55.17%), of the respondents (N = 58) indicated their ability to *perform clean surgical procedures* during management was compromised (view Figure 4.24). According to Pollak (2011: 9), air ambulance crews transporting critically ill and injured patients should be able to provide equal and, in many circumstances, better care than that which has been delivered at the transferring institution. This may include ALS procedures, for example, surgical airways, central line insertion, inter-costal drain insertion, ultrasound and ventilator procedures, which could fall outside the normal scope of practice of the in-hospital nurse or ALS paramedic. Forty-six (80.70%) respondents (n = 57) relayed they were proficient and skilled *to apply ALS procedures* in patient management.

The fact that 35 (60.34%) of the respondents (N = 58) were unable to manage *patients in privacy* as shown in Figure 4.24 is consistent with the observation made by O'Shea (2005: 85) that limited privacy is afforded to the patient in an air ambulance. Also, though the highest number of respondents (N = 58) indicated a *'Scoop and run'* run approach was not followed in the majority of cases, it still leaves a high number (23 [39.66%]) open for discussion. Additionally, the incidence of *'Stay and play'* were indicated as >75% by 15 (26.32%) respondents (n = 57), meaning that 42 (73.68%) admitted this approach was not followed. The significance is perhaps realised most fully when considering that a hurried evacuation of critically ill or injured patients compromises effectively caring for them. According to Warren *et al.* (2004: 261), there is currently no evidence to support a '*Scoop and run'* approach in the air transportation of patients. Wallace and Ridley (1999: 370) state insufficient preparation, assessment and stabilisation of the patient prior to transport due to a speedy evacuation can be detrimental to the patient's health and care since some measures are simply impossible to deal with during flight.

4.2.4.2 Cooperation of handover staff [V139 – V143]

Receiving the relevant and necessary records the handover staff is extremely important for providing the best possible medical care to the patient.

- **Patient X-rays (N = 58)**

Twenty-one (36.21%) respondents that they received the patient's X-rays in ≥75% of cases; 12 (20.69%) received it in 50- <75% of cases and 12 (20.69%) relayed they received it in 25- <50% of cases. Thirteen (22.41%) respondents showed they received patient X-rays in <25% of cases.

- **Patient laboratory results (N = 58)**

Sixteen (27.59%) respondents indicated that they received laboratory results in ≥75% of times. Eight (13.79%) indicated they received the results 50- <75% of times; 27 (46.55%) showed a response of 25- <50% and seven (12.07%) indicated that they receive the laboratory results in <25% of cases.

- **Referral notes (n = 56)**

Fifty six of the respondents answered this question. Twenty-three (41.07%) respondents were provided with referral notes in ≥75% of cases; 16 (28.57%) received it in 50- <75% of cases; nine (16.07%) indicated it was available 25- <50% of times and eight (14.29%) indicated receiving it <25% of times.

- **Nursing notes (N = 58)**

Sixteen (27.59%) respondents received nursing notes ≥75% of times; seven (12.07%) received it 50- <75% of times; six (10.34%) received it 25- <50% of times and 29 (50.00%) received it <25% of the time.

- **Receiving assistance in preparing the patient for transport (N = 58)**

Thirteen (22.41%) respondents received assistance in preparation for the flight in ≥75% of cases; 17 (29.31%) respondents indicated to have received it in 50-

<75% of flights; 18 (31.03%) in 25- <50% of flights and 10 (17.24%) in <25% of flights.

The cooperation received from the handover staff of the transferring facility is depicted in Figure 4.25.

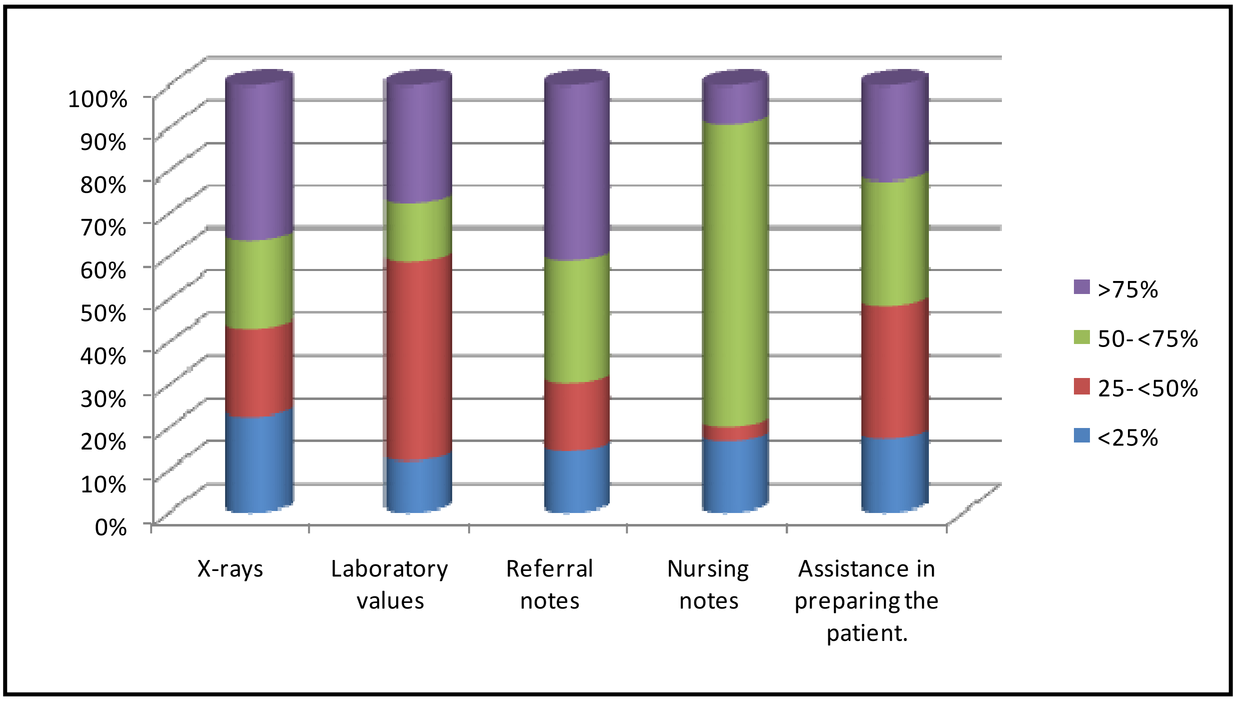


Figure 4.25: Assistance from transferring facility

Discussion: The handover of a patient also includes the handing over of medical records, laboratory results and radiology reports. Warren *et al.* (2004: 259) state that a thorough handover between registered nurse and registered nurse, as well as doctor and doctor, will ensure continuation of care. It is clear from the results in all sub-categories (view Figure 4.25) that, in all instances, this was not adhered to. Regarding the *X-rays* (N = 58), 37 (63.79%) respondents did not receive these; 42 (72.41%) did not receive *laboratory results* (N = 58); and 33 (58.92%) did not receive *referral notes*. Also, *nursing notes* were not received in 42 (72.41%) of cases (N = 58). Rajah and Lasersohn (2000: 23) advise, however, that a handover should be delayed until the patient's physiological derangements have been corrected. Wallace and Ridley (1999: 371) support this statement, but add that copies of all results and reports should be kept for future audits. Also, another problematic issue which can arise during handover is language barriers. Dewhurst *et al.* (2001: 886) comment that working conditions is not always ideal, and differences in verbal communication can further hamper handover as regards not only patient management, but also time management.

4.2.3.4 Transport of a patient [V144 – V148]

The following were sub-categories were assessed under this question.

- **Obtaining informed consent for a flight (N = 58)**

According to 43 (74.14%) respondents informed consent prior to the flight was obtained in ≥75% of cases; six (10.34%) responded it was obtained in 50- <75% of cases; three (5.17%) indicated it was obtained in 25- <50% of cases while six (10.34%) replied informed consent was obtained in <25% of cases.

- **Confined work space (N = 58)**

Thirty eight of the respondents (65.52%) regarded the space shared with the patient and the crew as confined as ≥75%, while 18 (31.03%) respondents indicated this was the case in 50- <75%. One (1.72%) respondent each marked the 25- <50% and <25% boxes respectively.

- **Passengers on board (N = 58)**

Ten (17.24%) respondents indicated passengers to be on board ≥75% of times; 21 (36.21%) respondents indicated this to be the situation in 50- <75% of flights; 10 (17.24%) relayed that in 25- <50% of flights passengers were also transported and 17 (29.31%) respondents indicated this occurred in <25% of flights.

- **In-flight electricity (N = 58)**

Forty-four (75.86%) of the respondents indicated in-flight electricity was available on ≥75% of flights; three (5.17%) indicated it was available on 50- <75% of flights; two (3.45%) noted its availability on 25- <50% of flights and, according to nine (15.52%), it was available on <25% of flights.

- **In-flight use of monitoring equipment (n = 57)**

Fifty (87.72%) of the respondents utilised in-flight monitoring equipment on ≥75% of flights; five (8.77%) respondents indicated using it on 50- <75% of flights; one (1.75%) utilised it on 25- <50% of flights and one (1.75%) also on <25% of flights.

The results of the transporting of a patient are set out in Figure 4.26.

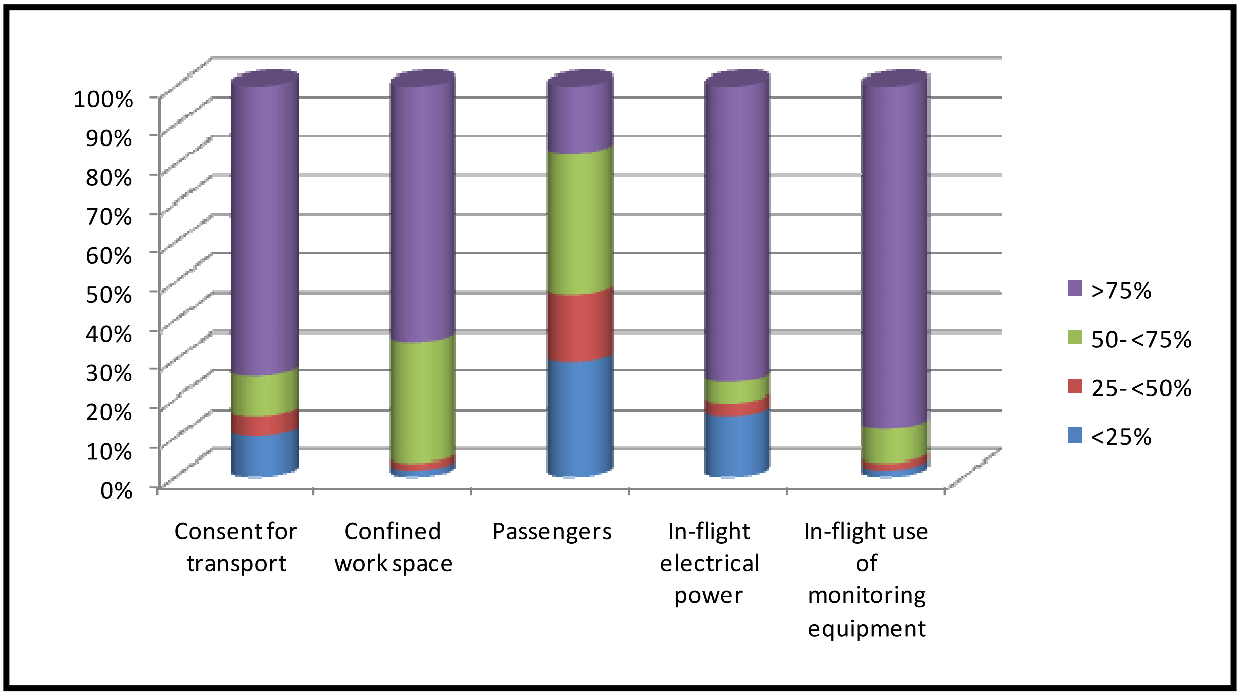


Figure 4.26: In-flight considerations

Discussion: Obtaining informed consent prior to a flight is crucial (Warren *et al.* 2004: 261) and the benefits and risks of the air ambulance mission should be explained to the orientated patients before they sign the form. Should the patient be illiterate, the legally authorised person should act on behalf of the patient (Warren *et al.* 2004: 258; Beninati *et al.* 2008: s374). Robinson (2007: 1022) agrees and states further that should someone, for example, a family member, accompany the patient on the aircraft, the aircraft safety procedures as well as its functioning during the flight should be explained to them. According to Figure 4.26, in the majority (43 [74.14%) of cases (n = 58) *informed consent* was obtained before a flight.

Dewhurst *et al.* (2001: 883) note that the cabin space on an air ambulance is limited and access to equipment is restricted. Figure 4.26 shows that 38

(65.52%) respondents (N = 58) thought the space on an air ambulance was limited.

In Figure 4.26 it is evidenced that the respondents did not experience problems with regard to the availability of the following: *in-flight electricity* - (44 [75.86%] responses from 58 [N = 58] respondents were >75%), and *monitoring equipment* - (a >75% response rate from 50 [87.72%] respondents [n = 57]).

Output

4.2.5 Section E: Post-flight considerations [V149 - V159]

This section covered the handover procedure and post-flight schedule.

4.2.5.1 Handover at receiving facility [V149 - V155]

This question involved specific data that needed to be obtained regarding the handover of the patient at the receiving facility.

- **Handing over the patient to a specialist doctor (n = 57)**

One respondent did not answer this question. Six (10.53%) respondents indicated they handed over the patient to a specialist doctor ≥75% of times; 10 (17.54%) handed the patient over to a specialist doctor 50- <75% of times; 16 (28.07%) relayed this was done 25- <50% of times and 25 (43.86%) indicated the handover to a specialist doctor was done <25% of times.

- **Handing over the patient to an emergency unit doctor (n = 57)**

Twenty-seven (47.37%) respondents indicated the handover was to an emergency unit doctor ≥75% of times; 22 (38.60%) indicated it to be 50- <75% of times; 5 (8.77%) respondents showed handover was to an emergency unit doctor 25- <50% of times and three (5.26%) indicated it to be <25% of times.

- **Handing over the patient to a registered nurse (n = 57)**

Twenty-seven (47.37%) responses were that the patient was handed to a registered nurse at the receiving hospital ≥75% of times. Ten (17.54%) indicated this to be the case 50- <75% of times. While six (10.53%) respondents marked the 25- <50% box, 14 (24.56%) marked the <25% box.

- **Handing over the patient to a paramedic (ALS) (n = 53)**

Four (7.55%) respondents agreed that handover to a paramedic (ALS) happened ≥75% of times and another four (7.55%) relayed it was the case 50- <75% of times. The 25- <50% box yielded a response of seven (13.21%) and the <25% box a response of 38 (71.70%).

- **Handing over the patient to admission staff (n = 52)**

Six of the completed questionnaires showed no response in the allocated box. Of the remaining 52 (n = 52), no respondents handed the patient over to admission staff either ≥75% or 50- <75% of times. One (1.92%) respondent said this occurred 25- <50% of times while the majority (51 [98.08%]) indicated it happened in <25% of cases.

In Figure 4.27 these results are illustrated**.**

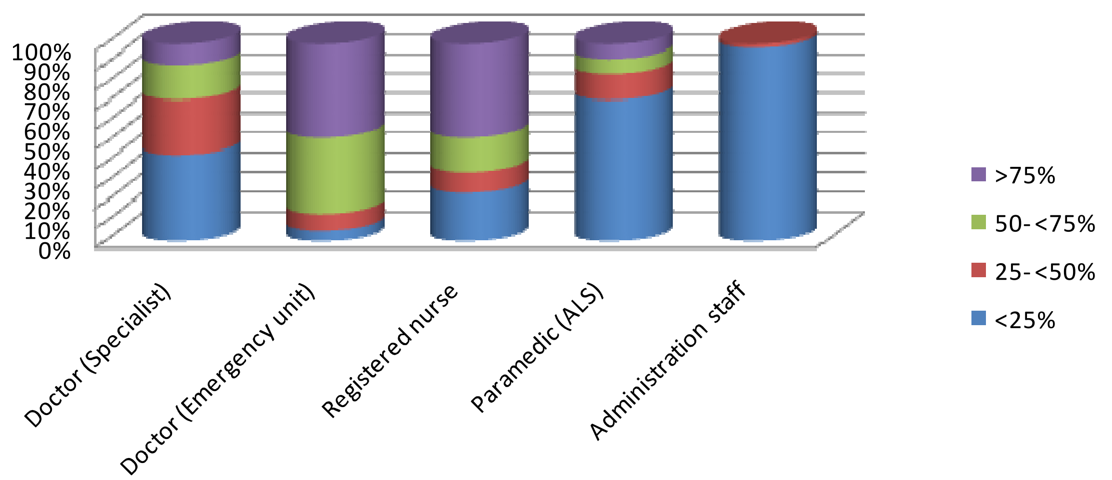


Figure 4.27: Handover of patient at the treating facility

Discussion: Handover is a continuous process: from the transferring facility to the air ambulance health care professionals, and from the air ambulance health care professionals to the receiving facility. Handover between similar disciplines of health care professionals ensure a continuation of the management plan (Warren *et al*. 2004: 257). According to Bristow and Toff (1992: 768) and Wallace and Ridley (1999: 371), handover should be to a receiving doctor and copies of all the medical reports should be handed over to this individual. As stated by Rajah and Lasersohn (2000: 24) and confirmed by Leggat and Fischer (2005: 145), the flight is not complete until all documentation has been completed and handed over to the receiving hospital.

4.2.5.2 Aircraft cleaning and restocking [V156 - V159]

It was considered important to assess whether the respondents were aware of, and carried out, their duties after they had handed over the patient to the receiving facility.

- **Cleaning the aircraft (N = 58)**

Forty-six [79.31%]) of the respondents marked the ≥75% box; four (6.90%) marked 50- <75% and three (5.17%) marked 25- <50%. Five (8.62%) marked <25%. This indicated that the majority (79.31%) of respondents regarded the cleaning of the aircraft after patient handover to the receiving facility as part of their duties.

- **Cleaning the aircraft after a flight (N = 58)**

Fifty (86.21%) respondents indicated ≥75% that the aircraft was cleaned after a mission. The responses of the remaining eight were distributed as follows: (6.90%) indicated 50-75% and two (3.45%) respondents indicated 25- <50% and <25% respectively, thus showing that most of the respondents cleaned the aircraft after a flight.

- **Cleaning the aircraft after an infectious disease (N = 58)**

If a patient with an infectious disease had been transported, special cleaning measures have to be implemented to ensure effective infection control and a safe working environment. As regards cleaning the aircraft after such a transport, the greater number (n=53 [91.38%]) of respondents (n=53 [91.38%]), marked ≥75% and one (1.72%) marked 50-74% of flights. Only two (3.45%) marked 25- <50% and another two (3.45%) the <25% box.

- **Restocking equipment after a flight (N = 58)**

Restocking of the aircraft after a flight were done by 48 (82.76%) respondents ≥75% of times; four (6.90%) indicated this was not done after flights (50-75%); no (0%) respondents marked the 25- <50% box while six (10.34%) respondents indicated that they did not restock equipment after a flight <25% of times.

The results of the cleaning and restocking of the emergency aircraft is illustrated in Figure 4.28.

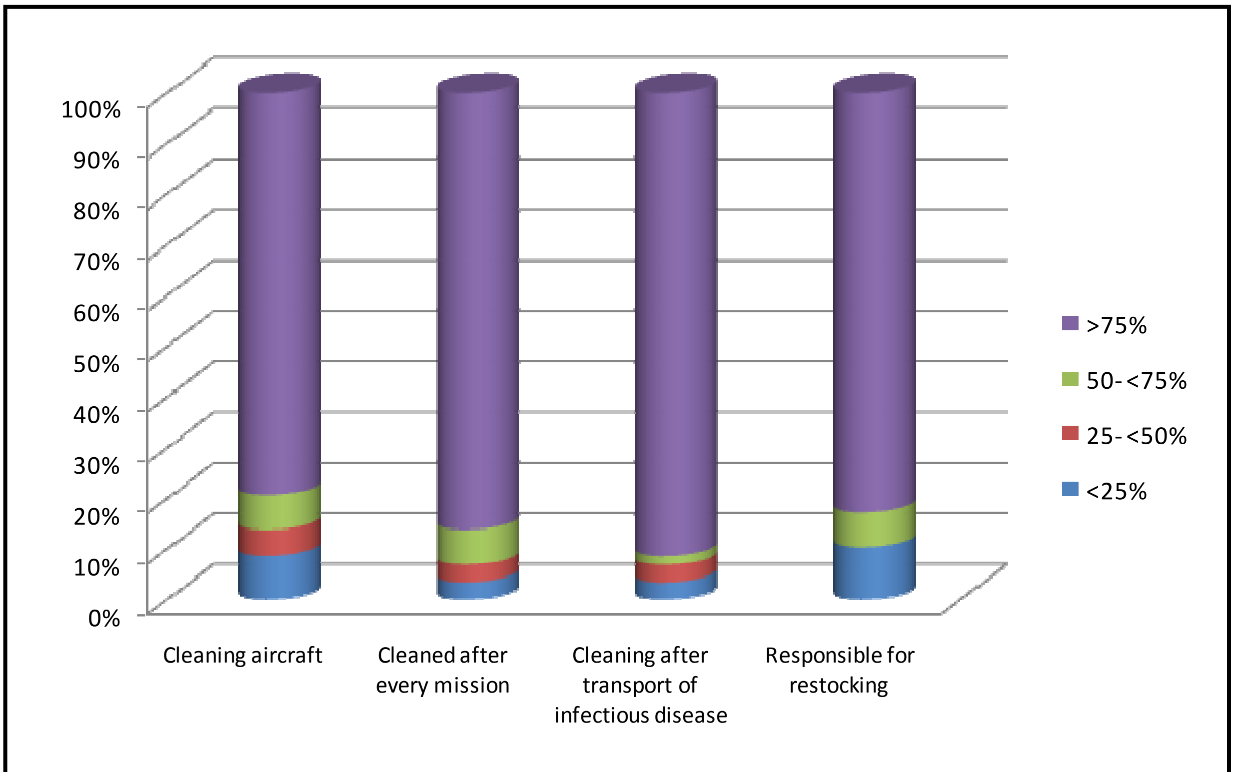


Figure 4.28: Post flight responsibilities

4.2.6 Section F: Feedback and control [V160 - V163]

This section assessed the implementation of the following

4.2.6.1 Continuous professional development [V160 – V163]

Quality of care does not only rely only on knowledge and skills, but also on the emotional health of the crew members.

- **Stress debriefing (N = 58)**

According to the results, responses showed that 13 (22.41%) respondents noted stress debriefing was done after a flight in ≥75% of cases; 13 (22.41%) reported it to be done in 50-74% of cases after flights; 12 (20.69%) indicated it was done in 25- <50% of cases and 20 (34.48%) relayed it was done in <25% of cases.

- **Support strategies (N = 58)**

Feedback regarding support strategies indicated that 30 (51.72%) of the respondents indicated it was implemented <25% of times. Only nine (15.52%) responded it was in place ≥75% of times. A further seven (12.07%) noted it was in place and implemented 50-74% of times, while 12 (20.69%) indicated 25- <50% of times.

- **Patient management feedback (n = 56)**

Only 56 of the respondents marked this question. It was noted by 25 (44.64%) of the respondents that patient feedback was given ≥75% of times. Thirteen (23.21%) respondents said it was done 50-74% of times. Eight (14.29%) and 10 (17.86%) respondents indicated that it was only done after 25- <50% of flights and after <25% of flights respectively.

- **Documentation auditing (n = 57)**

This question was marked by 57 of the respondents. According to 41 (71.93%) of the respondents, document auditing was in place ≥75% of times. Seven (12.28%) responded it was in place 50-74% of times. One (1.75%) indicated it was in place 25- <50% of times while eight (14.04%) conceded it was in place <25% of times.

The results of these sub-categories are shown in Figure 4.29.

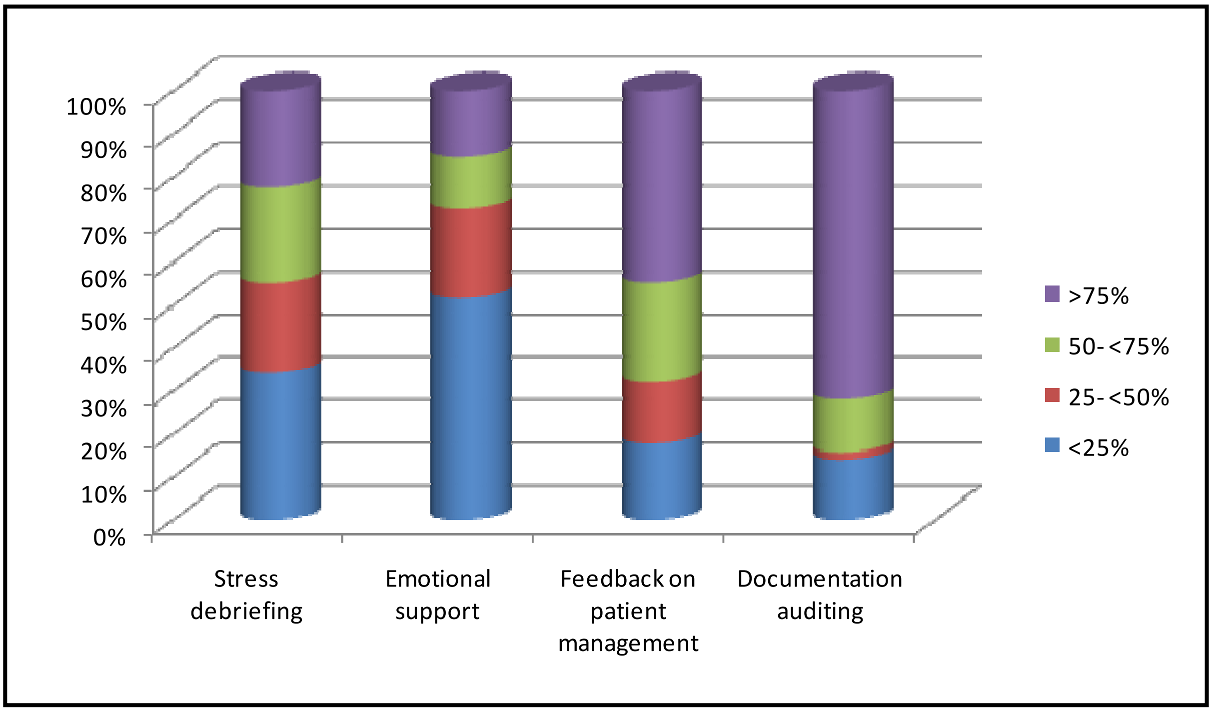


Figure 4.29: Continuous professional development

Discussion: In the opinion of Keene et al. (2010: 189), debriefing sessions is but one of the support structures a company can provide for health care professionals employed by them. Unfortunately, Figure 4.29 depicts that the compliance with the implementation of *stress debriefing* after critical situations was not upheld as confirmed by 45 (77.59%) of the respondents (N = 58). Keene *et al.* (2010: 189) claim the opportunity to reflect and debrief not only provides relief for the health care professionals themselves, but also teaches them to manage their emotions; this will help them to serve different patients and their families in future situations. In their study, Mayer *et al.* (2009: 84) identified 'burnout' as one of the reasons why health care professionals left the air medical transport service. The authors' stance is that the quality of care delivery by health care professionals does not only derive from knowledge and skill, but is greatly dependent on the emotional wellness of these professionals. They observed that, after implementing a chaplain service, health care professionals indicated to be more "soulful" and tolerable of their work environment.

According to Cheevakasemsook *et al.* (2006: 367), documentation serves multiple purposes. These include:

- continuation of care,
- it is legal evidence of the care rendered,
- it provides evidence for research and quality insurance,
- and appropriate billing and reimbursing are ensured.

Bristow and Toff (1992: 770) state documentation should be kept for a minimum of seven years. This should include the demographic detail of the patient as well as the clinical data (Warren *et al.* 2004: 261).

4.3 CONCLUSION

In Chapter 4 the data obtained from 58 respondents were analysed and interpreted. In various cases, the data obtained correlated with the available literature. In Chapter 5 conclusions are drawn and recommendations are made with regard to how management can contribute to limit the perceived challenges experienced by health care professionals during air ambulance transportation of patients. The limitations of this study are also discussed.

5 CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

In Chapter 4 the results of the research study was set out and validated with the relevant literature. Chapter 5 describes the conclusions, limitations and recommendations. The researcher's personal reflection with regard to the study is also presented.

5.2 AIM AND OBJECTIVES

The overall aim of this study was to explore the challenges experienced by health care professionals during air ambulance transportation of patients in sub-Saharan Africa.

In order to attain the aim of the study, the following objectives were formulated, based on the Systems Model approach:

- describe the challenges experienced by health care professionals during the pre-flight (input) phase
- describe the challenges experienced by health care professionals during the in-flight (throughput) phase
- describe the challenges experienced by health care professionals during the post-flight (output) phase
- recommend strategies for management in order to address the challenges experienced by health care professionals during air ambulance transport of patients in sub-Saharan Africa

5.3 CONCLUSIONS

The conclusions are discussed according to the input-throughput-output Systems Model approach on which the study was based (view Figure 1.1).

- **Input**
  - **Section A:** Personal information
  - **Section B:** Pre-flight considerations
  - **Section C:** Advanced emergency equipment

- **Throughput**
  - **Section D:** In-flight considerations

- **Output**
  - **Section E:** Post-flight considerations
  - **Section F:** Feedback and control

5.3.1 Input

The input component was delineated by means of three sections in the questionnaire. The sections are discussed in section 5.3.1.1 to 5.3.1.3.

5.3.1.1 Section A: Personal information

The results indicated that the majority of the respondents were female (62.07%). By sub-dividing the data during the analysis, the gender distribution of the health care professionals could be determined. It was revealed that the doctors were mostly female (68.75%). Also, all of the registered nurses were female (100%) while the paramedics (ALS and ILS) were predominantly male (63.64%). As mentioned in Chapter 4, no paramedics (BSL) participated in the study.

The data analysis indicated that the largest group who responded to the questionnaire was the registered nurse (34.48%). The second largest group comprised of the paramedics (ALS) (32.76%) with the doctors (27.59%) being the third largest group of the health care professionals who responded to this questionnaire.

It is interesting to note that 3 countries made use of only paramedics (Country A, C and E) while Country B utilised doctors and paramedics, but no registered nurses. This is inconsistent with the literature, which indicates the first member of the transport team to be a nurse, supported by either a doctor or a paramedic.

As seen in the data analysis, 5.17% and 18.97% of doctors specialised in Anaesthesiology and Primary Emergency Care respectively. This concurs with literature; doctors, as part of the air ambulance transport team should be specialised in one of the abovementioned fields. The registered nurses had a higher incidence of additional qualifications with 18.97% being qualified in Critical Care Nursing and 20.69% being trained in Trauma and Emergency Nursing.

As indicated in the study results, Advanced Cardiac Life Support is the additional course attended by most of the responding health care professionals (91.38%) with Paediatric Advanced Life Support having been attended by (81.03%). This correlates with the literature stating that both Advanced Cardiac Life Support and Paediatric Advanced Life Support are pre-requisites for joining an air ambulance service provider.

The age group 30-34 years was the largest (21.05%), with the second largest group being 35-39 years (29.83%). This is consistent with the literature which indicated the largest age group being 30-39 years of age. The smallest age group was <25 years of age with 1 (1.75%) respondent.

The research results indicated total years' experience of the health care professionals involved in the air transport of patients, whereas literature indicates years of experience prior to becoming a health care professional in the air transport services. According to the research results, the largest group (46.55%) of health care professionals had 1-4 years' experience, and the second largest group (36.21%) had 5-9 years' experience. A rapid decline in group size was evident in the groups with more than 10 years' experience, with only 1 (1.72%) respondent having >25 years' experience. It can thus be concluded that very few health care professionals remain in the air transport service longer than 10 years.

Participating Countries A to F were not identified in order to maintain anonymity and confidentiality (view section 3.3.1). Respondents from Country A, B, C, E and F ranged from 3.45% to 19.34%, while the largest response rate came from country D (70.69%).

5.3.1.2 Section B: Pre-flight considerations

SAMPLE history, primary survey, resuscitation phase and secondary survey form a universal patient management system utilised by health care professionals throughout sub-Saharan Africa. These components are also supported by advanced life support principles and are utilised when gaining and providing information with regard to the patient.

The majority of respondents, 42 (72.41%), indicated that they knew the exact location of the patient in >75% of flights, while 48 (84.21%) of them indicated that they were informed of the expected flight times in >75% of the flights. Only 33 respondents (58.93%) indicated that they were made aware of the exact distance of the patient from the airport in >75% of flights. This is of importance, for example, for calculation of oxygen consumption during mechanical ventilation during air transport.

5.3.1.3 Section C: Advanced emergency equipment

More than 80% of the respondents had access to airway and cervical spine control equipment on >75% of the flights. Concerning the equipment associated with breathing and ventilation, 78% of the responding health care professionals indicated that all the necessary equipment was available on >75% of the flights, except for arterial blood gas monitoring to which only 51.85% of respondents had access on >75% of the flights. Of the respondents, 56.14% had access to peak expiratory flow meters on >75% of flights and 63.79% of them had access to non-invasive ventilation on >75% of the flights. With reference to rapid laboratory tests utilised during circulatory and haemorrhage control, 42.59% of the respondents indicated that it was available on >75% of the flights. In addition, 57.14% of the respondents had umbilical venous access, 66% had intraosseous access for adults and 59.65% had intraosseous access for neonates; 43.40% of the respondents had air splints available >75% of flights while <45% had blood and blood products available on >75% of flights.

Regarding disability and drugs, 65.45% of the respondents indicated having Clopidogrel available in >75% of flights; 57.41% indicated having Glucagon; 64.91% had Heparin; 66.07% had Mannitol; 55.56% had intravenous Nitroglycerine; 64.29% had sublingual Nitroglycerine and 38.18% of the respondents had Streptokinase available in >75% of the flights. Regarding environmental control, <40% of the health care providers indicated that they had access to incubators in >75% of flights.

Only 63.16% of the health care professionals indicated that they were required to be immunised >75% of the time that they were actively involved as part of the air transport team. This may make them vulnerable to contracting communicable diseases. In 66.67% of times the health care professionals had access to aprons on >75% of the flights. Less than 65% respondents had access to HIV post-exposure packs on >75% of flights. Less than 45% of the respondents had access to HIN1 post-exposure packs on >75% of flights. Less than 60% of respondents had access to meningitis post-exposure packs on >75% of flights. Only 41% of the participating health care professionals were required to undergo annual health check-ups in >75% of the time while they were actively part of the air transport team.

The majority (42.55%) of health care professionals were allowed an 8-hour rest period between flights, which may compromise patient care.

5.3.2 Throughput

5.3.2.1 Section D: In-flight considerations

A total of 89.66% of the health care professionals took flight physiology into consideration in >75% of flights when transporting a patient. Of the respondents, only 44.83% indicated they were able to perform surgically clean procedures in >75% of the flights, which may compromise patient outcome due to the possibility of infections.

Of the health care professionals, 80.7% performed ALS skills in more than 75% of flights when managing patients; <40% of respondents indicated that patient privacy was maintained on >75% of flights. Regarding 'Scoop and run', 60.34% of the health care professionals indicated that they did not 'Scoop and run' in <25% of flights, therefore indicating that they stabilised patients prior to transport. Being pressed for time with patients was indicated by 37.93% of health care professionals in >75% of the flights.

With regard to patient reports, in less than 45% of flights X-rays, laboratory reports and referral notes were handed over to the transport team in >75% of flights. This may hamper the continuity of patient management.

Only 74% of the health care professionals indicated that informed consent for a flight was obtained prior to >75% of flights. Of the participating health care professionals, 17.24% indicated that passengers accompanied patients in >75% of flights. More than 75% of them indicated that in-flight electrical power was available in the aircraft, allowing 85% of respondents to perform in-flight monitoring in >75% of the flights.

5.3.3 Output

5.3.3.1 Section E: Post-flight considerations

As indicated by 10.53% of the respondents, handover to a specialist was done in >75% of flights, while 47.37% of respondents indicated to hand over to emergency doctors >75% of flights, which is equal to handing over to registered nurses. This indicates that handover did not always take place between doctor and doctor or from registered nurse to registered nurse. Only 7.55% of the respondents indicated that a patient was handed over to a paramedic (ALS) in >75% of flights. One incidence of patient handover to administration staff was reported.

More than 75% of the respondents indicated that routine aircraft cleaning after every flight by health care professionals, as well as cleaning of the aircraft after transport of a patient with a contagious disease, was done in >75% of flights. More than 80% of the respondents indicated that they restocked the aircraft with the necessary equipment for the next flight in >75% of the flights. This decreases the activation time for the next flight as health care professionals can concentrate on patient specific equipment and drugs prior to a flight.

5.3.3.2 Section F: Feedback and control

Less than 25% of the respondents indicated that debriefing and emotional support was available after >75% of flights. Less than 45% of them further indicated that mortality and morbidity discussions were done in >75% of cases after flights. More than 70% of the respondents indicated that >75% of flight documentation was audited post-flight. This can be of great value for continuous professional development.

5.4 LIMITATIONS OF THIS STUDY

Despite the insightful results found in this study, some limitations need to be noted.

- Only 58 respondents participated in this study, resulting in misleading or inconclusive results.

- This study was conducted in sub-Saharan Africa, comprising of Third World countries. The findings can thus not be generalised to First World countries.

- In some instances, literature pertaining to the questions asked was could not be found, therefore correlating results with literature was difficult.

- Communicating with health care providers from the participating countries within sub-Saharan Africa was extremely difficult due to the language differences, and could have led to questions being misinterpreted and answered incorrectly.

5.5 RECOMMENDATIONS

The recommendations are divided into pre-flight, in-flight and post-flight as depicted in the conceptual framework (view Figure 1.1 and Annexure C).

5.5.1 Pre-flight (input)

The following recommendations are made regarding the pre-flight:

- In accordance with international recommendations, the air medical transport team should ideally consist of at least one nurse, supported by a doctor or paramedic. This is subject to the training and role of the nurse in the specific country.

- Doctors as part of the medical transport team should have additional qualifications, for example, in Anaesthesiology or Primary Emergency Care.
- All health care professionals throughout sub-Saharan Africa should be trained in Advanced Life Support principles, in order to be able to treat the different patients being transported
- The exact patient location is of vital importance and should be relayed to the transport team in order for them to prepare thoroughly and sufficiently for the patient's transport.
- Even though point-of-care tests are costly and require a level of proficiency to interpret, it does contribute significantly to improving the level of care rendered to the critically ill and injured patient, and should thus be available to health care professionals when transporting patients via air ambulance.
- In order to administer Adrenaline during newborn resuscitation, an umbilical catheter is needed. This should be available to health care professionals when transporting patients via air ambulance.
- With regards to circulatory access in the adult patient, the intraosseous infusion is secondary to venous access, yet it can be indicated in patients in whom venous access cannot be obtained. Intraosseous devices should therefore be made available to health care professionals when transporting patients via air ambulance.
- Clopidogrel should be available to health care professional involved in air transportation of critically ill or injured patients since it is indicated in the treatment of Acute Coronary Syndromes and supported by the Resuscitation Council of Southern Africa.
- All health care professionals transporting patients in sub-Saharan Africa should be immunised. This is strongly supported by the National Institute for Communicable Diseases in order to minimise the risk of acquiring various communicable diseases in sub-Saharan Africa.
- Resting periods between all flights should be mandatory as this will ensure maintaining quality care of the critically ill or injured patient.

5.5.2 In-flight (throughput)

Recommendations regarding in-flight are made next.

- Health care professionals should be able to perform surgically clean procedures on their patients in order to minimise infection.
- Patient privacy during examinations and performance of procedures should be maintained when possible.
- Continuity of successful patient care can only be maintained if proper handover is done between the treating health care professionals from the transferring facility and the transport team health care professionals.

5.5.3 Post-flight (output)

Recommendations regarding post-flight include:

- As stated previously, continuation of care should be maintained. In order to achieve this, health care professionals transporting the patient should hand over to a health care professional of equal or higher status at the receiving facility.
- Auditing of flight documentation should be done after every flight. Not only for medico-legal aspects, but also for the purpose of morbidity and mortality discussions.

5.6 FUTURE RESEARCH

There are areas for research that have been identified during the discussion of the research results and related literature. These form the basis for the follow-up research in the following areas:

- Develop a theoretical framework based on the conceptual framework that derived from this research.
- Air ambulance transport worldwide: Challenges experienced by health care professionals.

- Develop best practice guidelines for pre-flight, in-flight and post-flight considerations.
- Monitor patient outcomes relating to pre-flight, in-flight and post-flight considerations.

5.7 PERSONAL REFLECTION

Initially this study seemed well set up and easy to execute as the steps were well set out. However, various drawbacks influenced the study. Communicating with the service providers throughout sub-Saharan Africa and obtaining email addresses to correspond with possible respondents was problematic. Not only did the language differences make this difficult, but internet access was not always available Literature pertaining to the different aspects in the study targeting specifically sub-Saharan Africa was scarce and this made verifying the findings difficult.

5.8 SUMMARY

Chapter 5 summarised the conclusions made in Chapter 4. The limitations pertaining to this study were indicated and recommendations were made as derived from the research findings. Recommendations with regard to future studies were made and the researcher reflected personally on this study.

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Annexure A

Ethical approval to conduct the research

A1	Faculty of Health Science Ethics Committee
A2	Air transport service providers

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A1 : Faculty of Health Science Ethics Committee

Faculty of Health Sciences Research Ethics Committee

31/03/2010

Number	:	**S33/2010**
Title	:	Air ambulance transport in sub-Sahara Africa: challenges experienced by health care professionals
Investigator	:	Marlize Visser, Department of Nursing Science, University of Pretoria (SUPERVISORS: Dr T Heyns / **Prof S P Hattingh**)
Sponsor	:	**None**
Study Degree:		**M. Cur (Clinical)**

This Student Protocol was approved by the Faculty of Health Sciences Research Ethics Committee, University of Pretoria on 30/03/2010. The approval is valid for a period of 3 years.

....

DR L SCHOEMAN; BPharm, BA Hons (Psy), PhD;
Dip. International Research Ethics
CHAIRPERSON of the Faculty of Health Sciences
Student Research Ethics Committee, University of Pretoria

....

DR R SOMMERS; MBChB; M.Med (Int); MPhar.Med.
VICE-CHAIR of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria

A2: Air transport service providers

Participation leaflet and Informed consent

Service Provider

Dear Service Provider,

Your company is invited to participate in a study conducted at the Department of Nursing, University of Pretoria, concerning the challenges experienced by health care professionals transporting critically ill and injured patients via air ambulances in sub-Saharan Africa. This information leaflet contains information that will assist you to understand the study as well as its value. If there is any need for further clarification, please feel free to contact the researcher, Marlize Visser, at any time.

TITLE OF STUDY

Air ambulance transport in sub-Saharan Africa: challenges experienced by health care professionals

1. The purpose and objectives of the study

The overall aim of this study is to:

Explore the challenges experienced by health care professionals during air transport of critically ill or injured patients in sub-Saharan Africa and then make recommendations to management in order to address the challenges.

2. Explanation of procedures to be followed

Once your service/company has agreed that the health care professionals (nurses, paramedics and doctors) working in your service may participate in the study and you have signed and returned the informed consent, I will contact you. You will then be requested to provide me with the email addresses of the health care professionals working in your service. If you wish to delegate this task, please provide me with the email address of a specific person in your service whom I can contact and who will be able to provide the email addresses of the health care professionals. Once I have received these, I will contact each health care professional individually via email, providing each with an informed consent document as well as a questionnaire (see Annexure A). The individual health care professional will be requested to complete the questionnaire and return it via email to an anonymous email address dedicated to this study, which will be used to ensure the confidentiality of the person returning the questionnaire.

3. Risk and discomfort involved

There is no risk involved in this study. Please understand that all information will be encoded so as to avoid your company or health care professionals being identified. Their input will be valued, as it will provide insight into the research topic.

4. Benefits of the study

Based on the findings, the researcher will make recommendations which can be utilised by the service providers to enhance the service provided. If required, these recommendations will be forwarded to your company, which will enable your service to address specific challenges.

5. Voluntary participation in and withdrawal from the study

Participation occurs on a voluntary basis, and your company and/or health care professionals can refuse to participate in the study without stating any reason.

6. Ethical approval

The Faculty of Health Sciences Research Ethics Committee of the University of Pretoria has granted written approval for this study (see Annexure B).

7. Additional information

If you have any questions about your company's participation in this study, please contact the researcher, Ms Marlize Visser, at:

Work telephone:	+27 12 354-2243
Cellphone:	+27 82 877 1417
Email address:	marlizevisser@yahoo.com

8. Confidentiality

The name of your service as well as your name and all input from the health care professionals will be kept confidential. Results will be published and presented in such a manner that you, your service and the participating health care professionals will remain anonymous. All data will be encoded to maintain anonymity.

9. Consent to participate in this study

Your service's participation in this research is subject to reading and accepting the above information and signing the informed consent document below.

INFORMED CONSENT

I have read the above information leaflet and fully understand what is expected of the service and the health care professionals working at my company. Its content and meaning have been explained to me. I have received the proposal, questionnaire and the ethical approval granted by the Research Ethics Committee, University of Pretoria. I have been given the opportunity to ask questions and received satisfactory answers. I hereby agree that the health care professionals working at this service may volunteer to participate in this research.

____

Company

______________________________ ____________

Service Provider's signature **Date**

______________________________ ____________

Witness **Date**

______________________________ ____________

Marlize Visser (Researcher) **Date**

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Annexure B

Participation leaflet and informed consent

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Participation leaflet and informed consent
Transport Team Members

Researcher:	**Contact details:**
Marlize Visser	Cellphone :+27 82 877 1417
Student number: 99035571	Fax number: +27 12 354 1490
Department of nursing science University of Pretoria	E-mail address: **marlizevisser@yahoo.com**

Dear colleague,

Re: Research study: 'Air ambulance transport in sub-Saharan Africa: challenges experienced by health care professionals'.

I am currently a MCur student in Emergency Nursing in the Department of Nursing Science, University of Pretoria. You are invited to voluntarily participate in my research project on 'Air ambulance transport in sub-Saharan Africa: challenges experienced by health care professionals'.

This letter contains information to help you decide whether you want to participate in this study. Before you agree you should fully understand what it involves. If you do not understand this information or have any questions, do not hesitate to contact me. You should not agree to participate unless you are willing to comply with what I expect of you.

The purpose of this study is to explore and assess the challenges experienced by health care professionals during air transport of critically ill or injured patients in sub-Saharan Africa, and make recommendations for management to address these challenges.

By completing and returning this questionnaire I will assume that you give your consent to participate in the abovementioned study. Completion of this questionnaire may take approximately 45 minutes.

The questionnaire must be returned to an independent recipient, who will print the questionnaire and assign a number to it before handing it over to me.

Please return your questionnaire via email to zarrabin@gmail.com and identify it as "Visser research" in the subject box.

The Research Ethics Committee of the University of Pretoria, as well as your service provider, has granted written approval for this study.

Your participation in this study is voluntary. Your name and that of the service provider will not appear on the questionnaire. I emphasise that anonymity will be maintained throughout as you do not provide your name or that of your service provider on the questionnaire. Once you have returned the questionnaire you cannot recall your consent as I will not be able to trace your contact information. Therefore, you will also not be identified as a participant in any publication that comes from this study.

I sincerely appreciate your help.

Yours faithfully

Marlize Visser

INFORMED CONSENT

I have read the above information leaflet and fully understand what is expected of me. The content and meaning have been explained to me. I have been given the opportunity to ask questions and received satisfactory answers. I hereby agree to participate in this research study. For the purpose of this study, by sending back the questionnaire I consent to participate in this study, without further written consent.

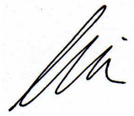
____

Company

(Already obtained)

________________________________ ______________

Service provider's signature Date



________________________________ ______________

Marlize Visser (Researcher) Date

Annexure C

Questionnaire

C1	Questionnaire compiled by the researcher
C2	Questionnaire adopted based on feedback from experts
C3	Questionnaire adopted based on feedback following the pre-test

C1 : Questionnaire compiled by the researcher

1. Personal information

Sex	M/F
Qualifications	Medical doctor
	Registered nurse
	Paramedic/CCA
	PALS
	ACLS
	ATLS
Additional qualifications	Critical Care Nursing
	Trauma and Emergency Nursing
	FMA / AHCP
	Other
How old are you?	
How many years of experience do you have in air medical transport of patients?	
On average, how many flights a month do you undertake?	

2. Incentives provided by employer/company

		Yes	No
1.1	Are the following incentives provided by your employer/company?	------	------
	Availability of company transport		
	Parking expenses remunerated		
	Travelling expenses covered		
	Required immunization costs covered		
	Uniforms supplied		
	Safety gear supplied (e.g. safety glasses)		
	Additional compulsory courses paid for by employer/company (e.g. AHCP, PALS)		
	Incentives for food		
	Accommodation incentives		
	Equipment provided (e .g stethoscope)		
Which additional costs of essential services/equipment are covered by you?			

3. Pre-flight information regarding the patient

		Yes	No
3.1	Do you receive pre flight medical information about the patient's diagnosis?		
	Do you receive pre-flight information regarding the following of the patient:		
	History (SAMPLE)		
	Age of the patient		
	Seatbelt		
	Allergies		
	Chronic medication		
	Previous illnesses		
	Last meal		
	Events (e.g. mechanism of injury, progression of illness)		
	Primary survey		
	Current airway management		
	Breathing status (e.g. mechanical ventilation, oxygen mask)		
	Haemodynamic status		
	Disability (Glasgow Coma Scale)		
	Drug management		
	Environmental control		
	Resuscitation phase		
	Additional lines inserted (e.g. central line, femoral line)		
	Additional tubes inserted (e.g. underwater drain, urinary catheter)		
	Continuous medication received (e.g. dobutamine, phynelephrine, sedation, Cordarone X)		
	Secondary survey		
	Findings based on head-to-toe assessment		
3.2	Do you regard this medical report as sufficient to prepare for the flight?		
	If no, please comment on what additional information you would add:		

4. Pre-flight information regarding the location of the patient

4.1	Exact location of the patient		
4.2	Specific information regarding the location of the patient:		
	Political information/safety		
	Climate		
	Available resources (e.g. level of hospital, ambulance service)		
	Who will accompany the patient / Who is currently in charge of the patient		
4.3	Document additional challenges that you think need to be addressed pertaining to the pre-flight information about the location of the patient		

5. Travelling to and from the airport

5.1	What mode of transport do you make use of to travel to the airport:		
	Own transport		
	Friend/ Family/Colleague		
	Public transport		
	Shuttle service		
	Company transport		
	Other (Please explain)		
5.2	Do you experience any challenges regarding transport to and from the airport?		
5.3	If yes, please explain:		
5.4	Do you perceive your journey to and from the airport as being safe?		
	If yes, please comment:		
5.5	Approximately how far do you have to travel to the airport?	Km	
5.6	How long does it take you to reach the airport?	Min	

6. Pre-flight information regarding health care professional accompanying you on the flight

6.1	Are you informed of the health care professional(s) that will accompany you on the flight?	Y	N
6.2	Do you perceive accompanying health care professionals as a challenge		
6.2.1	If yes, please explain:		

7. Flight preparation

7.1	Are there adequate equipment available to manage the patient during transport	Y	N
7.1.1	If no, please elaborate the challenges experienced:		
7.2	Is it challenging to pack the necessary equipment within the weight prescriptions?		
7.2.1	If yes, please elaborate on the challenges you experience:		
7.3	Is it challenging to pack the necessary equipment within the available space?		
7.3.1	If yes, please elaborate on the challenges you experience:		
7.4	Are you solely responsible for the pre-flight packing of equipment?		
7.4.1	If yes, describe the challenges experienced:		

7.5	Add additional challenges during the pre-flight preparation

8. On the apron

8.1	Are you exposed to adverse environmental conditions?				
8.1.1	If yes, describe the challenges experienced:				
8.2	Do the ground personnel make provision for the Air Ambulance crew regarding the environmental factors?				
8.3	Do you receive support from the ground personnel regarding the following:				
		Never	Seldom	Often	Always
8.3.1	Offering/restocking beverages				
8.3.2	Safety procedures regarding other aircraft in place				
8.3.3	Update health care professionals regarding patient's status				
8.3.4	Demarcate area surrounding air ambulance				
8.3.5	Assist in privacy for the patient				
8.4	If applicable, add any other challenges experienced on the apron				

9. En-route to the patient

		never	seldom	often	always
9.1	Do you receive continuous updates en route to the patient?				
9.2	If appropriate, add additional challenges you experience during the flight en-route to the patient				

10. Arrival at the airport

10.1	Do you perceive the transport for the health care professionals via ground ambulance to the receiving facility as safe?	Never	Seldom	Often	Always
10.2	Do you receive assistance from the ambulance personnel?				
10.3	Are modes of communication with the treating staff available?				
10.4	In case of foreign languages, is a translator available?				
10.5	If appropriate, add additional challenges you experience on arrival at the airport				

11. At the current treating facility

11.1	On arrival at the receiving hospital, is the staff treating the patient cooperative during your assessment of the patient?	Never	Seldom	Often	Always
11.2	Do you receive applicable reports from the treating staff, including:				
11.2.1	X- rays				
11.2.2	Laboratory reports				
11.2.3	Referral notes				
11.2.4	Current treatment plan				
11.3	Do the initial patient information (history, primary survey, resuscitation and secondary survey) received correlate with your examination findings of the patient?				
11.3.1	If appropriate, please elaborate on the challenges experienced as a result of the above question: :				
11.4	Are you able to perform sterile procedures?				
11.5	Do you have adequate equipment to perform invasive monitoring should the patient condition require this?				
11.6	Can you facilitate privacy for your patient?				
11.7	Do you experience challenges regarding the patients cultural or spiritual believes?				
11.8	Do you experience obtaining informed consent for air ambulance evacuation from the patient/family as a challenge?				

11.9	If appropriate, add additional challenges you experience at the receiving hospital

12. Transport of patient to aircraft

12.1	Do you experience loading the patient into the aircraft as a challenge?	Never	Seldom	Often	Always
12.2	Do you receive help from the flight crew in loading and securing the patient?				
12.3	Please elaborate should you have experienced more challenges during the stabilizing of the patient:				

13. Transferring the patient via air ambulance to treating facility

13.1	Is the work space in the air ambulance challenging?	Y	N
	If yes, please elaborate:		
13.2	List challenges experienced with performing procedures in the aircraft:		
13.3	List challenges experienced with monitoring a patient progress		
13.4	Indicate additional challenges you experience during the transportation of the patient during flight		

14. Transport of patient from aircraft to the receiving facility

		never	seldom	often	always
14.1	Is a ground ambulance available on arrival to transport the patient to the treating facility?				
14.2	If no: please explain the challenges:				
14.3	Is adequate equipment available on the ground ambulance service to transport the patient safely?				
14.4	Do you receive assistance from the ambulance personnel regarding lifting and placing the patient in the ambulance?				
14.5	Do you perceive the transport via ground ambulance as safe?				
14.6	How far are you from the treating facility?	Between to km			
14.7	How long does it take you to travel to the treating facility?	Between to min			
14.8	Indicate additional challenges you experience during the transportation of the patient from the aircraft to the receiving hospital				

15. Handing over the patient at receiving facility

		never	seldom	often	always
15.1	your patient transfer arranged prior to your arrival?				
15.2	Who receives the patient at the receiving facility? Please indicate:	Doctor			
		Nurse			
		Paramedic			
		Admin staff			
		Other			
15.3	Do you perceive the handing over of the patient as being a challenge?			Y	N
If yes, please explain:					
15.4	Are there any challenges pertaining to patient records that you are aware of?				
If yes, please explain:					

16. Completing the mission

		Y	N
16.1	Are you responsible for cleaning the air ambulance after the mission?		
16.2	Are you responsible for restocking the air ambulance?		
16.3	If your answered yes to one or both of the above questions (16.1 and 16.2), please elaborate the challenges experienced by you:		

17. Support from employer/company

		Y	N
17.1	Are you supported by your employer/company by means of the following:		
17.1.1	Critical incident stress debriefing or other formal emotional support strategies		
17.1.2	Continuous professional development		
17.1.3	Feedback on patient management		
17.1.4	Report on patient outcome		
17.1.5	Performance appraisals		
17.1.6	Other (please specify)		

18. Additional comments

Please add any additional challenges which were not mentioned in the questionnaire.

Thank you for your valuable input!

C2 : Questionnaire adopted based on feedback from experts

Recommendations by experts

Note:

The remarks were quoted as it appears on the questionnaires

Experts were asked to evaluate the questionnaire during Phase 1, Step 2 and make recommendations if appropriate to how the questionnaire could be improved. These questions asked and recommendations made that were used can be summarised as follows:

1. Personal information

- Why ask male/female?
- Rather use gender than male/ female
- Add tick box to tick applicable qualification
- Not CCA but rather advanced life support paramedics add qualification, ex. B-tec: EMS, N. Dip, CCA or other.
- Add additional courses and not qualifications
- Add ALS instructors qualifications
- Additional qualifications as dippec/ da/ NRP for the dr's/als
- Not how many years but rather how many hours; More accurate.
- Age instead of how old are you?
- Aero medical transportation, not air medical...
- Add critical care "science"
- Write out Flight Medical Ass and Aviation HCP
- Part time or full time crew

- Be specific; ask experience in fixed wing flight service

2. Incentives provided by employer or company Benefits rather than incentives

- Take away tick box at the heading of question 1.1
- Does safety gear include or exclude PPE? Goggles/ glasses?
- Be specific about S & T's on comm. or AA?
- Accommodation provision AA/ Comm? Business acc?
- Annual medical occupational health checkups, audiology, etc?
- Parking expenses remunerated/ additional protocol in place?
- Medical insurance?
- Partially covered costs & explain

3.1 Pre-flight information regarding the patient

- Remove tick box at heading of question 3.1
- Remove tick box at heading primary survey
- S: Seatbelt, worn as passenger/ driver
- Elaborate on seatbelt, signs and symptoms in case of medical patients
- Remove tick box at heading resuscitation phase
- Remove tick box at heading secondary survey
- Remove blank row under findings from head to toe assessment
- Please explain environmental control in SAMPLE
- Elaborate on events, ex, other occupants?
- Add C Spine control!!
- At breathing status, please add ventilation parameters
- Change UWD to IC drain

- In the resuscitation phase elaborate on continuous and stat meds.
- Blood results? For example Hb to take blood with
- Is this available to your flight service?
- Add a partial column as all the info is not always available immediately
- Is extensive info given regarding specific injuries noted

4. Pre flight information regarding location of the patient

- Add tick box next to question 4.2
- Please motivate reason for weather update
- Political information and safety security advise
- Who is currently in charge of this patient?
- Accessibility roads, lifts in hospital, etc
- Recent infectious diseases outbreaks, ex VHF/cholera

5. Travelling to and from the airport

- Differentiate between AA and Comm
- Comment on both yes and no question 5.4
- Add a time range, in peek traffic vs 24:00 at night
- Clearly define which airport!!! Confusion

6. Pre flight information regarding health care professionals accompanying you on the flight

- Take out question on accompanying health care professionals.
- Questions are not clearly understandable
- What about: is the acc flight as qualified for the level of care provided by your service?

7. Flight preparation

- 7.1.1 Very broad question, add something like considering configuration, space and weight limitations, are there adequate equipment?
- Is this equipment always in working condition? / Maintained?
- Do you find luggage restrains a challenge?

8. On the apron /Airport tarmac

- Are you exposed to adverse / extreme weather conditions?
- Do the ground handling agents make provision for the AA crew in regard to adverse weather?
- 8.3.2 Safety procedures regarding nearby aircraft on tarmac/ refuelling trucks?
- Update on pt's status not from ground personnel, but rather from AC?
- Demarcate area surrounding AA for safety and privacy?
- Indicate clearly that from question 8.3 participants should answer never, seldom, often, and always. Recommend a break in the questionnaire

9. En route to the patient

- Differentiate between patients coming to AA or crew going to fetch patient.

10. Arrival at the airport/ destination

- 10.2 Assistance from ambulance personnel regarding treatment/ equipment
- ? Indicate which countries are regarded as safe and which not?
- 10.3 How, if at all, do you communicate with the treating facility?

11. At current treating facility pt's current treating facility

- Not sterile but surgically clean?
- How well does the initial patient report correlate with your clinical findings of the patient?
- Is AA transport consent obtained prior to your arrival?
- By Who?

12. Transport of the patient to the aircraft

- 12.1 Make provision to elaborate on which challenges specific do you experience

13. Transferring the patient via air ambulance to the treating facility

- List challenges experienced with monitoring of your patient

14. Transport of patient from the aircraft to the treating facility/ Ground transport to the treating facility

- Separate the yes/no box from the never/seldom/often/always box
- How far on average do you have to travel to the treating facility?
- NB: receiving and not treating hospital!
- ? Add a question regarding crew's thoughts on whether a helicopter transfer would be justified in the case of spinal patients, or in the case of the longer distance transfers to hospitals in peak hour traffic? Just of personal interest to myself?

15. Handing over the patient at the treating facility

- Was patient transfer arranged prior to your arrival?
- Handing over to A&E Unit/Specialist?
- Do you escort the patient to the hosp or handing over at airport to transferring crew?

16. Completion of the mission

- Is it a dedicated plain or chartered?
- Differentiate between aircraft and equipment

17. Support from employer or company

- Add availability of senior advice and support

C3: Questionnaire adopted based on feedback following pre-test

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QUESTIONNAIRE: CHALLENGES IN AIR AMBULANCE TRANSPORT IN SUB-SAHARAN AFRICA

Respondent number — V1 [| |] 1

PLEASE BE AWARE THAT BY COMPLETING THIS QUESTIONNAIRE AND SENDING IT BACK TO MS MARLIZE VISSER, YOU HAVE GIVEN YOUR CONSENT TO USE THE DATA FOR RESEARCH PURPOSES AND ACKNOWLEDGE THAT YOU HAVE READ AND UNDERSTOOD THE ACCOMPANYING INFORMATION LEAFLET

Please answer all the questions by using the mouse to 'point and click' on a red box (☐). Should you make a mistake please remove the inappropriate X and 'click' on a box to indicate your amended answer.

SECTION A: PERSONAL INFORMATION

1. What is your **gender**?

			For office use
Male	1	☐	V2 [ ] 4
Female	2	☐	

2. What **health professional responsibility** do you exercise as a **member** of the air transport **team**? (Please select only a **single** answer)

			For office use
Medical practitioner	1	☐	V3 [ ] 5
Registered nurse	2	☐	
Paramedic (Advanced Life Support)	3	☐	
Paramedic (Intermediate Life Support)	4	☐	
Paramedic (Basic Life Support)	5	☐	

3. Which of the following **areas of speciality** do you have?

			For office use
Diploma in Anaesthesiology	1	☐	V4 [ ] 6
Diploma in Primary Emergency Care	2	☐	V5 [ ] 7
Critical Care Nursing	3	☐	V6 [ ] 8
Trauma and Emergency Nursing	4	☐	V7 [ ] 9
Other (specify):			V8 [ ] 10

4. Which of the following **additional courses** have you attended?

			For office use
Paediatric Advanced Life Support (PALS)	1	☐	V9 [ ] 11
Advanced Cardiac Life Support (ACLS)	2	☐	V10 [ ] 12
Advanced Trauma Life Support (ATLS)	3	☐	V11 [ ] 13
Neonatal Resuscitation Program (ANLS)	4	☐	V12 [ ] 14
Advanced Neonatal Life Support	5	☐	V13 [ ] 15
Other (specify):			V14 [	] 16

Question 5 follows on the next page …

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5. What was your **age** at your last birthday?

	V15 ☐☐ 18

6. How many **years experience** do you have as a member of an **air transport** team?

	V16 ☐☐ 20

7. Which **country** does your Air Ambulance Service **operate from**? (Please select only a **single** answer)

Angola	1 ☐	V17 ☐ 22
Botswana	2 ☐	
Gabon	3 ☐	
Kenya	4 ☐	
Namibia	5 ☐	
South Africa	6 ☐	
Tanzania	7 ☐	
Zambia	8 ☐	
Zimbabwe	9 ☐	

SECTION B: PRE-FLIGHT PATIENT INFORMATION

8. **How often** do you **receive pre-flight** information pertaining to the **SAMPLE history** of a patient in respect of:

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more	For office use
S: Seatbelt worn (if applicable)	1 ☐	2 ☐	3 ☐	4 ☐	V18 ☐ 23
S: Signs and symptoms pertaining to …					
A: Allergies	1 ☐	2 ☐	3 ☐	4 ☐	V19 ☐ 24
M: Medical history	1 ☐	2 ☐	3 ☐	4 ☐	V20 ☐ 25
P: Past illness	1 ☐	2 ☐	3 ☐	4 ☐	V21 ☐ 26
L: Last meal	1 ☐	2 ☐	3 ☐	4 ☐	V22 ☐ 27
E: Events (e.g. mechanism of injury, progression of illness)	1 ☐	2 ☐	3 ☐	4 ☐	V23 ☐ 28
the age of the patient	1 ☐	2 ☐	3 ☐	4 ☐	V24 ☐ 29
the diagnosis of the patient (final or differential)	1 ☐	2 ☐	3 ☐	4 ☐	V25 ☐ 30

Question 9 follows on the next page …

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9. **How often** do you **receive pre-flight** information regarding the **primary survey** of a patient in respect of …

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
cervical spine control	1	2	3	4	V26		31
current airway management	1	2	3	4	V27		32
breathing status (e.g. oxygen mask, mechanical ventilation and settings thereof)	1	2	3	4	V28		33
haemodynamic status	1	2	3	4	V29		34
disability (Glasgow Coma Scale)	1	2	3	4	V30		35
environmental control (e.g. using a space blanket)	1	2	3	4	V31		36

10. **How often** do you **receive pre-flight** information regarding the **resuscitation phase** of a patient in respect of …

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
additional lines inserted (e.g. central line, femoral line)	1	2	3	4	V32		37
additional tubes inserted (e.g. underwash drain, urinary catheter)	1	2	3	4	V33		38
continuous drugs received (e.g. inotropic support, analgesia or sedation)	1	2	3	4	V34		39
blood results (e.g Hb, potassium level)	1	2	3	4	V35		40
total amount of fluid received	1	2	3	4	V36		41
total number of units of blood products received	1	2	3	4	V37		42
results of diagnostic procedures	1	2	3	4	V38		43

11. **How often** do you **receive pre-flight** information regarding the **secondary phase** of a patient in respect of …

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
findings based on head-to-toe assessment	1	2	3	4	V39		44
patient management (if possible) discussed with the medical crew prior to take-off	1	2	3	4	V40		45

Question 12 follows on the next page …

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12. **How often** do you **receive pre-flight** information regarding the **location** of a patient in respect of …

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
the exact location of the patient	1	2	3	4	V41		46
the expected duration of the flight	1	2	3	4	V42		47
an approximate distance of location from the airport (if applicable)	1	2	3	4	V43		48

SECTION C: ADVANCED EMERGENCY EQUIPMENT AND STOCK

Please **rate** whether the following **is in stock:**

13. Emergency equipment pertaining to **airway** and **cervical spine control:**

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
Laryngoscope with blades (sizes: 000 to 4, curved blades)	1	2	3	4	V44		49
Laryngoscope with blades (straight blade)	1	2	3	4	V45		50
Endotracheal tubes (sizes: 2.5 to 9 mm)	1	2	3	4	V46		51
Surgical cricothyroidotomy set	1	2	3	4	V47		52
Cervical collars (sizes: small, medium, large, xlarge)	1	2	3	4	V48		53
Head immobilising device (HID/Ferno blocks)	1	2	3	4	V49		54
Scoop stretcher/Spine board	1	2	3	4	V50		55
Vacuum mattress	1	2	3	4	V51		56
Kendrick Extrication Device (KED)	1	2	3	4	V52		57

Question 14 follows on the next page …

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14 Emergency equipment pertaining to **breathing** and **ventilation:**

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
Oxygen bottles (full)	1	2	3	4	V53		58
Bag-valve-mask devices (neonate)	1	2	3	4	V54		59
Bag-valve-mask devices (paediatric)	1	2	3	4	V55		60
Bag-valve-mask devices (adult)	1	2	3	4	V56		61
Peripheral saturation monitor	1	2	3	4	V57		62
Arterial blood gas monitor	1	2	3	4	V58		63
Exhaled or end-tidal CO_2 monitor (capnography)	1	2	3	4	V59		64
Peak expiratory flow meter (e.g. asthma patients)	1	2	3	4	V60		65
Mechanical ventilator: non-invasive ventilation	1	2	3	4	V61		66
Mechanical ventilator: volume control modes	1	2	3	4	V62		67
Mechanical ventilator: pressure control modes	1	2	3	4	V63		68
Intercostal drain set	1	2	3	4	V64		69
Intercostal drain tubes (various sizes)	1	2	3	4	V65		70
Heimlich valves (intercostal drain set)	1	2	3	4	V66		71

15. Emergency equipment pertaining to **circulation** with **haemorrhage control:**

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
3 lead ECG monitor	1	2	3	4	V67		72
12 lead ECG monitor	1	2	3	4	V68		73
"Rapid laboratory tests" (e.g. BHCG, malaria, cardiac enzymes)	1	2	3	4	V69		74
Infusion pumps	1	2	3	4	V70		75
Lines: high flow intravenous sets	1	2	3	4	V71		76
Lines: peripheral access	1	2	3	4	V72		77
Lines: jugular venous access	1	2	3	4	V73		78
Lines: femoral venous access	1	2	3	4	V74		79
Lines: umbilical venous access	1	2	3	4	V75		80
Lines: umbilical arterial access	1	2	3	4	V76		81
Lines: central access	1	2	3	4	V77		82
Intraosseous needle (adult)	1	2	3	4	V78		83
Intraosseous needle (paediatric)	1	2	3	4	V79		84
Intraosseous needle (neonate)	1	2	3	4	V80		85
Limb splints (rigid)	1	2	3	4	V81		86
Limb splints (air splints)	1	2	3	4	V82		87
Limb splints (traction splints)	1	2	3	4	V83		88
Availability of blood	1	2	3	4	V84		89
Availability of other blood products	1	2	3	4	V85		90

Question 16 ***follows on the next page …***

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16. Equipment/Medication pertaining to **disability, defibrillation and drugs:**

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
Blood glucose monitor	1	2	3	4	V86		91
Defibrillator	1	2	3	4	V87		92
External pacer	1	2	3	4	V88		93
Adrenaline	1	2	3	4	V89		94
Atropine Sulphate	1	2	3	4	V90		95
Amiodarone (Cordarone X)	1	2	3	4	V91		96
Adenosine	1	2	3	4	V92		97
Asprin (Disprin)	1	2	3	4	V93		98
Calcium chloride	1	2	3	4	V94		99
Clopidogrel (Plavix)	1	2	3	4	V95		100
Dextrose 50%	1	2	3	4	V96		101
Diazepam (Valium)	1	2	3	4	V97		102
Dobutamine (Dobutrex)	1	2	3	4	V98		103
Dopamine (Intropine)	1	2	3	4	V99		104
Flumazinal (Anexate)	1	2	3	4	V100		105
Furosemide (Lasix)	1	2	3	4	V101		106
Glucagon	1	2	3	4	V102		107
Heparin/Enoxaparin	1	2	3	4	V103		108
Lignocaine (Lidocaine)	1	2	3	4	V104		109
Magnesium sulphate	1	2	3	4	V105		110
Mannitol	1	2	3	4	V106		111
Midazolam (Dormicum)	1	2	3	4	V107		112
Morphine Sulphate	1	2	3	4	V108		113
Naloxone (Narcan)	1	2	3	4	V109		114
Nitro-glycerine (intravenous)	1	2	3	4	V110		115
Nitro-glycerine (sublingual)	1	2	3	4	V111		116
Nitro-glycerine (spray)	1	2	3	4	V112		117
Oxygen	1	2	3	4	V113		118
Sodium bicarbonate (Soda-bic)	1	2	3	4	V114		119
Skeletal muscle relaxation (short/long acting)	1	2	3	4	V115		120
Streptokinase (Streptase)	1	2	3	4	V116		121

17. Equipment pertaining to **environmental control:**

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
Patient warmer	1	2	3	4	V117		122
Incubator	1	2	3	4	V118		123

Question 18 ***follows on the next page …***

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Please **rate** whether you are **provided with the following:**

18. **Personal/Universal protection** such as …

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
coverall/ Overall suits	1	2	3	4	V119		124
immunisation	1	2	3	4	V120		125
eye protection (glasses)	1	2	3	4	V121		126
gloves	1	2	3	4	V122		127
face masks	1	2	3	4	V123		128
apron	1	2	3	4	V124		129
alcohol based hand wash	1	2	3	4	V125		130
post exposure starter packs for HIV	1	2	3	4	V126		131
post exposure starter packs N1H1	1	2	3	4	V127		132
post exposure starter packs Meningitis	1	2	3	4	V128		133
compulsory annual health checkups	1	2	3	4	V129		134
medical insurance	1	2	3	4	V130		135

19. What is the **minimum rest period** between missions (**hours**)?

V131 136

SECTION D: IN-FLIGHT CONSIDERATIONS

20. Regarding your **first contact** with a patient, please rate the following:

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
Flight physiology is taken into consideration when stabilising a patient (e.g. consideration of gas laws, altitude changes, mode of ventilation, etc.)	1	2	3	4	V132		138
Ability to perform surgical clean procedures during management	1	2	3	4	V133		139
Use of ALS skills when managing the patient	1	2	3	4	V134		140
Ability to maintain patient privacy during patient management	1	2	3	4	V135		141
How often do you “Scoop and Run”?	1	2	3	4	V136		142
How often do you “Stay and Play”?	1	2	3	4	V137		143
Do you have a time limit to adhere to when managing the patient?	1	2	3	4	V138		144

Question 21 follows on the next page …

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21. With respect to the **cooperation of handover staff**, please rate your **reception of patients' reports** pertaining to the following:

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
X-rays	1	2	3	4	V139		145
Laboratory values	1	2	3	4	V140		146
Referal notes	1	2	3	4	V141		147
Nursing notes	1	2	3	4	V142		148
Assistance to prepare and package the patient for flight	1	2	3	4	V143		149

22. With respect to the **transport of a patient**, please rate the following:

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
Consent is given to transport the patient (patient, family, significant other(s))	1	2	3	4	V144		150
Space to work in is confined	1	2	3	4	V145		151
There are passengers on the air ambulance mission	1	2	3	4	V146		152
There is in flight electrical power made available	1	2	3	4	V147		153
There is in flight use of all monitoring equipment	1	2	3	4	V148		154

SECTION E: POST-FLIGHT CONSIDERATIONS

23. During patient handover, who do you **hand over** the patient to?

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
Doctor (specialist)	1	2	3	4	V149		155
Doctor (emergency unit)	1	2	3	4	V150		156
Registered nurse	1	2	3	4	V151		157
Paramedic (advanced life support)	1	2	3	4	V152		158
Administration staff	1	2	3	4	V153		159
Other (specify):	1	2	3	4	V154		160
					V155		161

Question 24 follows on the next page …

For office use

24. After **mission completion** …

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
are you responsible for cleaning the air ambulance?	1	2	3	4	V156		162
is the aircraft cleaned after every mission?	1	2	3	4	V157		163
is the aircraft cleaned specifically after transporting a patient with a contagious disease?	1	2	3	4	V158		164
are you responsible for restocking the air ambulance?	1	2	3	4	V159		165

SECTION F: FEEDBACK AND CONTROL

25. In respect of **continuous professional development**, how are the following **implemented**?

	Less than 25%	25% to less than 50%	50% to less than 75%	75% or more			
Critical incident stress debriefing	1	2	3	4	V160		166
Formal emotional support strategies	1	2	3	4	V161		167
Feedback given on patient management during air ambulance transport (e.g. morbidity and mortality discussions)	1	2	3	4	V162		168
Auditing of your patient documentation after a mission	1	2	3	4	V163		169

Please save this document after completion to your desktop and then mail it to:

zarrabin@gmail.com

Thank you for your participation and time

Annexure D

Letter from statistician

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DEPARTMENT OF STATISTICS

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LETTER OF STATISTICAL SUPPORT

Date: 28 February 2010

This letter is to confirm that **Miss M Visser (Student Number: 99035571)**, studying at the University of Pretoria, discussed the project with the title **Air Ambulance Transport in Sub-Saharan Africa** with me.

I hereby confirm that I am aware of the project and also undertake to assist with the statistical analysis of the data generated from the project.

The data analysis will consist of basic descriptive statistics and if the data allows Chi-Square Tests.

The data will be collected from all Companies and their personnel consenting to participate.

Miss J Coetsee
Department of Statistics
Internal Consultation Service
Tel 012 420 2397

Annexure E

Letter from editor

31 January 2011

TO WHOM IT MAY CONCERN

I, Suzette Marié Swart (ID 5211190101087), confirm that I have edited the following thesis:

Name of student:

Marlize Visser

Title of thesis:

Air ambulance transport in sub-Saharan Africa: challenges experienced by health care professionals.

Thank you

Suzette M Swart* *(not signed – sent electronically)*
0825533302
smswart@vodamail.co.za

LANGUAGE PRACTITIONER/EDITOR:
The Consortium for Language and Dimensional Dynamics (CLDD)
University of Pretoria (UP)
Tshwane University of Technology (TUT)
University of Johannesburg (UJ)
University of South Africa (UNISA)

*Member of *The Professional Editors' Group*

The edit included the following:

- Spelling
- UK vs USA English
- Vocabulary
- Punctuation
- Grammar (tenses; pronoun matches; word choice etc.)
- Language tips
- Correct acronyms (please supply list)
- Consistency in terminology, italisation etc.
- Figure/Table numbers etc.
- Sentence construction
- Suggestions for text with unclear meaning
- References (consistency in text and against bibliography)
- Basic layout, font, numbering etc.
- Logic, relevance, clarity, consistency
- Style

The edit excluded:

- Correctness of crediting another's work – PLAGIARISM.
- Content
- Correctness or truth of information (unless obvious)
- Correctness/spelling of specific technical terms and words (unless obvious)
- Correctness/spelling of unfamiliar names and proper nouns (unless obvious)
- Correctness of specific formulae or symbols, or illustrations
- Style
- Professional formatting

Suzette M Swart