THE SCOPE OF PRACTICE OF PHYSIOTHERAPISTS WHO WORK IN INTENSIVE CARE IN SOUTH AFRICA: A QUESTIONNAIRE-BASED SURVEY

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DECLARATION

I, Michèle Anderson Lottering, declare that this research report is my own work. It is being submitted for the degree of Masters of Science in Physiotherapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University

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ABSTRACT

Introduction : Patients admitted to the intensive care unit (ICU) require continuous monitoring and care from all staff working in ICU; this includes doctors, nursing staff, physiotherapists, dieticians and various other medical staff. Conventionally ICU was predominantly staffed by physicians and nursing personnel, with other members of health care having a minor part to play in the patient's care whilst in ICU. Depending on the country, type of unit, amount of staff and level of training, the physiotherapist may screen the patients to assess if they require physiotherapy and if so, what intervention will be required; on the other hand, in some units the physiotherapist may rely on referral from the doctors and administer the treatment requested by the doctor for the particular patient. In 2000, Norrenberg and Vincent conducted a study to establish the profile of physiotherapists working in ICU in Europe. Van Aswegen and Potterton (2005) adjusted the questionnaire compiled by Norrenberg and Vincent (2000) to be more suitable for the South African setting. A pilot study using this questionnaire was done to determine the scope of practice of physiotherapists in ICU in South Africa. The content of the modified questionnaire used by Van Aswegen and Potterton (2005) was not validated prior to its implementation and a sample of convenience was used. Results reported from that survey were therefore only preliminary and no additional surveys had been performed to date.

Objectives: The aim of this study was to establish the current scope of practice of physiotherapists in ICU in South Africa. To determine if physiotherapists' scope of practice in ICU in South Africa has changed since the report published by Van Aswegen and Potterton (2005). To compare South African physiotherapists' scope of practice in ICU with that reported on an international level.

Methodology: A pre-existing questionnaire used by Van Aswegen and Potterton (2005) was content validated for this study. After consensus was reached on the final version of this questionnaire, it was uploaded onto SurveyMonkey. Physiotherapists that worked in ICU in the government sector, hospitals belonging to the Life, MediClinic and NetCare groups or that were members of the Cardiopulmonary Physiotherapy Rehabilitation Group of the South African Society of Physiotherapy were invited to participate in this study.

Results: A total of 319 questionnaires were sent out and 108 responses were received. The combined response rate for this survey was 33.9%. An assessment technique that was performed 'very often' by respondents was an ICU chart assessment (n=90, 83.3%), auscultation (n=94, 81, 8%) and strength of cough effort (n=81, 75%). Assessment techniques that were 'almost never' or 'never' used included assessment of lung compliance (n=75; 69.4%), calculation for the presence of hypoxemia (n=74; 68.5%) and patient readiness for weaning (n=63; 58.3%). Treatment techniques performed by respondents 'very often' included manual chest clearance techniques (n=101, 93.5%), mobilising a patient in bed (n=91, 84.3%), positioning a patient in bed (n=91,

84.3%), airway suctioning (n=89, 82.4%), mobilising a patient out of bed (n=84, 77.8%), deep breathing exercises (n=83, 76.9%) and peripheral muscle strengthening exercises (n=79, 73.1%). Treatment techniques that were ‘never’ or ‘almost never’ used included the flutter device (n=77, 71.3%), implementation and supervision of non-invasive ventilatory support (n=77, 71.3%) and adjustment of mechanical ventilation settings for respiratory muscle training (n=76, 70.4%). Physiotherapists working in the private sector made up 60.2% (n=65) of the respondents. An after-hours physiotherapy service was provided to ICU patients by 78 (72.2%) of the respondents during the week. One hundred and five (97.2%) of the respondents provided a physiotherapy service for ICU patients over the weekend. When comparing the results of the current study to the studies by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005), there was a significant difference ($p < 0.05$) in the usage of IPPB/NIPPV, weaning patients from MV, adjustment of MV settings and IS between the studies. Results from the current study showed a significant difference ($p < 0.05$) in the involvement of respondents in suctioning, extubation and adjustment of MV settings compared to that reported by Norrenberg and Vincent (2000).

Conclusion: Physiotherapists in this study performed a multisystem assessment of their patient’s which is important since physiotherapists are first line practitioners in South Africa. Physiotherapists play an important role in treating and preventing respiratory and musculoskeletal complications that occur in ICU. The results from this study showed that physiotherapists in South Africa are treating their patient’s according to evidenced based practice but due to the high non-response bias these results should be interpreted with caution. The results from this study can be used to develop preliminary clinical practice guidelines for physiotherapists working in ICU in South Africa.

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LIST OF ABBREVIATIONS

ACBT	-	Active Cycle of Breathing Technique
BiPAP	-	Bilevel Positive Airway Pressure
CIM	-	Critical Illness Myopathy
CIP	-	Critical Illness Polyneuropathy
cmH_2O	-	Centimetres of Water
COPD	-	Chronic Obstructive Pulmonary Disease
CPAP	-	Continuous Positive Airway Pressure
CPD	-	Continuous Professional Development
CPRG	-	Cardiopulmonary Physiotherapy Rehabilitation Group
CT scan	-	Computerized Tomography Scan
FET	-	Forced Expiratory Technique
FIM	-	Functional Independence Measure
FiO_2	-	Fraction of Inspired Oxygen
FVC	-	Forced Vital Capacity
FRC	-	Functional Residual Capacity
HPCSA	-	Health Professions Council of South Africa
ICU	-	Intensive Care Unit
IMT	-	Inspiratory Muscle Training
INR	-	International Normalised Ratio
IPPB	-	Intermittent Positive Pressure Breathing
IS	-	Incentive Spirometry
MDT	-	Multi-Disciplinary Team
MHI	-	Manual Hyperinflation
MIP	-	Maximum Inspiratory Pressure
MV	-	Mechanical Ventilation
NIPPV	-	Non-Invasive Positive Pressure Ventilation
PaO_2/FiO_2 ratio	-	Ratio of Partial Pressure of Arterial Oxygen to Faction of Inspired Oxygen
PEEP	-	Positive End Expiratory Pressure
PEP	-	Positive Expiratory Pressure
PFIT	-	Physical Function in the ICU Test
RSBI	-	Rapid Shallow Breathing Index
SASP	-	South African Society of Physiotherapy
TEE	-	Thoracic Expansion Exercises
VAP	-	Ventilator Associated Pneumonia
V/Q	-	Ventilation Perfusion ‘
WCPT	-	World Confederation for Physiotherapy

CHAPTER 1

1. INTRODUCTION

1.1 BACKGROUND

Patients admitted to the intensive care unit (ICU) require continuous monitoring and care from all staff working in ICU; this includes doctors, nursing staff, physiotherapists, dieticians and various other medical staff (Denehy and Berney 2006).

Conventionally ICU was predominantly staffed by physicians and nursing personnel, with other members of health care having a minor part to play in the patient's care whilst in ICU. Over time this has changed to a more multidisciplinary approach (Chaboyer et al. 2004). In ICU the various health care professionals function as a multidisciplinary team in which the physiotherapist plays an important role in both respiratory and rehabilitative care (Clini and Ambrosino 2005; Denehy and Berney 2006; Ambrosino et al. 2011); however, the physiotherapist's part in this multidisciplinary team is inconsistent between countries (Gosselink et al. 2008; Stiller 2013).

Depending on the country, type of unit, amount of staff and level of training, the physiotherapist may screen the patients to assess if they require physiotherapy and if so, what intervention will be required; on the other hand, in some units the physiotherapist may rely on referral from the doctors and administer the treatment requested by the doctor for the particular patient (Hodgin et al. 2009). In 2000, Norrenberg and Vincent conducted a study to establish the profile of physiotherapists working in ICU in Europe (Norrenberg and Vincent 2000). Van Aswegen and Potterton (2005) adjusted the questionnaire compiled by Norrenberg and Vincent (2000) to be more suitable for the South African setting. A pilot study using this questionnaire was done to determine the scope of practice of physiotherapists in ICU in South Africa. A response rate of 60% was reported. The study was conducted on physiotherapists working in the government and private sectors; no statistical difference was noted between the roles of physiotherapists in ICU in these two health care sectors in South Africa, besides the use of intermittent positive pressure breathing (IPPB). The use of techniques such as deep breathing exercises, postural drainage, manual chest therapy, coughing, huffing, suctioning, involvement in mechanical ventilation (MV) setting adjustments, weaning of patients from MV and mobilisation of patients in ICU was examined in both studies (Norrenberg and Vincent 2000; Van Aswegen and Potterton 2005). There were no significant differences when the profiles of physiotherapists in ICU were compared between the two studies except for the administration of non-invasive positive pressure ventilation (NIPPV). Only 28% of

physiotherapists in South Africa were involved in NIPPV in comparison to 46% of physiotherapists in Europe (Norrenberg and Vincent 2000; Van Aswegen and Potterton 2005).

1.2 STATEMENT OF PROBLEM AND JUSTIFICATION FOR RESEARCH

The content of the modified questionnaire used by Van Aswegen and Potterton (2005) was not validated prior to its implementation and a sample of convenience was used. Results reported from that survey were therefore only preliminary and no additional surveys had been performed to date. Since this survey was performed eight years ago, the role of physiotherapists in South African ICUs might have changed and therefore another survey of scope of practice in ICU is warranted. Content validation of the original questionnaire and better sampling of participants will add to the reliability of the results of such a follow-up survey.

1.3 RESEARCH QUESTION

What is the scope of practice of physiotherapists in ICUs in South Africa?

1.4 SIGNIFICANCE OF RESEARCH

The results from this study will help to define the current scope of practice of physiotherapists in ICU in South Africa. Information obtained from this survey will be compared with results from international surveys on the profile of ICU physiotherapists and could be used to develop clinical practice guidelines for the role of ICU physiotherapy in South Africa.

1.5 RESEARCH AIM

The aim of this study was to establish the scope of practice of physiotherapists in ICU in South Africa.

1.6 RESEARCH OBJECTIVES

- To modify and validate the content of an existing questionnaire used in a pilot study conducted by Van Aswegen and Potterton (2005) to determine the scope of practice of physiotherapy in ICU in South Africa.

- To establish the current scope of practice of physiotherapists in ICU in South Africa.

- To determine if physiotherapists' scope of practice in ICU in South Africa has changed since the report published by Van Aswegen and Potterton (2005).

- To compare South African physiotherapists' scope of practice in ICU with that reported on an international level.

1.7 TYPE OF STUDY

A quantitative descriptive survey based study was performed.

CHAPTER 2

2. LITERATURE REVIEW

Articles for this study were sourced from journals cited in PubMed, Medline and Science Direct data bases. Keywords used for searches included “physiotherapy in ICU”, “physiotherapy scope of practice”, “physiotherapy in South Africa”, “physiotherapy techniques”.

2.1 PHYSIOTHERAPY SCOPE OF PRACTICE

The World Confederation for Physical Therapy (WCPT) (2011) defines physiotherapy as a service that strives to conserve and improve quality of life of communities and their members. The practice of physiotherapy includes health promotion, preventing illnesses, treating and rehabilitating individuals and their communities. Physiotherapists are trained to evaluate, diagnose, establish and implement a treatment plan and re-evaluate the patient’s response to treatment to determine if the treatment given has achieved the desired results. Due to the fact that a physiotherapist is trained to evaluate and diagnose they are able to practice as first line practitioners in certain countries including South Africa. Physiotherapists offer services in various settings including hospitals, rehabilitative centres, clinics and other health care settings (WCPT 2011).

The Health Professions Council of South Africa (HPCSA) guides health care professionals in their practice of services delivered to the public. In their description of the scope of practice of physiotherapists they explain the various settings in which physiotherapists practice which include ICU. The practice of physiotherapy is similar to that described by WCPT and includes evaluating the patient, selecting appropriate techniques, and applying these techniques, educating and giving necessary advice to the patient regarding their diagnosis. Treatment modalities offered by physiotherapists in ICU, as described in the current HPCSA guidelines, include postural drainage, active and passive exercises, mobilisation, breathing exercises and inhalation therapy which includes the use of intermittent positive pressure breathing and respiratory function tests (peak flow measurements) (HPCSA 2003). A project is currently underway to update the information in this guideline.

2.2 THE ROLE OF PHYSIOTHERAPY IN ICU

Patients who suffer severe injury or exacerbation of chronic pulmonary disease or undergo major surgery are admitted to medical, surgical, cardiothoracic or neurosurgical ICUs depending on the stability of their condition (Van Aswegen and Potterton 2005).

Critical illness inevitably leads to periods of prolonged bed rest or immobility. Immobility may put the patient at risk of the development of complications that affect the pulmonary, cardiac, haematological, dermatological and musculoskeletal systems (Gosselink et al. 2008; Orman and Westerdahl 2010). Cardiac complications include postural hypotension, impaired cardiac function, and elevation of resting heart rate (Volman 2010). Haematological complications associated with immobility include venous thromboembolism (Anderson and Spencer 2003). Dermatological complications include skin breakdown and impaired wound healing (Volman 2010). Pulmonary complications may develop post-operatively (e.g. lung volume loss, retention of secretions or pulmonary oedema) or from mechanical ventilation (e.g. ventilator-associated pneumonia, diaphragmatic dysfunction, respiratory muscle weakness or poor lung compliance) or prolonged bed rest (e.g. lung volume loss) (Denehy and Berney 2006; Gosselink et al. 2008; Hodgin et al. 2009; Orman and Westerdahl 2010; Clarke et al. 2013). Musculoskeletal complications of immobility include muscle weakness, reduced joint range of motion, muscle contractures and muscle wasting (Gosselink et al. 2008; Hodgin et al. 2009).These complications may lead to prolonged ICU and hospital length of stay and functional limitations including reduced participation in activities of daily living and therefore reduced quality of life (Clarke et al. 2013).

Some patients with critical illness may be predisposed to developing ICU acquired weakness (Nordon-Craft et al. 2012). Intensive care unit acquired weakness may be caused by sepsis, acute respiratory distress syndrome, prolonged mechanical ventilation or medications such as corticosteroids (Nordon-Craft et al. 2012). Intensive care unit acquired weakness may also be referred to as critical illness myopathy (CIM), critical illness polyneuropathy (CIP) or a combination of the two namely critical illness polyneuromyopathy (Nordon-Craft et al. 2012). Patients with CIP present with neuromuscular symptoms which include muscle weakness, reduced deep tendon reflexes and diminished pain, temperature and vibration sensation (Nordon-Craft et al. 2012). Patients presenting with CIM have no sensation loss and may have preserved deep tendon reflexes. CIM has a better prognosis and a faster rate of recovery compared to CIP (Nordon-Craft et al. 2012). Patients presenting with ICU acquired weakness require intense physical rehabilitation that starts in ICU and is continued after discharge from the acute care setting (Nordon-Craft et al. 2012).

Physiotherapists are important members of the multidisciplinary team in ICU. Physiotherapists prevent physical deconditioning of patients, development of musculoskeletal complications and prevent and treat respiratory complications (Gosselink et al. 2008). Physiotherapy in ICU includes patient assessment, chest physiotherapy interventions and mobilisation of patients. Multimodal chest physiotherapy assists in reducing the incidence of respiratory complications, facilitates short-term improvements in respiratory function and may reduce ICU length of stay and duration of ventilation (Berney et al. 2012). Multimodal chest physiotherapy includes positioning, manual chest clearance techniques, manual hyperinflation and airway suction for patients who are sedated or uncooperative. Those who are able to cooperate with treatment receive encouragement to perform deep breathing exercises and to actively cough and expectorate retained secretions. Mobilisation of patients includes active limb exercises, actively moving or turning in bed, sitting on the edge of the bed, sitting in a chair, standing and walking. Early mobilisation in ICU prevents the complications of bed rest and has being shown to reduce length of ICU and hospital stay (Stiller 2013). If physiotherapists are not part of the multidisciplinary team in ICU patients are at risk of developing complications of the pulmonary, cardiac, haematological, dermatological and musculoskeletal systems. These complications may lead to increased ICU and hospital stay as well as reduced quality of life (Gosselink et al. 2008).

2.3 ASSESSMENT OF THE ICU PATIENT

Patients in ICU require detailed and regular assessments by the physiotherapist to ensure that they receive the most appropriate physiotherapy treatment relevant to their condition (Hanekom et al. 2011). Thus regular patient reassessment and progression of rehabilitation are the cornerstones of physiotherapy in ICU.

Initial assessment of a critically ill patient includes an in-depth assessment of the patient's respiratory, cardiovascular, muscular and neurological systems. Assessment of the cardiac system includes assessment of the patient's vital signs including heart rate, heart rhythm and blood pressure. The patient's platelet level, haemoglobin and international normalised ratio (INR) must be reviewed to ensure the patient is not at an increased risk of bleeding. The patients skin must be assessed for any abrasions or broken skin so that the necessary precautions can be taken to prevent further skin damage. Assessment of the respiratory system includes assessing the patient's respiratory rate, airway pressures, radiological investigations, auscultation of the lungs, percussion note to determine the integrity of the underlying lung tissue, thoracic expansion, arterial blood gas analysis, lung compliance, quantity and quality of sputum and readiness for weaning from the mechanical ventilator (Pryor and Prasad 2008, pg. 7-17; Kacmarek et al. 2013, pg 337-354). Assessment of the

neuromusculoskeletal system includes assessment of the patient's muscle tone and sensation, active and passive joint range of motion and muscle strength (Pryor and Prasad 2008, pg. 187). The patient's functional abilities such as rolling in bed, bridging, sitting over the edge of the bed and mobilising out of the bed should be assessed. Prolonged bed rest results in decreased endurance of patients. The patient's functional abilities and endurance can be measured objectively using assessment tools such as the Functional Independence Measure (FIM) or the Physical Function in ICU Test (PFIT) (Nordon-Craft et al. 2012). Assessment of the patient's medication and medical and surgical plan is essential to ensure a holistic approach of the patient and appropriate treatment plan (Pryor and Prasad 2008, pg. 2). Assessment of the renal system to determine the patient's fluid balance is important as it affects the consistency of the patient's secretions (Kacmarek et al. 2013, pg. 1206). Radiological investigations including x-rays and computerized tomography scans (CT scans) of the whole body or part thereof should be reviewed to determine if there is any musculoskeletal or tissue damage (Pryor and Prasad 2008, pg. 22).

This multi-system assessment aids the physiotherapist in identifying the patient's main and potential problems and precautions and contraindications to treatment. With this information at hand the physiotherapist can set appropriate treatment aims and plan an appropriate treatment intervention for each patient that aligns with the International Classification of Function (Gosselink et al. 2008; Berney et al. 2012). During treatment the physiotherapist must continually re-assess and monitor the patient's vital functions to ensure the treatment remains safe and effective (Gosselink et al. 2008; Berney et al. 2012). Each patient's response to treatment should be evaluated and taken into consideration as treatment is progressed. In the pilot survey conducted by Van Aswegen and Potterton (2005) no questions related to physiotherapy assessment of an ICU patient were posed to participants.

The physiotherapy treatment techniques used for patients in ICU can be divided into three broad categories, namely those that aim to counteract physical complications associated with critical illness and immobility; those that aim to prevent the onset of respiratory complications and those that aim to manage respiratory diseases and their related complications. These techniques will be explained further in section 2.4.

2.4 PHYSIOTHERAPY TREATMENT TECHNIQUES

2.4.1 Rehabilitation to Counteract Physical Complications Associated with Immobility and Critical Illness

As mentioned previously, patients who suffer from critical illness are placed on bed rest for a certain time period depending on their severity of illness which leads to immobility, muscle wasting, muscle shortening, joint stiffness and for some ICU acquired weakness (Stiller 2000; Needham 2008; Wiles and Stiller 2010). Muscle strength may decrease by up to 40% during one week of bed rest (Cirio et al. 2003). Previously patient care in ICU was only aimed at the clinical goals to improve the patient's medical condition and not the patient's concerns such as how long recovery will take or their functional ability after discharge. More recently the view of medical staff has changed in an attempt to improve the patient's function and long term outcomes after critical illness (Bailey et al. 2009) and as a result patients in ICU receive less sedatives and are mobilised out of bed earlier than previously (Needham 2008; Clark et al. 2013). Mobilising cooperative mechanically ventilated patients in ICU out of bed and away from the bedside has been shown to be safe, effective and advantageous to patient outcome (Bailey et al. 2009; Clark et al. 2013). Positioning, passive limb range of motion exercises, active muscle strengthening and mobilisation can help prevent the consequences of prolonged ICU stay (Wiles and Stiller 2010).

In a recent study Hanekom et al. (2011) developed evidence based clinical algorithms to assist physiotherapists in decision making regarding patient mobilisation in ICU. Patients were divided into three categories namely the unconscious patient; the physiologically stable awake patient and the deconditioned patient. Each of these categories will be discussed below.

2.4.1.1 Rehabilitation of the unconscious patient in ICU

The unconscious patient should be assessed to ensure they are stable prior to physiotherapy treatment. Rehabilitation of an unconscious patient is mainly passive. According to the clinical algorithm published by Hanekom et al. (2011) the physiotherapist should aim to position these patients in a head up tilt of 30°, participate in regular repositioning of the patient and perform passive movements of upper and lower limb joints. Passive movements should be performed in the patient's full physiological range of motion and Hanekom et al. (2011) recommend that five repetitions of each joint movement be done daily (Hanekom et al. 2011). These movements may be combined with stretching of muscle tissue to prevent loss of joint range of motion (Wiles and Stiller 2010).

2.4.1.2 Rehabilitation of the awake and responsive patient in ICU

Physiologically stable awake patients, including intubated patients, should be mobilised as soon as possible and therefore the benefits of patient mobilisation versus patient recumbency should be discussed with the multidisciplinary team early during the patient's stay in ICU. The patient must be assessed to ensure they are stable and have sufficient cardiovascular and pulmonary reserve to cope with mobilisation. Sufficient cardiovascular reserve includes a resting heart rate of less than 50% of age predicted maximum, less than 20% variability in blood pressure, no electrocardiogram and an absence of orthostatic hypotension (Hanekom et al. 2011). Sufficient pulmonary reserve includes a ratio of partial pressure of arterial oxygen to fraction of inspired oxygen (PaO_2/FiO_2) of more than 300, oxygen saturation of more than 90% with a variation of less than 4%, satisfactory respiratory pattern, fraction of inspired oxygen (FiO_2) of less than 0.6 and a positive end expiratory pressure (PEEP) of less than 10 centimetres of water (cmH_2O) (Hanekom et al. 2011). The patient's vital signs and clinical condition must be monitored continuously during mobilisation. Mobilisation includes upper and lower limb exercises, lying to sitting on the edge of the bed, sitting to standing, standing transfer from the bed to the chair, walking with assistance, walking independently and climbing stairs. Detailed documentation is essential including goals to ensure progression of patient management in the acute care setting (Hanekom et al. 2011).

2.4.1.3 Rehabilitation of the deconditioned patient with a prolonged stay in ICU

Patients who have been immobile for a prolonged period of time (more than 5 days) due to instability are referred to as deconditioned patients. These patients should begin mobilising as soon as they are haemodynamically stable. Low resistance, high repetition exercises are recommended for these patients and should include trunk, upper limb and lower limb exercises. These exercises should be done once daily provided the patient is stable and monitored throughout the treatment session. As the patient grows accustomed to exercise, the frequency of exercise should be increased to twice daily (Hanekom et al. 2011).

Mobilisation and positioning of ICU patients seems to form part of physiotherapy treatment majority of the time as 100% of European physiotherapists and 98% of South African physiotherapists reportedly mobilise patients in ICU (Norrenberg and Vincent 2000; Van Aswegen and Potterton 2005). Slightly less European (90%) and South African (95%) physiotherapists seem to combine positioning with their management of patients in ICU (Norrenberg and Vincent 2000; Van Aswegen and Potterton 2005).

2.4.2 Physiotherapy Management of Pulmonary Complications

In section 2.2 the various types of pulmonary complications that a patient may develop due to immobility and mechanical ventilation were listed. One of the main roles of a physiotherapist in ICU is to prevent the onset of these complications and to manage a patient who develops complications in an effective way to restore pulmonary function. The methods used by physiotherapists during the management of the pulmonary system will be discussed below.

2.4.2.1 Physiotherapy techniques that assist with mobilisation of secretions

2.4.2.1.1 Nebulisation

Nebulisation is a method of delivering medication directly to the respiratory system. This can be administered to patients who are intubated and those who are not intubated. A nebulizer converts a solution into fine droplets in an aerosol form that can be delivered directly to the respiratory tract. Mucolytics, bronchodilators and antibiotics can be delivered via a nebulizer. Care must be taken that the selected medication is safe for the patient (Kacmarek et al. 2013, pg. 715). Nebulisation can be combined with postural drainage positions to assist with the drainage of secretions (Pryor and Prasad 2008, pg. 170-174). Nebulisation should be initiated 10-15 minutes prior to the application of other chest clearance techniques.

2.4.2.1.2 Postural drainage

Drainage of bronchial secretions can be addressed by positioning the patient in gravity assisted positions or modified gravity assisted positions. Positions specific to each lung segment are related to the anatomy of the bronchial tree (Pryor and Prasad 2008, pg. 123, 163; Kacmarek et al. 2013, pg. 968-970). Patients must be assessed to determine if the position to be used is safe for their condition (Kacmarek et al. 2013, pg. 968-970).

Contraindications for a head–down tilt position (Trendellenburg) include cardiac failure, cerebral oedema, aortic and cerebral aneurysms, abdominal distension, gastro-oesophageal reflux, severe haemoptysis and recent surgery to the head or neck (Pryor and Prasad 2008, pg. 123, 163). If the position is not suitable for the specific patient then a modified postural drainage position in the horizontal position can be used (Naylor et al. 2005). When the patient is placed in a gravity assisted position, the patient must be observed for any signs of distress and their heart rate, blood pressure, oxygen saturation and intracranial pressure (in the presence of acute traumatic brain injury) must be closely monitored for signs of adverse effects (Pryor and Prasad 2008,123, 163; Kacmarek et al. 2013, pg. 968-970).

In South Africa 82% of government and 92% of private sector physiotherapists use postural drainage during treatment of patients in the ICU (Van Aswegen and Potterton 2005). Ninety percent of the respondents in the study by Norrenberg and Vincent (2000) used postural drainage as a treatment technique in ICU.

2.4.2.1.3 Manual chest techniques

Manual chest physiotherapy techniques include percussions, vibrations and chest shaking. These techniques are used to mobilise excessive retained secretions in patients who have developed pulmonary complications (Denehy and Berney 2006; Gosselink et al. 2008; Makhabah et al. 2013).

Percussions are performed with a cupped hand with rhythmic flexion and extension of the wrist, over the affected lung segments. Percussions should not be applied directly to the skin but over a layer of clothing or a towel as this will avoid sensory stimulation of the skin. Chest wall vibrations and shaking are performed by the physiotherapist placing both their hands on the patient's chest wall directly over the skin. When the patient expires a vibratory force is applied in the direction of the normal chest movement. This enhances the expiratory flow and aids the mobilisation of secretions. Vibrations are a finer and higher frequency movement compared to shaking. Percussions, vibrations and shaking should not be used in patients with cardiovascular instability, over open wounds or patients with severe osteoporosis, frank haemoptysis or bronchospasm (Pryor and Prasad 2008, pg. 338).

Manual chest physiotherapy is frequently used by physiotherapists when treating patients in ICU. In the study done by Norrenberg and Vincent (2000) 98% of European physiotherapists used manual chest physiotherapy techniques. Similarly 100% of South African physiotherapists reported using manual chest physiotherapy techniques while treating patients in ICU (Van Aswegen and Potterton 2005).

Manual chest physiotherapy techniques may result in short-term improvements in pulmonary function. There is limited evidence that indicates that manual chest physiotherapy techniques result in a reduction of time that patients are mechanically ventilated and may reduce their length of stay in ICU, however there is also evidence proving it may not (Stiller 2013).

2.4.2.1.4 Airway suctioning

Effective suctioning is essential in clearing retained pulmonary secretions from central airways and to maintain a patent airway in intubated patients (Ntoumenopoulos 2008; Stiller 2013). Suctioning of patients that are unable to clear their secretions may reduce the incidence of pulmonary complications such as pneumonia (Stiller 2013).

Suctioning of an intubated patient can be done by open or closed suctioning methods; both methods are equally effective (Pedersen et al. 2009). Open suction requires opening the airway circuit and inserting a catheter down the artificial airway. This may improve secretion clearance but may result in derecruitment of the lungs due to loss of the patient's PEEP when opening the airway circuit. Closed suction has fewer risks in patients receiving a high level of PEEP (Ntoumenopoulos 2008). The catheter size must not exceed half of the endotracheal tube diameter as a larger catheter may cause atelectasis and hypoxia (Kacmarek et al. 2013, pg. 736). Pre-oxygenation of 100% for at least 30 seconds is recommended prior to and after suctioning to prevent hypoxemia (Pedersen et al. 2009)

Oronasal suction is performed in intubated and non-intubated patients to remove accumulated secretions in the oronasal region that may lead to micro-aspiration and increase the patient's risk of ventilator associated pneumonia (Lou-Sole et al. 2002; Kacmarek et al. 2013, pg. 739).

Suctioning may have adverse side effects including episodic hypoxemia, cardiac arrhythmias, haemodynamic instability and increased oxygen consumption (Berney et al. 2012; Stiller 2013). Pre-oxygenation and optimal technique minimises the occurrence of these side-effects (Stiller 2013).

2.4.2.1.5 Active cycle of breathing technique

Active cycle of breathing technique (ACBT) consists of breathing control, thoracic expansion exercises (TEE) and forced expiratory technique (FET). The three components are repeated in a cycle to help mobilise and clear bronchial secretions. The technique can be adjusted to suit the needs of each patient. Patients are able to continue with the technique independently after it has been demonstrated to them and they should be able to perform the technique without any assistance from the physiotherapist (Fink 2007; Lewis et al. 2012).

To perform ACBT, the patient must be positioned comfortably, in sitting or in a modified postural drainage position. Breathing control consists of the patient breathing at their normal rate and tidal volume, encouraging movement of the diaphragm allowing the upper lung segments and shoulders to relax. The patient places one of their hands on their upper abdomen and is encouraged to feel their hand move up and out with inspiration and down and in with expiration. The patient breathes in through their nose allowing the air to be filtered, humidified and warmed, unless their nose is blocked. During breathing control inspiration is the active phase and expiration relaxed and passive (Fink 2007; Lewis et al. 2012).

During TEE the patient breathes at large volumes, close to vital capacity and may include an inspiratory hold for 3 seconds. Thoracic expansion exercises aim to loosen secretions, improve ventilation by re-expanding lung tissue and to deliver sufficient volume for FET. Care must be taken when repeating TEE in succession as the patient may hyperventilate and tire; breathing control may be performed between TEE to allow the patient to rest. To promote air entry to areas where it may be limited the physiotherapist may place their hand or the patient's hands over the effected segment providing proprioceptive input for the underlying lung tissue. At the end of inspiration the patient may be encouraged to sniff to increase lung volume. The sniff is not suitable if the patient is hyperventilating. Thoracic expansion exercises are then followed by FET (Fink 2007; Lewis et al. 2012). Patients who are intubated may find it difficult to perform TEE if they are on a ventilator setting that prevents breath holding.

Forced expiratory technique is one or two forced expirations (huffs) followed by breathing control. Forced expiratory technique is performed at medium to low lung volumes which is repeated one or two times and then followed by breathing control. The aim of FET is to help clear secretions with less change in pleural pressures than a cough. Forced expiratory technique is initially performed at low lung volumes to mobilise secretions from the small distal airways. Once the secretions have been mobilised to the larger more proximal airways a huff at a large volume is performed to move secretions into the mouth for expectoration. As FET requires less effort by the patient they will experience less pain compared to coughing. This technique is more effective when combined with postural drainage (Kacmarek et al. 2013, pg 976)

Active cycle of breathing technique can be used to treat any awake and cooperative haemodynamically stable patient, whether intubated or breathing spontaneously

(Fink 2007; Lewis et al. 2012) Active cycle of breathing technique has been shown to decrease ICU length of stay, decrease time that non-invasive ventilation was required, decrease hypercapnia, decrease atelectasis and increase forced vital capacity (FVC), peak expiratory flow rate, arterial oxygenation and sputum clearance (Savci et al. 2006). The use of ACBT was not examined in the study by Norrenberg and Vincent (2000) or Van Aswegen and Potterton (2005).

2.4.2.2 **Techniques that improve lung capacity and lung volumes**

2.4.2.2.1 Positioning

Lung perfusion and ventilation is directly influenced by gravitational forces and thus changing body position results in changes in ventilation and perfusion of the lungs (Pryor and Prasad 2008, pg. 121). Functional residual capacity (FRC) is the volume of gas left in the lungs after normal expiration (Kacmarek et al. 2013, pg. 421). This volume alters in relation to the patient's body position. As patients move from supine to a head up tilt, to sitting and then standing their FRC increases. This increase in FRC is due to increased pulmonary stretch receptor activity and the downward movement of the abdominal contents (Chang et al. 2005). Chang et al. (2005) reported that increased FRC and changing of body positions were associated with improved lung compliance and less resistance to airflow which resulted in improvements of respiratory system mechanics.

Changing body position can result in increased compressive forces on the myocardium such as in left side-lying, while sitting results in increased oxygen consumption (Jones and Dean 2004). Standing results in a larger increase in alveolar ventilation than the sitting head up tilt position in bed. Standing also results in an increase in the patient's metabolic rate and may not be tolerated in patients with reduced cardiovascular and pulmonary reserve. Therefore in the ICU setting where some patients may be unable to mobilise into standing or maintain a standing position due to their severity of illness, a semi-fowlers position should be used to optimise ventilation (Chang et al. 2005).

2.4.2.2.2 Manual hyperinflation

Manual hyperinflation (MHI) aids ventilation by mobilising secretions (Hodgson et al. 2000; Berney and Denehy 2002), increasing tidal volumes, improving lung compliance (Choi and Jones 2005) and improving alveolar recruitment (Maa et al. 2005). Manual hyperinflation involves introducing larger than normal tidal volumes to an intubated or a non-intubated patient to improve lung volume and mobilise

secretions and is frequently integrated into the physiotherapy treatment programme (Hodgson et al. 2000; Berney and Denehy 2002).

Manual hyperinflation is administered by using a breathing circuit; commonly used circuits include Air Viva, Mapleson C and Magill circuits (Maxwell and Ellis 2003). When performing MHI, a PEEP valve should be attached to the breathing circuit to prevent a decrease in FRC, oxygenation and potential shear stress of the distal lung units. The PEEP valve is adjusted to the pre-set PEEP on the patient's ventilator (Savian et al. 2005). A pressure manometer must be attached to the MHI circuit to regulate the airway pressure delivered to the patient (Van Aswegen et al. 2013). The oxygen flow meter is opened to a flow rate of 10-15 litres of oxygen and the MHI circuit is attached to the flow meter using oxygen tubing (Maa et al. 2005). The MHI breathing circuit is then attached to the patient's endotracheal- or tracheostomy tube (Maa et al. 2005). A large tidal volume breath is then slowly delivered followed by an inspiratory pause and a quick release of the bag to mimic a cough to clear secretions from the distal airways to the central airways (Hodgson et al. 2000; Maa et al. 2005).

Manual hyperinflation as adjunct to physiotherapy patient management is not suitable for patients that have a retained pneumothorax, high PEEP (>10cmH_2O), are ventilated on a fraction of inspired oxygen of 1.0, are haemodynamically unstable, have lung pathology such as acute respiratory distress syndrome or an acute exacerbation of chronic obstructive pulmonary disease or unexplained haemoptysis (Maa et al. 2005; Savian et al. 2005).

In the South African survey, MHI was more frequently used by physiotherapists in the government sector (82%) compared to 57% of private physiotherapists (Van Aswegen and Potterton 2005). It is not clear as to why there was such a large difference in the use of MHI in the government sector compared to the private sector but it may be due to further in-service training of junior physiotherapists by senior staff in the government sector as MHI may not always be taught at the undergraduate level.

Patients in ICU are frequently treated in the supine position as a result of their injuries and medical condition (Van Aswegen et al. 2013). Van Aswegen et al. (2013) examined the distribution of airflow through the lungs in the supine position. The patients were ventilated using Laerdal and Mapleson C MHI circuits and airflow distribution was examined through a gamma camera. The left lung field showed less

airflow distribution than the right and the lower segments of the left lung the least airflow distribution. This indicates that positions other than supine should be adopted during the use of MHI to improve airflow distribution into the left lower lobes (Van Aswegen et al. 2013).

2.4.2.2.3 Positive expiratory pressure devices

Collateral pathways of ventilation allow for collateral flow of air within the lungs. There are three types of collateral pathways namely inter-alveolar pores of Kohn, channels of Lambert and channels of Martin. These collateral pathways play an important role in aiding ventilation of obstructed airways and may develop further in the presence of pulmonary disease. Collateral pathways allow gaseous exchange in obstructed or diseased airways (Cetti et al. 2006).

Positive expiratory pressure (PEP) devices aim to increase the expiratory pressure within the alveoli and this promotes ventilation through the collateral pathways. Collateral ventilation allows air to get behind secretions and thereby assist in mobilising the secretions. Examples of PEP devices include bubble-PEP devices (blow bottles), the flutter device and PEP masks. These devices can only be used in spontaneously breathing patients (Westerdahl 2005). There is however no evidence to show that PEP devices are superior to manual chest physiotherapy in patients who have undergone upper abdominal or thoracic surgery (Orman and Westerdahl 2010). Positive expiratory pressure masks with expiratory flow resistors are rarely used in clinical practice in South Africa and will not be discussed further.

2.4.2.2.3.1 Bubble-PEP

A bubble-PEP device is an oscillatory PEP device through which a patient exhales. Exhalation against resistance aids in splinting open partially collapsed airways and enhances the lungs' FRC. Bubble-PEP is often used in the management of post-operative patients to reduce atelectasis and improve pulmonary function in addition to deep breathing exercises and chest physiotherapy (Filbay et al. 2012).

A bubble PEP device is made using a bottle and a piece of plastic tubing with a diameter of one centimetre. The bottle is filled with 10cmH_2O creating a PEP of 10cmH_2O . The one end of the tubing is submerged in the water and the other end is used as the patient's mouth piece (Westerdahl et al. 2005). Although the bubble PEP device is an expiratory technique the patient is required to take in a deep breath in order to blow air out into the bottle and thus inspiratory muscle training is also done (Filbay et al. 2012). The bubble-PEP device has been shown to aid the

mobilisation of secretions and increase lung volumes (Westerhal et al. 2001). The bubble-PEP device is frequently used by physiotherapists in South Africa with 71% of government and 68% of private sector physiotherapists using bubble-PEP devices as part of the treatment of spontaneously breathing ICU patients (Van Aswegen and Potterton 2005).

2.4.2.2.3.2 Flutter device

The flutter device is a small plastic device that contains a metal ball and delivers oscillatory PEP to a patient's airways. The mouth piece is placed in the patient's mouth and they exhale through the device. The ball creates an oscillating resistance to the air flow. The flutter device has been shown to assist with sputum clearance in patients with cystic fibrosis (Morrison and Agnew 2011).

There is no evidence to prove that one PEP device is superior to another (Morrison and Agnew 2011). Its effectiveness would depend on the patient's ability to use each device correctly. No research was found on the use of flutter devices in ICU; this may be because only a small number of ICU patients with chronic respiratory diseases are mechanically ventilated and would benefit from using the flutter device after extubation; due to the cost associated with the purchase of flutter devices, most physiotherapists may opt to use bubble-PEP instead for patients without chronic respiratory diseases

2.4.2.2.4 Incentive spirometry

The use of incentive spirometry (IS) is indicated for spontaneously breathing patients who have reduced lung volumes (partial or complete atelectasis). Incentive spirometry may also be used prophylactically for patients that are at risk of developing atelectasis (Haefener et al. 2008). Incentive spirometry is safe to use in all patients as long as they are able to cooperate and understand how to use the device and are monitored for signs of hyperventilation, use of accessory respiratory muscles and fatigue. Patients in ICU can only use incentive spirometers after they are extubated. The device is small and portable and the patient should be able to use it effectively on their own after sufficient instruction received from a physiotherapist (Pryor and Prasad 2008, pg. 163, 167-169).

Patients are required to place the mouth piece in their mouth, close their lips tightly around the mouth piece, so as to create a seal. The patient then takes a slow deep breath through the mouth piece in order to generate adequate volumes in the lung periphery (Pryor and Prasad 2008, pg. 163, 167-169). This is facilitated by the

physiotherapist placing their hands over the patient's basal lung segments and verbally encouraging them to breathe into their lower lung segments while inhaling through the incentive spirometer. This may be followed by an inspiratory hold for 5-10 seconds (Kacmarek et al. 2013, pg. 951). This is followed by normal expiration. Some of the IS devices allow for adjustment for expiratory muscle training as well (Kacmarek et al. 2013, pg. 949). Incentive spirometry combined with expiratory positive airway pressure has been shown to improve respiratory muscle strength, lung function and functional capacity as well as reduce post-operative pulmonary complications in spontaneously breathing patients who have under gone thoracic surgery (Haeffener et al. 2008; Agostini and Singh 2009).

In the South African survey, 41% of government and 59% of private sector physiotherapists combined IS with their treatment of extubated ICU patients, thus IS was used more frequently in the private sector (Van Aswegen and Potterton 2005). The large difference in the use of IS by government sector compared to private sector physiotherapists may be due to IS not being available in all government sectors due to its associated cost in resource-restricted government hospitals.

2.4.2.2.5 Intermittent positive pressure breathing

Intermittent positive pressure breathing devices are used to deliver intermittent positive pressure to the airways of non-intubated patients during inspiration (Denehy and Berney 2001). Intermittent positive pressure breathing assists in increasing tidal volumes and reduces shortness of breath and atelectasis (Denehy and Berney 2001).

When using an IPPB device, the physiotherapist sets the FiO_2, flow rate, trigger sensitivity and peak inspiratory pressure according to the needs of each individual patient. A breathless patient should ideally be positioned in a semi-Fowlers position; alternatively, IPPB may also be administered in a modified postural drainage position. The patient is instructed to place the mouth piece in their mouth and close their mouth to ensure a tight seal to prevent air leaks. The patient is then instructed to breathe in to trigger the in-flow of air and to allow the machine to assist them with deep inhalation (Kacmarek et al. 2013, pg. 956).

Intermittent positive pressure breathing is contra-indicated in patients with a tension pneumothorax, intracranial pressure above 15 mmHg, haemodynamic instability, active haemoptysis, tracheo-oesophageal fistula and recent oral or facial surgery (Kacmarek et al. 2013, pg. 953). Intermittent positive pressure breathing was used

by 29% of the government sector and 73% of the private sector physiotherapists in the study by Van Aswegen and Potterton (2005). Norrenberg and Vincent (2000) did not examine the use of IPPB by physiotherapists in Europe.

2.4.2.3 **Techniques used by physiotherapists to improve respiratory muscle strength**

2.4.2.3.1 Inspiratory muscle training

Inspiratory muscles are made up of striated muscle fibres and are therefore susceptible to weakening like any skeletal muscle (Kacmarek et al. 2013, pg. 319). Patients that are mechanically ventilated are at risk of developing inspiratory muscle weakness and reduced inspiratory muscle endurance. This is due to the mechanical ventilator taking over the role of the inspiratory muscles. It is advised that mechanically ventilated patients should undergo some form of respiratory muscle training (Moodie et al. 2011). Inspiratory muscle weakness may also occur in patients with neuromuscular diseases, chronic obstructive pulmonary disease (COPD) and obesity (Kacmarek et al. 2013, pg. 999). This may lead to dyspnoea related decreased quality of life, prolonged ventilation and failure to wean the patient from the mechanical ventilator (Cirio et al. 2003; Padula and Yeaw 2007; Moodie et al. 2011). Respiratory muscle weakness results in reduction in FRC and may result in a decrease in residual volume depending on the severity of respiratory muscle weakness (Hart et al. 2002).

Inspiratory muscle training (IMT) involves inspiration against resistance that improves the strength and function of the respiratory muscles. This is done using a spring-loaded Threshold® IMT or POWERbreathe® device (Padula and Yeaw 2007). Inspiratory muscle training is safe to use in all intubated patients providing they are able to understand how to use the device and breathe spontaneously for short periods of time. Inspiratory muscle training has been shown to increase respiratory muscle strength and endurance (Martin et al. 2002; Cader et al. 2010; Condessa et al. 2013). The effect of IMT of weaning patients from a mechanical ventilator was investigated by Cader et al. (2010) and Condessa et al. (2013). The participants in the study by Cader et al. (2010) were all older than 70 (mean = 83) years old in comparison Condessa et al (2013) the participants were younger with a mean age of 64 years old. In the study by Condessa the patients maximum inspiratory pressure (MIP) was started at a higher level but not increased compared to the study by Cader et al. (2010) where the patients MIP was increased gradually. In the study by Cader et al. (2010) IMT was shown to assist with weaning patients from mechanical ventilators while Condessa et al. (2013) found that IMT did not assist weaning.

2.5 AFTER-HOURS AND WEEKEND PHYSIOTHERAPY SERVICES IN ICU

Physiotherapy in ICU may be provided after normal working hours particularly to address respiratory complications in patients who are unwell. Patients that may benefit from an after-hours physiotherapy service and may deteriorate if left until normal working hours include those with acute atelectasis, excessive sputum retention and a poor cough effort. Acute atelectasis or retention of excessive amounts of secretions with an inability to clear the secretions may result in worsening gas exchange and potential respiratory failure if physiotherapy is delayed until normal working hours (Hough 2001). In the European survey, Norrenberg and Vincent (2000) reported a 42% availability of physiotherapists to ICUs during the night at university hospitals. In the South African survey, an on call night service was available to 50% of the government and university affiliated private sector hospitals (Van Aswegen and Potterton 2005). Ninety-six percent of the respondents indicated that they provided weekend physiotherapy services to their ICUs (Van Aswegen and Potterton 2005).

2.6 FACTORS THAT AFFECT PHYSIOTHERAPY SERVICE DELIVERY

Various factors may affect the service delivery of physiotherapists. These factors include the amount of physiotherapists employed at the hospital in comparison to the amount of patients requiring physiotherapy, particularly in the government sector where staff may be limited. Senior physiotherapists may not remain in the government sector which results in loss of senior physiotherapists to assist the junior physiotherapists in developing advanced knowledge and skills required when treating patients in ICU (Pawlik and Kress 2013). Although continued education is compulsory for all physiotherapists not all employees emphasise the importance on attending continued education lectures or workshops. In hospitals that have an on-call service there should be a compulsory in-service training program to ensure that all physiotherapists will be able to treat the patients requiring after-hour physiotherapy safely and effectively.

The next chapter in this research report will describe the methodology that was followed to conduct the data collection to answer the research question.

CHAPTER 3

3. METHODOLOGY

The study design, sample population, inclusion and exclusion criteria as well as instrumentation and data collection procedure used during this survey are discussed in detail. The ethical considerations that were taken into account when the study was conducted are shared towards the end of the chapter.

3.1 STUDY DESIGN

This study was cross-sectional, quantitative, descriptive and survey based in nature.

3.2 SUBJECTS

3.2.1 Sample Selection

The participants for this study were qualified physiotherapists working in ICUs in South Africa in the government or private health care sector at the time of the study.

3.2.2 Inclusion Criteria

Physiotherapists who worked in ICU for three years or more were invited to participate in the survey.

3.2.3 Exclusion Criteria

Physiotherapy students and community service physiotherapists were not included in this survey.

3.2.4 Sample Size

The exact sample size was not known but extrapolated from available information; in 2012 there were 146 members of the Cardiopulmonary Physiotherapy Rehabilitation Group (CPRG) of the South African Society of Physiotherapy (SASP); this included physiotherapists from the academic, government and private sectors.

In 2012, there were 71 central and regional government hospitals with ICUs in South Africa and with an estimated two physiotherapists per hospital that met the inclusion criteria for the survey, it was estimated that 142 government employed physiotherapists could potentially participate in this survey. In 2012, there were 125 Medi-Clinic, Life and Netcare hospitals with ICUs in South Africa with at least one physiotherapy practice servicing each ICU. In each practice it was assumed that at least one physiotherapist would have three years or more working experience.

The total study population was therefore 413 physiotherapists with working experience in cardiopulmonary physiotherapy. As not all members of the CPRG were likely to work in ICU and there being duplication between the physiotherapists working in the government and private hospitals and being members of the CPRG and that not all physiotherapists working in ICU had three or more years of working experience, the estimated sample size for this survey was a minimum of 207 physiotherapists (50% of the population).

3.3 STUDY PROCEDURES

3.3.1 Instrumentation

A questionnaire compiled by Norrenberg and Vincent (2000) to evaluate the role of physiotherapists in ICU in Europe was adjusted by Van Aswegen and Potterton (2005) to be suitable for the South African setting. The questionnaire used in 2005 had not been content validated at the time. For this survey the first stage consisted of content validation of the 2005 questionnaire. This was done with the assistance of a peer review group that consisted of five physiotherapists who worked in various intensive care units in Johannesburg. Majority of the physiotherapists in the peer review group had more than five years' experience working in intensive care.

The group of physiotherapists was emailed the 2005 questionnaire and the study objectives prior to their meeting with the researcher. This allowed them to read through the questionnaire and decide if the questions were suitable and if any questions should be removed, edited or added. The peer review group then met to discuss the questionnaire. Questions that were deemed unsuitable were either removed or adjusted and additional questions were added where required. The researcher then adjusted the content of the questionnaire as discussed with the peer review group. The adjusted questionnaire was then emailed back to the peer review group members to determine if the questionnaire was adjusted appropriately. The researcher re-adjusted the questionnaire until all the members of the peer review group were satisfied with the content of the questionnaire. The final version of the questionnaire (Appendix A) consisted of the following sections: the demographics of the physiotherapist, the type of ICU in which they work, how many patients are in each ICU, hours worked in ICU, how patients are referred to the physiotherapist, after hours work, assessment and treatment techniques, multidisciplinary meetings and professional development of physiotherapists and other medical staff.

3.3.2 Data Collection Procedure

After completion of the content validation of the questionnaire, the final version of the questionnaire was uploaded onto SurveyMonkey on the 1st of May 2013. Once the survey was uploaded the researcher made contact with the physiotherapy heads of department of government sector hospitals in South Africa that have ICUs and informed them of the aims of the study as well as the inclusion and exclusion criteria. They were invited to participate in the study and were asked to either distribute the postal questionnaire and self-addressed return envelopes, to be sent to them, to their staff that met the inclusion criteria or to distribute the email link to the electronic survey to their staff if they had access to email and the internet from work. The postal questionnaires were accompanied by study information sheets and were coded to keep the responses anonymous. The email with the email link to the survey contained information about the aims and objectives of the study and the inclusion criteria.

The researcher also contacted private sector hospitals in South Africa that have ICUs and belong to the Life, MediClinic and NetCare groups. The unit manager of the ICU was asked for contact details of the physiotherapy private practices working in their unit. The relevant physiotherapists were contacted, screened against the inclusion and exclusion criteria for the study and invited to participate. The email link to the electronic survey was sent to them or postal questionnaires, with self-addressed return envelopes, were sent if preferred.

Lastly the researcher contacted the chairperson of the CPRG of the SASP and informed her of the aims of the study. The chairperson was asked to inform the CPRG membership of the survey if she was in agreement for her members to be contacted regarding participation in the study. The researcher provided written information about the survey inclusion criteria, aims and objectives as well as an electronic link to the on-line survey to the secretary of the CPRG. The CPRG secretary circulated this information to the CPRG membership.

The participants were given three months from the 19th of May 2013 to complete the questionnaire. A blanket reminder email was sent out to all the participants that were emailed to remind them to complete the questionnaire and thank those who had already completed the online questionnaire. This email was sent out one and two months after the start of the study.

The heads of departments of hospitals that received postal questionnaires were phoned one and two months after the beginning of the study to remind their staff to complete and

return the questionnaires and to thank those who had already completed and returned their questionnaires.

If the participant completed the survey it was assumed that they gave consent to participate in the survey; this was stated in the study information sheet. The survey closed on the 19th of August 2013.

3.4 STATISTICAL ANALYSIS

The data obtained from the study was nominal data. The data was tabulated in the form of an Excel spread sheet. Descriptive statistics was used to present the data. Categorical data was summarised as frequencies and percentages in both text and in illustrative tables, pie charts and graphs. Comparisons of findings between the current survey and that reported by Van Aswegen and Potterton (2005) and Norrenberg and Vincent (2000) were made statistically using the chi-squared test or in narrative form where statistical comparisons were not possible. A p-value of < 0.05 was considered statistically significant.

3.5 ETHICAL CONSIDERATIONS

Ethical clearance from the Human Research Ethics Committee of the University of the Witwatersrand was sought and obtained prior to commencement of the survey (Clearance Certificate Number M130131) (Appendix B).

An information sheet (see Appendix C) was sent to all the participants explaining the aims of the survey and what was expected of them. At the end of the participant information sheet it was stated that participation was voluntary. The postal questionnaires were coded to keep the responses anonymous and no personal data was used in reporting the results of the survey.

The results and analysis of data collected will be presented in Chapter 4.

CHAPTER 4

4. RESULTS

Physiotherapists working in ICU in South Africa in the private and government health care sectors were included in this study. Private hospitals from the Life, Medi-Clinic and Netcare hospital groups that had ICUs were included in the study. There were 64 Life, 49 Medi-Clinic and 56 Netcare hospitals in South Africa and of these 49 Life, 32 Medi-Clinic and 44 Netcare hospitals had ICUs with physiotherapists servicing them. Thus in total 125 private hospitals were contacted by the researcher. Each of the unit managers of private hospital ICUs were asked for the contact details of the physiotherapy private practice servicing their ICU. A total of 154 physiotherapy practices working in private ICUs were identified and contacted. In addition, the researcher identified 71 government hospitals that had ICUs and contacted the physiotherapy heads-of-department to inform them of the purpose of the survey.

A total of 319 questionnaires were sent out, 252 emails with links to the questionnaire and 67 questionnaires were posted. The posted questionnaires were sent to physiotherapists at government hospitals that did not have internet access at work. Of the 252 emails, 85 responses were received, resulting in a response rate of 33.7% for the online survey. Of the 67 questionnaires that were posted, 23 (34.3%) were returned. The combined response rate for this survey was 33.9% (n=108).

4.1 WORKING ENVIRONMENT OF THE RESPONDENTS

Physiotherapists working in the private sector made up 60.2% (n=65) of the respondents. The remainder of the respondents were from university, university-affiliated, government, tertiary and quaternary hospitals in South Africa (Figure 4.1). Reponses were received from most of the provinces in South Africa with the exception of Limpopo province. Majority of respondents (n=51; 47.2%) were from Gauteng.

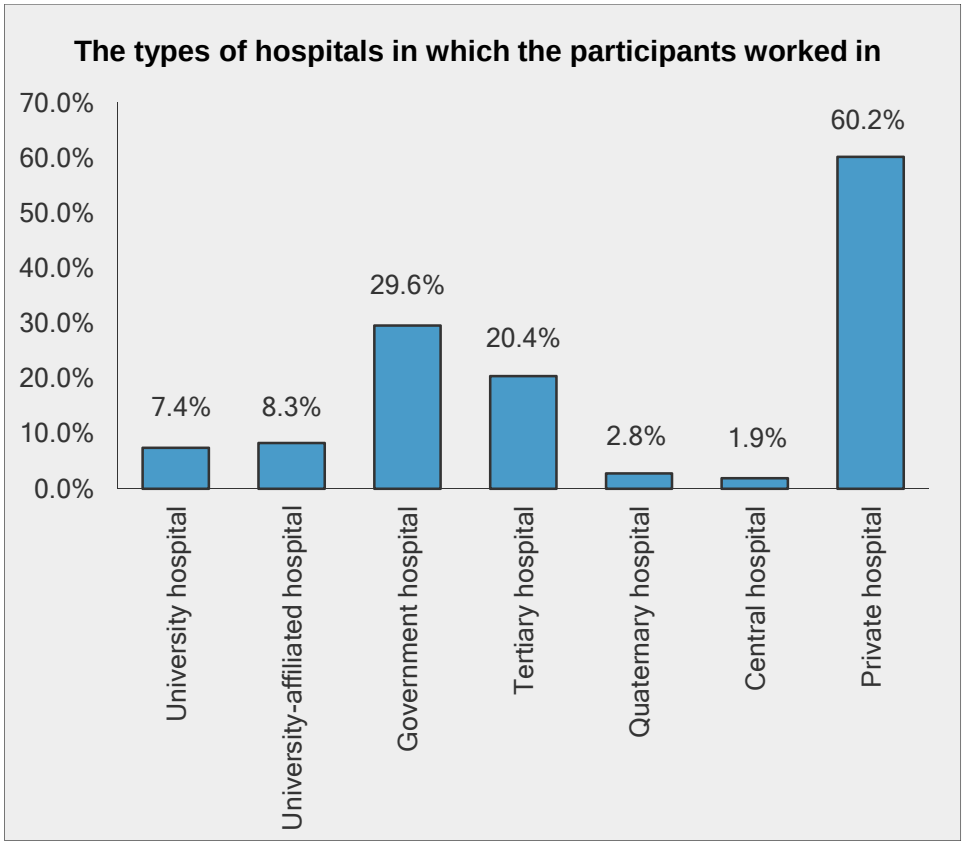

Figure 4.1: The Types of Hospitals in which the Participants Worked in

The amount of ICUs in each hospital varied from only one to more than five, the most prevalent being two ICUs in a hospital (Figure 4.2).

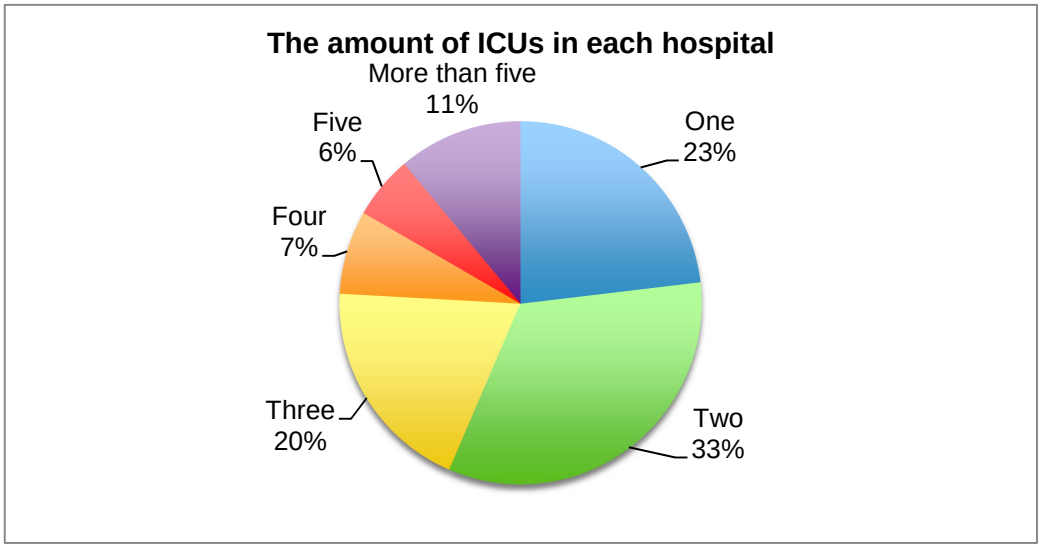

Figure 4.2: The Amount of ICUs in Each Hospital

The respondents reportedly worked in various types of ICUs and these are summarised in figure 4.3. The majority worked in medical, surgical or combined medico-surgical ICUs.

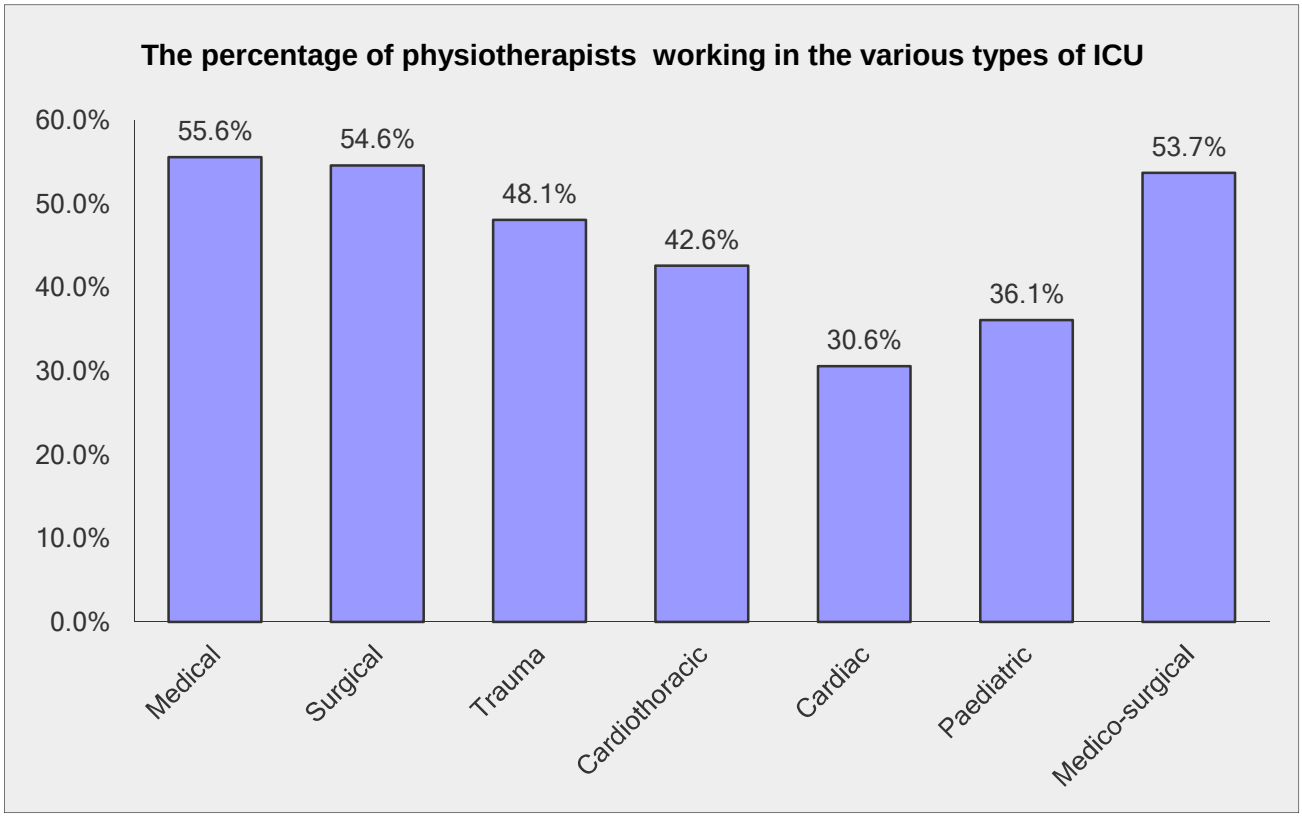

Figure 4.3: The Percentage of Physiotherapists Working in the Various types of ICU

The amount of ICU beds in a hospital ranged from four to 90 beds. The total amount of beds actively used in respondents' ICUs varied from less than six to more than 18; the most prevalent being 18 beds and the least prevalent being less than 6 beds (Figure 4.4).

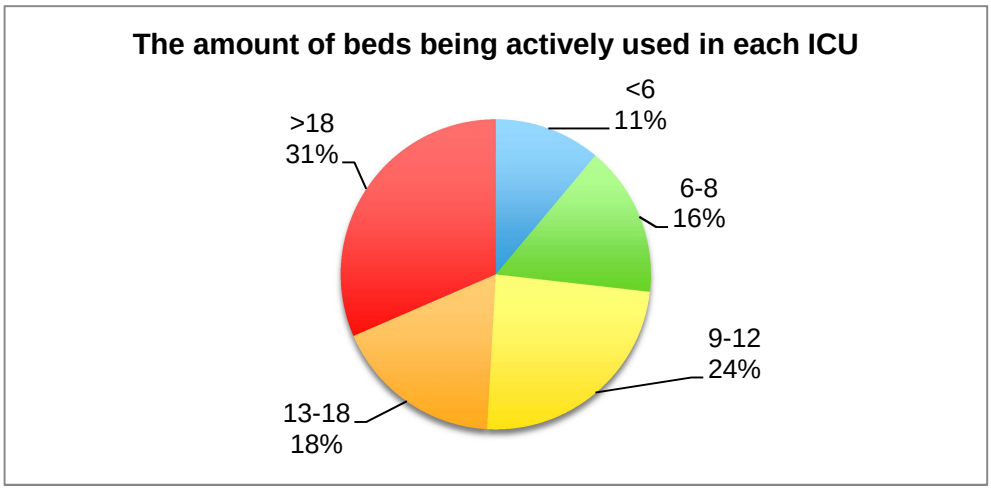

Figure 4.4: The Amount of Beds being Actively Used in Each ICU

A small number of respondents (n=4; 3.7%) worked exclusively in paediatric ICU and 28 respondents (25.9%) worked exclusively in adult ICUs. The remainder (n=76; 70.4%) of the respondents worked in both paediatric and adult ICUs.

The number of physiotherapists working in each ICU varied from one (18%) to more than four (44%). Majority of respondents (n=101; 93.5%) worked in ICU part-time as they had patients to see in other wards in the hospital.

4.2 PHYSIOTHERAPY SERVICE PROVISION TO CRITICAL CARE UNITS IN SOUTH AFRICA

Respondents reported that patients in ICU were referred for physiotherapy by doctors or nurses (n=59; 54.6%) in most cases or that the physiotherapist working in ICU screened the patients to determine if they required physiotherapy (n=49; 45.4%).

An after-hours physiotherapy service was provided to ICU patients by 78 (72.2%) of the respondents during the week. Five (6%) of the physiotherapists were required to remain on the hospital premises when they provided an after-hours service. The physiotherapist on call was either contacted by phone (n=59; 93.7%) or pager (n=4; 6.3%). Thirty three (52.4%) of the respondents indicated that there were specific criteria as to which patients could be referred for after-hours physiotherapy. Respondents stated that patients were referred for after-hours physiotherapy by nursing staff (n=13; 20.0%), doctors (n=58; 89.2%), consultants (n=31; 47.7%), registrars (n=20; 30.8%) and interns (n=13; 20%).

One hundred and five (97.2%) of the respondents provided a physiotherapy service for ICU patients over the weekend. Physiotherapists were contacted for referrals either by phone (n=99; 96.1%) or by pager (n=4; 3.9%). Forty-one (38.7%) of the respondents indicated that there were specific criteria as to which patients could be referred to weekend physiotherapy services. Two (1.9%) of these respondents only provided a physiotherapy service on Saturdays and two (1.9%) only on Saturdays and Sundays. One of the physiotherapists provided an after-hours service only on public holidays. The rest (n=100; 95.2%) of the respondents provided a weekend physiotherapy service to ICU patients on Saturdays, Sundays and public holidays. Patients in ICU who required weekend physiotherapy were referred by nursing staff (n=39; 37.1%), physiotherapists (n=50; 47.6 %%), doctors (n=102; 97.1%), consultants (n=48; 45.7%), registrars (n=33; 31.4%) and interns (n=20; 19.0%).

4.3 TECHNIQUES USED BY SOUTH AFRICAN PHYSIOTHERAPISTS FOR ASSESSMENT OF CRITICALLY ILL PATIENTS

The participants were asked how often they used various methods of assessment to assess patients in ICU. The participants could select responses indicating either ‘never’, ‘almost never’, ‘sometimes’, ‘fairly often’ or ‘very often’ (Table 4.1).

An assessment technique that was performed ‘very often’ by respondents was an ICU chart assessment (n=90, 83.3%), auscultation (n=94, 81, 8%) and strength of cough effort (n=81, 75%). Assessment techniques that were ‘almost never’ or ‘never’ used included assessment of lung compliance (n=75; 69.4%), calculation for the presence of hypoxemia (n=74; 68.5%) and patient readiness for weaning (n=63; 58.3%). One (0.9%) of the physiotherapists never conducted an ICU chart assessment. Assessment of the patient’s chest x-ray and CT scan were performed ‘very often’ by 73 (67.6%) of the respondents.

Table 4.1: The Frequency with which Respondents Used Each Assessment Method in ICU

Assessment Technique	Never	Almost Never	Sometimes	Fairly Often	Very Often
ICU chart review	1	0	5	12	90
Arterial blood gas analysis	3	6	15	24	60
Calculation of lung compliance	39	36	18	8	7
Calculation for the presence of hypoxemia	45	29	20	9	5
X-ray/CT scan	0	0	7	28	73
Auscultation	0	1	2	11	94
Strength of cough effort	4	3	7	13	81
Thoracic expansion	3	9	20	22	54
Percussion note to assess quality of lung tissue	29	24	24	17	14
Respiratory muscle strength (MIP)*	25	24	25	18	16
Readiness for weaning (RSBI)**	39	24	17	15	13
Readiness for mobilization using specific criteria	7	10	15	33	43
Peripheral muscle strength (dynamometry or Medical Research Scale)	30	16	21	19	22
Need for humidification	22	13	25	20	28

*MIP - Maximum Inspiratory Pressure

**RSBI - Rapid Shallow Breathing Index

4.4 TREATMENT TECHNIQUES USED BY SOUTH AFRICAN PHYSIOTHERAPISTS IN ICU

Treatment techniques performed by respondents 'very often' included manual chest clearance techniques (n=101, 93.5%), mobilising a patient in bed (n=91, 84.3%), positioning a patient in bed (n=91, 84.3%), airway suctioning (n=89, 82.4%), mobilising a patient out of bed (n=84, 77.8%), deep breathing exercises (n=83, 76.9%) and peripheral muscle strengthening exercises (n=79, 73.1%). Treatment techniques that were 'never' or 'almost never' used included the flutter device (n=77, 71.3%), implementation and supervision of non-invasive ventilatory support (n=77, 71.3%) and adjustment of mechanical ventilation settings for respiratory muscle training (n=76, 70.4%).

Only one (1%) participant was involved in intubating ICU patients. Sixty five (60.20%) of the respondents were involved in extubation of patients. Eighty four (77.80%) of the respondents were not involved in changing their patients tracheostomy tubes.

Table 4.2 The Frequency with which Respondents Used Various Treatment Techniques in their Management of Critically Ill Patients

Physiotherapy Technique	Never	Almost Never	Sometimes	Fairly Often	Very Often
Manual chest clearance techniques (percussions, vibrations, shaking)	2	0	1	4	101
Postural drainage/modified postural drainage	2	2	12	25	67
Airway suctioning	1	0	2	16	89
Manual hyperinflation (ambubagging)	14	26	33	20	15
Intermittent positive pressure breathing (IPPB)	27	19	28	21	13
Incentive spirometery	19	7	24	21	37
Active cycle of breathing techniques	5	6	15	26	56
Inspiratory muscle training (threshold device/ devices by other manufacturers)	31	23	23	15	16
Flutter device	46	31	17	11	3
Blow bottle	20	11	16	30	31
Blowing up a glove	33	6	31	18	20
Deep breathing exercises	2	0	2	21	83
Nebulization	2	4	7	43	52
Mobilizing a patient in bed	0	1	0	16	91
Mobilizing a patient out of bed	0	2	6	16	84
Positioning a patient in bed	0	0	5	12	91
Positioning a patient out of bed	0	3	8	18	79
Peripheral muscle strengthening exercises	2	0	5	29	72
Adjustment of mechanical ventilation settings for respiratory muscle training	53	23	15	13	4
Active involvement in weaning a patient from mechanical ventilation	39	24	16	16	13
Implementation and supervision of non-invasive ventilator support (CPAP, BiPAP)*	55	22	13	15	3

***CPAP=Continuous positive airway pressure, BiPAP = Bilevel Positive airway pressure

4.5 COMPARISON OF PHYSIOTHERAPY TREATMENT MODALITIES USED IN SOUTH AFRICAN ICUS WITH RESULTS FROM OTHER SURVEYS

To see whether physiotherapy practice in ICU in South Africa is similar to or different from international physiotherapy practice a comparison was made between the results of the current survey and that reported by Norrenberg and Vincent (2000) (Table 4.3). In the study by Norrenberg and Vincent, the participants were given three options to indicate the frequency with which they used each technique namely 'yes', 'rarely' and 'no'. In this study the participants selected responses that ranged from 'never', 'almost never', 'sometimes', 'fairly often' to 'very often' to indicate how often they used each of the treatment techniques (Table 4.2). In order to compare the results from the two studies 'never' and 'almost never' were regarded as 'no' and 'sometimes', 'fairly often' and 'very often' were regarded as 'yes'.

Table 4.3: A Comparison of Physiotherapy Techniques used by the Respondents in the Study by Norrenberg and Vincent (2000) and the Current Study

Treatment Technique	Europe		South Africa 2014		P-Value
	Yes	No	Yes	No	
Respiratory treatment	98%	2%	98%	2%	1
Suctioning	70%	16%	99%	1%	0.00
IPPB/NIPPV*	46%	29%	57%	43%	0.56
Intubation	1%	90%	1%	99%	0.95
Extubation	25%	50%	60%	40%	0.00
Adjustment of mechanical ventilation	12%	65%	30%	70%	0.02
Weaning from mechanical ventilation	22%	56%	42%	58%	0.06
Mobilising	100%	0%	99%	1%	0.32
Positioning	90%	1%	99%	1%	0.95

*IPPB = Intermittent Positive Pressure Breathing
NIPPV = Non-Invasive Positive Pressure Ventilation

The differences in the practice of suctioning, involvement in extubating patients and adjustment of mechanical ventilator settings were statistically significant ($p < 0.05$) when comparing results from the study by Norrenberg and Vincent and the current study. The practice of adjusting a patient's mechanical ventilator settings was statistically significant between the two studies but still not performed frequently in either study.

To establish whether physiotherapy scope of practice in ICU in South Africa had changed over the past seven years or not, a comparison was made between results of the study published by Van Aswegen and Potterton (2005) and the current study (Table 4.4).

Table 4.4: A Comparison of Physiotherapy Techniques used by the Respondents in the Current Study and that Reported by Van Aswegen and Potterton (2005)

Treatment Technique	South Africa 2005		South Africa 2014		P-value
	Yes	No	Yes	No	
Respiratory treatment	98%	2%	98%	2%	1
Suctioning	98%	2%	99%	1%	0.56
IPPB/NIPPV*	28%	72%	57%	43%	0.00
Intubation	2%	98%	1%	99%	0.56
Extubation	65%	35%	60%	40%	0.46
Adjustment of mechanical ventilation	15%	85%	30%	70%	0.01
Weaning from mechanical ventilation	19%	81%	42%	58%	0.00
Mobilising	98%	2%	99%	1%	0.56
Positioning	95%	5%	99%	1%	0.1
Blow bottle	70%	30%	71%	29%	0.88
MHI*	75%	25%	63%	37%	0.07
IS*	46%	54%	76%	24%	0.00

*IPPB = Intermittent Positive Pressure Breathing
NIPPV = Non-Invasive Positive Pressure Ventilation
MHI = Manual Hyperinflation
IS = Incentive Spirometry

The respondents in the study by Van Aswegen and Potterton (2005) were given the option to answer ‘yes’ or ‘no’ to indicate whether they used certain physiotherapy treatment techniques in ICU or not. In the current survey the participants selected responses that ranged from ‘never’, ‘almost never’, ‘sometimes’, ‘fairly often’ to ‘very often’ to indicate how often they used each of the treatment techniques (Table 4.2). In order to compare the results from the two studies ‘never’ and ‘almost never’ were regarded as ‘no’ and ‘sometimes’, ‘fairly often’ and ‘very often’ were regarded as ‘yes’.

When comparing results from the study by Van Aswegen and Potterton (2005) to the current study the differences in the use of IPPB/NIPPV, adjustment of mechanical ventilator settings, active involvement in weaning patients from the mechanical ventilator and IS were statistically significant ($p < 0.05$).

4.6 INTERACTION OF SOUTH AFRICAN PHYSIOTHERAPISTS WITH THE MULTI-DISCIPLINARY TEAM IN ICU

Sixty (55.60%) of the respondents reportedly attended ward rounds in ICU. The frequency of attendance is summarised in figure 4.5. The majority attended ward rounds on a daily or weekly basis.

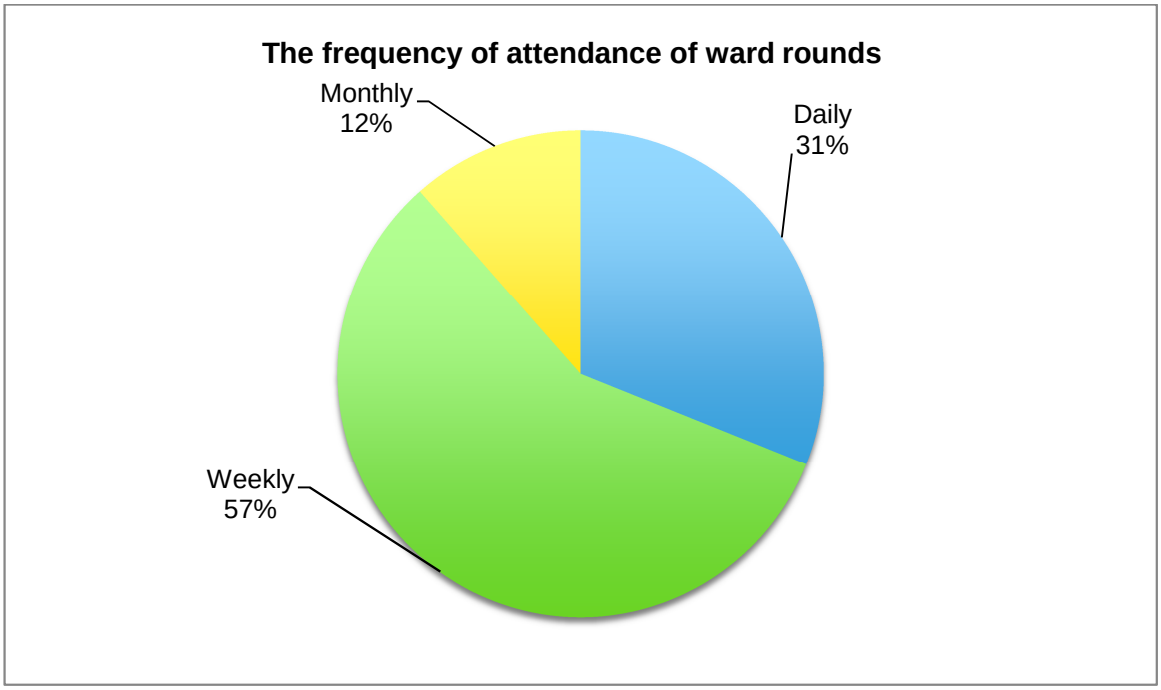

Figure 4.5: The Frequency of Attendance of Ward Rounds

Only 9 (8.3%) of the respondents attended morbidity and mortality meetings held in their ICU.

4.7 CONTINUOUS PROFESSIONAL DEVELOPMENT OF ICU PHYSIOTHERAPISTS IN SOUTH AFRICA

Fifty six (46.30%) of the respondents held a post-graduate qualification related to cardiopulmonary physiotherapy. Figure 4.6 shows the percentage of physiotherapists with the type of post-graduate qualifications.

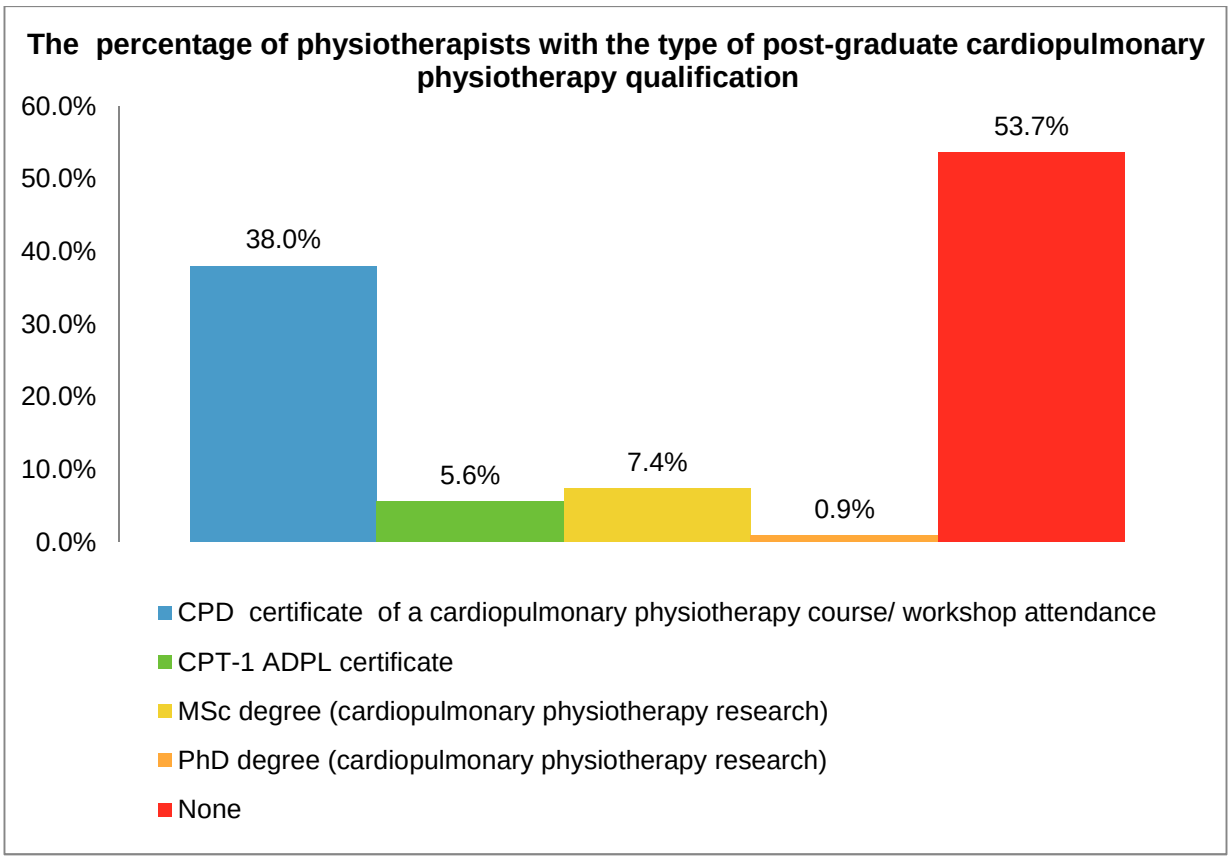

Figure 4.6: The Percentage of Physiotherapists with the Type of Post-Graduate Cardiopulmonary Physiotherapy Qualification

Forty nine (45.4%) of the respondents attended an ICU related continuous professional development (CPD) lecture within the last year. Figure 4.7 indicates when last the physiotherapists attended an ICU related CPD lecture.

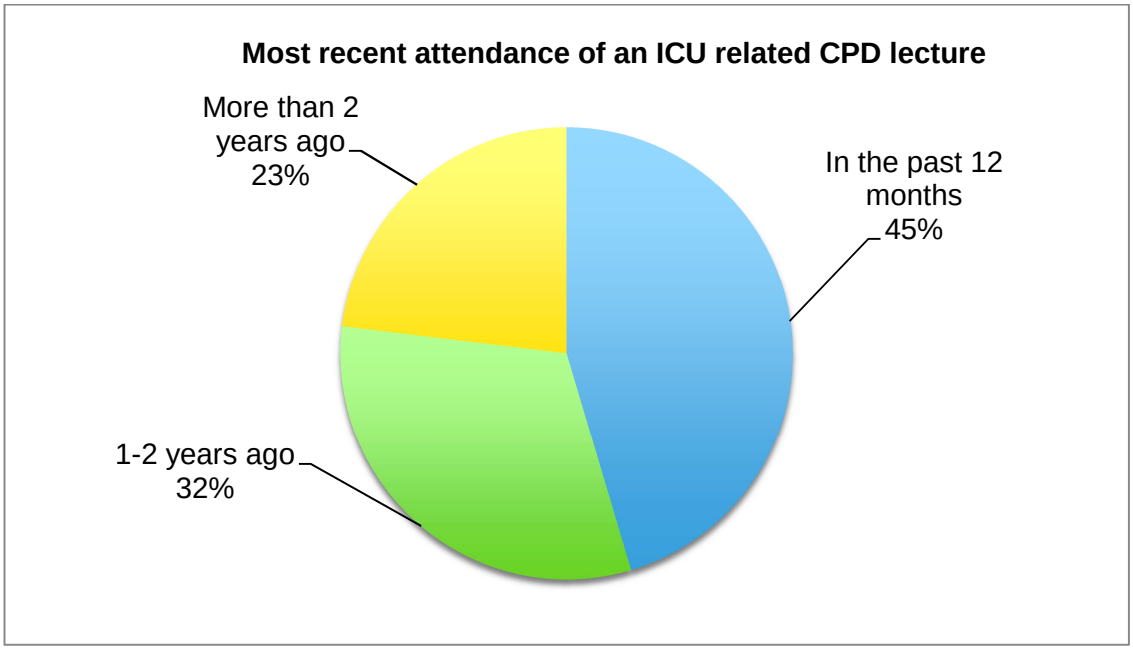

Figure 4.7: Most Recent Attendance of an ICU related CPD Lecture

Thirty seven (34.3%) of the respondents were involved in student training. Thirty six (33.3%) of the respondents were involved in training of other members of the multi-disciplinary team in ICU. Thirty two (29.6%) of the respondents presented seminars on the role of physiotherapists in their hospitals. Some of the respondents were involved in more than one of these activities.

Majority of respondents were involved with in-service training of colleagues such as training of junior physiotherapists to work safely in ICU (n=51, 47.2%) and training of all other physiotherapists at their hospital or their own practice to work safely in ICU (n=55, 50.9%).

The results reported here will be discussed in chapter five and compared with evidence from the literature.

CHAPTER 5

5. DISCUSSION

The only previous study to investigate the scope of practice of physiotherapists in ICU in South Africa was done in 2005 by Van Aswegen and Potterton. The study by Van Aswegen and Potterton (2005) was a pilot study and the questionnaire used was not validated and no follow-up study has been done. This study provides data to help establish the scope of practice of physiotherapists working in ICU in South Africa. The results from this study were compared with those from the previous study by Van Aswegen and Potterton (2005), the study by Norrenberg and Vincent (2000) and international studies that examined physiotherapy practice in ICU.

5.1 RESPONSE RATE OF THE CURRENT STUDY

The response rate of survey based studies may influence the standard and quality of research, it is important to know if a survey-based study has a high non-response bias (Fincham 2008). A response rate of 60% should be the goal for all survey-based studies. A low response rate results in a high non-response bias. A survey with a response of only 30% has a 70% non-response bias (Fincham 2008). The current study carries a 66% non-response bias. In the study by Norrenberg and Vincent (2000) the poor response resulted in a 78% non-response bias compared to the 40% non-response bias in the study by Van Aswegen and Potterton (2005). The current study had a lower non-response bias than the study by Norrenberg and Vincent (2000) but it was still much higher than the study by Van Aswegen and Potterton (2005). Due to the high non-response bias the results of this study should be interpreted with caution.

5.2 ASSESSMENT OF THE ICU PATIENT

In the surveys conducted by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005) there were not any questions related to the practice of patient assessment by physiotherapists and therefore direct comparison between the results of the current survey and these two surveys is not possible. Patient assessment forms part of training of physiotherapy students (WCPT 2011). It is essential that physiotherapists in ICU assess their patients thoroughly before treating them (Berney et al. 2012). Since physiotherapists are first line practitioners in South Africa and are therefore required to assess their patients appropriately, it was decided to include questions on patient assessment techniques used in ICU in this survey. The respondents were given a list of assessment techniques and asked to indicate how often they used each technique. No previous surveys investigating physiotherapy assessment of the ICU patient were found.

As discussed in chapter two, literature suggests that a multi-system assessment of an ICU patient assists the physiotherapist in identifying potential problems and precautions and contra-indications to treatment (Gosselink et al. 2008; Berney et al. 2012). Intensive care unit charts in most South African ICUs have information regarding the patient's vital signs and cardiac rhythms, arterial blood gas results, ventilator support, blood results, fluid balance and medications administered over the past 24 hours. It also contains information on the patient's change in status as recorded by the nursing staff and plans for the patient's management as recorded by doctors and other members of the ICU multi-disciplinary team; therefore reviewing the chart will aid the physiotherapist to gain insight into the patient's condition. Most of the respondents in this study conducted an ICU chart assessment which is in keeping with the recommendations by Gosselink et al. (2008) and Berney et al. (2012) to perform a multi-system assessment of ICU patients.

Reduced dynamic lung compliance (50-80 ml/cmH_2O) indicates resistance of airflow out of the lungs due to retention of excess secretions in the airways, bronchospasm, atelectasis, pneumonia, pulmonary oedema or acute respiratory distress syndrome (Kacmarek et al. 2013, pg. 230-231). Thus dynamic compliance is a useful calculation to determine the presence of reduced lung compliance or not. Chest physiotherapy techniques to mobilise retained pulmonary secretions and nebulisation with bronchodilators can improve dynamic lung compliance (Kacmarek et al. 2013, pg. 966). Hypoxaemia indicates insufficient oxygen reaching the blood resulting in a decreased partial pressure of oxygen in the arterial blood (Kacmarek et al. 2013, pg. 320). Hypoxaemia may be as a result of interstitial lung disease (hypoxic hypoxaemia) or the inability of haemoglobin to transport oxygen to the tissues (anaemic hypoxaemia) (Kacmarek et al. 2013, pg. 320). Respiratory diseases affecting the alveolar membrane or retained secretions prevent diffusion of oxygen across the alveolar membrane and result in a diffusion defect (Kacmarek et al. 2013, pg. 251-253). Hypoxic hypoxaemia occurs when the diffusion defect of oxygen across the alveolar membrane is more than 10 mmHg in spontaneously breathing patients and less than 65 mmHg in patients receiving 100% oxygen (Kacmarek et al. 2013, pg. 251-253). Physiotherapy cannot have any direct effect on anaemic hypoxia as the patient would require a blood transfusion to increase their haemoglobin. Physiotherapy techniques can help reduce hypoxic hypoxaemia by positioning the patient to improve ventilation perfusion (V/Q) matching, mobilisation, manual chest physiotherapy techniques, manual hyperinflation and IS (Frownfelter and Dean 2006). If the physiotherapist is unaware of the patient's oxygenation status they will not be certain if the patient can be mobilised safely. Many of the physiotherapists in this study did not assess their patients' lung compliance or for the presence of hypoxaemia which is concerning. Physiotherapists should be encouraged to assess their patients' lung compliance and for the presence of hypoxaemia prior to

treatment to monitor their response to chest physiotherapy interventions and to ensure that they can be mobilised safely.

Chest x-rays and CT scans enable physiotherapists to view structural abnormalities of the lungs and surrounding tissues and pathologies such as atelectasis, retained secretions and reduced lung volumes. X-rays or CT-scans also assist physiotherapists to identify injuries outside of the thoracic cage in patients who suffered trauma-related injury. These findings may help support what the physiotherapist has found during their objective assessment of their patient. Since physiotherapists are first line practitioners it is essential that they are able to interpret chest x-rays and CT scans (Pryor and Prasad 2008, pg. 17; Kacmarek et al. 2013, pg. 451). All of the physiotherapists in this study assessed their patients' x-rays or CT scans which is very positive as it is important to conduct a thorough assessment of ICU patients prior to treatment.

Chest auscultation provides the physiotherapist with vital information regarding the patient's lungs. When auscultating, the physiotherapist can assess the patient's breaths sounds for any areas of decreased air entry and added sounds for the presence of secretions or bronchospasm. Auscultation of the lungs is an easy and non-invasive method of assessment providing vital information regarding the patients' ventilation (Pryor and Prasad 2008, pg. 14; Kacmarek 2013, pg. 347). Majority of the respondents in this study auscultated their patients' lungs. Auscultation of patient's lungs provides essential information concerning the patient's ventilation and which physiotherapy techniques are required to address the respiratory problem.

Assessment of the patients' strength of cough effort indicates if the patient is able to clear secretions effectively or if they require suctioning (Kacmarek et al. 2013, pg. 334). If the patient is unable to take in a deep breath or has respiratory muscle weakness their cough effort may be reduced. This occurs in patients with neuromuscular disease, pain, bronchospasm and prolonged MV (Kacmarek et al. 2013, pg. 334). Majority of the respondents in this study assessed their patient's strength of cough effort. An ineffective cough will result in inability of the patient to clear retained secretions and may put the patient at risk of a secondary chest infection or development of lung volume loss due to obstruction of the airways; thus it is important to assess. Assessment of the patients cough is important prior to extubation to prevent weaning failure (Gosselink et al. 2011).

Thoracic expansion evaluates expansion of the chest cavity during deep inspiration (Kacmarek et al. 2013, pg. 247). The expansion should be symmetrical and larger basally than apically. This is done anteriorly by the physiotherapist placing their hands on the patient's anterolateral chest wall with their thumbs extended towards the xiphoid process and posteriorly by placing their hands on the posterolateral chest wall with thumbs approximating at the eighth thoracic vertebra (Kacmarek et al. 2013, pg. 247). The patient is then instructed to exhale completely followed by a deep breath. Basal thoracic expansion should be three to five centimetres (Kacmarek et al. 2013, pg. 247). Thoracic expansion may be decreased in patients with consolidation, atelectasis, pain, neuromuscular disease or pleural disease (Kacmarek et al. 2013, pg. 247). Thoracic expansion is an essential assessment method to gain insight in to the patient's lung expansion and it was encouraging that most of the respondents in this study assessed their patient's thoracic expansion.

Calculating the patients RSBI and MIP can help physiotherapists to assess their patient's readiness to wean from MV (Martin et al. 2002; Tobin et al. 2009, Kacmarek et al. 2013, pg. 1172-1173; Patsaki et al. 2013). The RSBI calculates the ratio of respiratory rate to the tidal volumes of the patient. A RSBI of below 100 has been associated with successful weaning from a mechanical ventilator (Pryor and Prasad 2008, pg. 276, 301; Tobin et al. 2009; Haas and Loik 2012). Maximal inspiratory pressure provides information regarding the maximal output of the inspiratory muscles. An increase in MIP would indicate an increase in inspiratory muscle strength (Kacmarek et al. 2013, pg. 1173; Patsaki et al. 2013). An increase in inspiratory muscle strength has been shown to facilitate weaning from MV (Martin et al. 2002) thus an increase in MIP should assist weaning from MV. It is therefore important that physiotherapists assess patients' RSBI and MIP to determine if they are ready to wean as physiotherapist driven weaning protocols have been shown to be effective. The implementation of a nurse and physiotherapist led weaning and extubation protocol in a trauma ICU in Gauteng was shown to be safe and lead to a clinically significant reduction in MV time (Plani et al. 2013). Complications resulting from prolonged MV include ventilator associated pneumonia, increased mortality, respiratory muscle weakness, peripheral muscle weakness and prolonged ICU and hospital stay (De Jonghe et al. 2007; Plani et al. 2013). Thus it is important that patients are weaned and extubated as soon as possible to avoid complications of prolonged MV. Physiotherapy driven weaning protocols have been shown to be safe and effective thus physiotherapists should be more involved in weaning patients from the MV.

The mucus membranes of the upper airways warm and humidify inspired air which is essential to prevent mucus from becoming too viscous and to promote mucociliary

transport (Pryor and Prasad 2008, pg. 176). Patients that are receiving supplemental oxygen via non-invasive ventilation (Esquinas Rodriguez et al. 2012) and artificial airways connected to mechanical ventilators (Branson 2007; Solomita et al. 2009) require adequate humidification to prevent secretions from becoming too viscous. When physiotherapists suction their patients they are able to evaluate the viscosity and amount of secretions the patient has. The physiotherapist should recommend humidification in patients that have viscous secretions to enhance secretion clearance. Only two thirds of the respondents in this study assessed their patients for the need for humidification. Physiotherapists should be made aware of the importance of humidification and recommend it when necessary.

As discussed in chapter two, early mobilisation in ICU improves the patient's short- and long-term outcomes (Hanekom et al. 2011). Individual patient assessment is required prior to mobilising a patient to determine if the patient is ready to mobilise (Hanekom et al. 2011). Assessment of ICU patients' peripheral muscle strength can be done using handheld dynamometry (Baldwin et al. 2012). Assessment of peripheral muscle strength aids physiotherapists in detecting and quantifying muscle weakness (Baldwin et al. 2012). No research was found regarding the frequency of the use of peripheral muscle strength testing using dynamometry in ICU. Only 57% of the participants in this study assessed their patient's peripheral muscle strength but no information was obtained as to how muscle strength was measured.

Hanekom et al. (2011) developed an algorithm to guide physiotherapists when mobilising patients in ICU. This divided patients into three categories namely: the unconscious patient, the physiologically stable awake patient and the deconditioned patient. Thorough assessment of an ICU patient prior to mobilisation is essential to establish within which of these categories a patient fits. This will ensure that the treatment given is safe and appropriate (Hanekom et al. 2011). Majority of the respondents in this study assessed their patient's readiness to mobilise but there were still a few that did not. Most of the respondents mobilised their patients so it is concerning that there are still physiotherapists that do not assess their patients readiness to mobilise prior to mobilising.

5.3 PHYSIOTHERAPY TREATMENT TECHNIQUES USED IN ICU

5.3.1 Rehabilitation in Intensive Care Units

Majority of the respondents in this study mobilised their ICU patients in or out of bed. In the study by Van Aswegen and Potterton (2005) 98% of the respondents indicated that they mobilised their ICU patients. In the study by Norrenberg and Vincent (2000) 100% of the respondents mobilised their ICU patients. When comparing the three studies, there was no statistical difference between them regarding mobilising patients in ICU ($p > 0.05$). Early

mobilisation has been shown to be safe and effective and advantageous to patient outcome (Bailey et al 2009). The importance of mobilisation of patients in ICU was discussed in more detail in chapter two. As mentioned previously, early mobilisation of patients in ICU improves their short-term and long–term outcomes (Hanekom et al. 2011). All three studies are in keeping with the latest evidence.

5.3.2 Physiotherapy Techniques that Assist with Mobilisation of Secretions

Nebulisation with mucolytics such as saline (0.9% NaCl) can assist with mobilising secretions and bronchodilators such as short and long acting beta-2 agonists reduce bronchospasm (Kacmarek et al. 2013, pg. 1242). The use of nebulisation was not assessed in the two previous studies. Majority of the physiotherapists in this study indicated that nebulisation forms part of their patient treatment in ICU. No comparison can be made between the results of this study and those of the previous two surveys.

More of the respondents in this study used postural drainage as part of the treatment of ICU patients in comparison to the study by Van Aswegen and Potterton (2005). Since postural drainage is effective in mobilising retained pulmonary secretions (Pryor and Prasad 2008, pg. 123) current practice seems to be in keeping with evidence based practice regarding the use of postural drainage in ICU.

A combination of postural drainage, manual chest physiotherapy techniques and airway suctioning was shown to reduce the incidence of ventilator associated pneumonia (VAP) in patients that were ventilated for more than 48 hours (Ntoumenopolous et al. 2002) and may result in short-term improvements of pulmonary function (Stiller 2013). Manual chest clearance techniques were performed by the majority of the respondents in the study by Norrenberg and Vincent (2000) and in the study by Van Aswegen and Potterton (2005) as well as in the current study. The abovementioned evidence may be a reason for the frequent use of manual chest clearance techniques by physiotherapists in ICU. These techniques are mainly used in sedated uncooperative patients in ICU.

Airway suctioning is essential in the removal of pulmonary secretions in the intubated patient to maintain a patent airway (Stiller 2013). As mentioned in chapter two, suctioning may result in adverse side-effects such as hypoxaemia, haemodynamic instability and tracheobronchial injury and care must be taken to avoid these adverse effects (Stiller 2013). Suctioning was performed by majority of the respondents in the study by Van Aswegen and Potterton (2005) and the current study. Fewer of the respondents suctioned their patient’s in the study by Norrenberg and Vincent (2000). An explanation for this finding may be because suction is regarded as a nursing procedure in Europe. As mentioned in

the literature review chapter, patients that are intubated or unable to clear retained pulmonary secretions require endotracheal suctioning to maintain a patent airway and reduce the risk of pulmonary complications (Ntoumenopoulos 2008; Stiller 2013). Majority of the respondents in this study suctioned their patients which seem to be in line with the previous results of Van Aswegen and Potterton (2005).

Active cycle of breathing technique has been shown to decrease length of stay in ICU, decrease time that non-invasive ventilation was required, decrease atelectasis and increase FVC in patients who had coronary artery bypass graft surgery (Savci et al. 2006). This technique is easy to apply and can be used on both intubated and non-intubated patients providing they are awake and able to understand how to perform the technique (Savci et al. 2006; Kacmarek et al. 2013, pg. 976). Active cycle of breathing technique was used by 76% of the physiotherapists in this study. The use of ACBT by physiotherapists working in ICU was not assessed in the study by Norrenberg and Vincent (2000) or Van Aswegen and Potterton (2005). The frequent use of ACBT in this study is in keeping with the latest evidence.

5.3.3 **Physiotherapy Techniques that Improve Lung Capacities and Volumes**

The goal of positioning a patient was not specified in this study. In patients that are spontaneously breathing the dependent (lower) zones of the lung are preferentially ventilated. This is reversed in patients that are ventilated as in this case patients apical zones are preferentially ventilated (Kacmarek et al. 2013, pg. 1048-1049). Mechanical ventilation increases the intrathoracic pressure and decreases the cardiac output and venous return which results in a V/Q mismatch. Positioning of a patient in ICU can be used to optimise ventilation, recruit alveoli and improve lung perfusion (Gosselink et al. 2008). Functional residual capacity is greatest in the standing position and the least in supine (Frownfelter and Dean 2006). Optimal positioning for V/Q matching is the upright position thus it is recommended that patients are sitting and if this is not possible due to the patient's condition a head up tilt is recommended (Chang et al. 2005; Frownfelter and Dean 2006). Majority of the respondents in the studies by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005) and the current study positioned their patients, however the goal of positioning was not stated. Further investigation is recommended in to the use of positioning patients in ICU to optimise V/Q matching and increase FRC.

In chapter two, MHI was discussed and evidence suggests it to be effective in mobilising secretions (Hodgson et al. 2000; Berney and Denehy 2002), increasing tidal volumes, improving static lung compliance (Choi and Jones 2005), and improving alveolar recruitment (Maa et al. 2005) in intubated and non-intubated patients. Care should be taken

that MHI is safe to use on patients (refer to section 2.4.2.2.2 of chapter two). Sixty three percent of the respondents in this study used MHI as a treatment technique which is less than the 75% in the study by Van Aswegen and Potterton (2005). The use of MHI was not examined in the study by Norrenberg and Vincent (2000). The decrease in the use of MHI is concerning as it has been shown to be an effective treatment technique to use in appropriately selected patients in ICU.

Blow bottles are often used as bubble-PEP devices to help improve lung capacity (Filbay et al. 2012). A bubble-PEP device is an oscillatory PEP device through which a patient exhales. Exhalation against resistance aids in splinting open partially collapsed airways and enhances the lungs' FRC. The use of blow bottles in the study by Van Aswegen and Potterton (2005) was slightly lower than in the current study. Many of the respondents' patients may have been intubated and therefore would not be able to use a blow bottle which might explain the findings of this study.

Sixty-four percent of the respondents in this study used blowing up a glove as a treatment technique however there is no research evidence for the effectiveness of this technique. When blowing up a glove there is no way to monitor and control the PEP delivered to the peripheral airways by the resistance of the glove and the researcher assumes that the PEP would increase as the glove is blown up. Blowing up a glove is not safe as there is no way to control the PEP that the patient receives and therefore its use should be discouraged.

The flutter device has been shown to assist with sputum clearance in patients with cystic fibrosis (Morrison and Agnew 2011). Research in the use of the flutter device is mainly on patients with chronic lung disease. There are many alternative physiotherapy techniques that assist in the mobilisation of secretions which may be the reason that only a few of the respondents used a flutter in ICU. Physiotherapists that took part in this survey may also not have seen many patients with chronic respiratory disease in their ICUs which would explain the low incidence of use of this device. Another reason for a flutter device not being used frequently is the cost associated with the device as each patient would require their own device. The use of a flutter device was not assessed in the studies by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005).

Incentive spirometry has been shown to assist with lung re-expansion in patients who have undergone thoracic surgery (Agostini and Singh 2009) and to improve respiratory muscle strength, lung function and functional capacity when combined with expiratory positive airway pressure in patients who had thoracic surgery and were intubated for less than 24 hours (Haeffener et al. 2008). The use of IS in South Africa has increased dramatically since the study by Van Aswegen and Potterton (2005). The use of IS was not assessed by

Norrenberg and Vincent (2000). Some of the respondents may have indicated that they do not use IS as it was not an appropriate treatment to use for their patients and incentive spirometers may not be available in all government hospitals due to cost associated with the fact that each patient requires their own device. Majority of the participants in this study that used IS worked in surgery and cardiothoracic surgery ICU which may be the reason for the frequent use of IS by the participants.

Intermittent positive pressure breathing assists in increasing tidal volumes and reduces shortness of breath and atelectasis in post-surgery patients (Denehy and Berney 2001). Intermittent positive pressure breathing is not suitable for all patients as discussed in chapter two. The use of IPPB by physiotherapists is higher in this study in comparison to the study by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005). Almost half of the respondents in this study did not use IPPB as part of patient care in ICU. A possible explanation for this finding could be lack of IPPB equipment in their hospitals or that IPPB was not appropriate for the types of patients that these respondents regularly saw in ICU.

5.3.4 **Physiotherapists' Involvement in Weaning of Patients from MV**

Inspiratory muscle training devices are costly and each patient requires their own device; this may account for IMT devices not being available in all government hospitals. As mentioned in chapter two the patient must be able to breath spontaneously for a short period when using such devices (Martin et al. 2002). This may explain why IMT was not used as frequently as other techniques by respondents to this survey. Respiratory muscle weakness in ICU was discussed in chapter two. This occurs in patients who are ventilated for a prolonged length of time and IMT can assist in strengthening inspiratory muscles (Martin et al. 2002); however further research is required. The use of IMT was not assessed in the study by Norrenberg and Vincent (2000) or Van Aswegen and Potterton (2005) and therefore direct comparison between these studies and the current study is not possible.

The researcher wanted to investigate if physiotherapists adjusted mechanical ventilator settings to strengthen respiratory muscles to prepare patients for weaning from MV. The adjustment of the settings of the mechanical ventilator would be done during treatment while the patient performs deep breathing exercises and would be returned to the patient's original settings after treatment. Majority of the respondents in the studies by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005) and the current study did not adjust patient mechanical ventilator settings for this purpose. There were however more respondents in the current study that adjusted MV settings compared to those in the study

by Van Aswegen and Potterton (2005) and this was statistically significant. Prolonged mechanical ventilation results in inspiratory muscle weakness and decreased inspiratory muscle endurance. As discussed in chapter two respiratory muscle training is recommended for patients who are mechanically ventilated (Moodie et al. 2011). Physiotherapists should be encouraged to include respiratory muscle training in their treatment of patients who undergo prolonged ventilation. Temporary adjustment of a patient's mechanical ventilator settings during deep breathing is an alternative if IMT devices are not available in the local ICU.

In this study weaning of patients from MV was regarded by the researcher as decreasing ventilatory support with the aim of extubation. With the question regarding 'adjustment of the mechanical ventilator' the researcher was referring to adjustment of the mechanical ventilator settings for respiratory muscle training (as discussed above) compared to this question where the researcher wanted to investigate the respondents involvement in weaning patients from MV. A physiotherapist driven weaning protocol used in a trauma ICU setting reduced the number of days that patients were mechanically ventilated and reduced the patient's length of stay in ICU (Plani et al. 2013). Although the number of physiotherapists who were actively involved with weaning of patients from the mechanical ventilators in this study was more than double that reported by Van Aswegen and Potterton (2005), physiotherapists could be more involved in weaning patients from mechanical ventilators.

5.3.5 **Physiotherapists' Involvement in Airway Management in ICU**

The vast majority of respondents in this study were not involved in intubation of patients in ICU. In the study by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005) majority of respondents were also not involved in intubation. Intubation is not part of the scope of practice of physiotherapists in South Africa (South African Medical and Dental Council 1976) and this could explain these findings. The one respondent that indicated that they were involved in intubation of patients may have been assisting with intubation for example giving oxygen to the patient using manual hyperinflation while the doctor was intubating. This study did not investigate how many years of experience each of the physiotherapists had and it is also not known whether this respondent had any formal training in intubating patients.

The involvement of physiotherapists in extubation of patients was similar in the study by Van Aswegen and Potterton (2005) and this study. Physiotherapist's involvement in extubating patients in the study by Norrenberg and Vincent was much less than in the study by Van Aswegen and Potterton (2005) and the current study. A possible explanation for

these findings is firstly that extubation forms part of the scope of practice of physiotherapists in ICU in South Africa (South African Medical and Dental Council 1976). Secondly, anecdotal evidence suggests that in Europe health care practitioners are of the viewpoint that if you remove a patient's artificial airway, you need to be able to safely insert another artificial airway if the patient becomes distressed. Since intubation doesn't form part of physiotherapy scope of practice in any country, the hesitance of physiotherapists to extubate patients in Europe is understandable especially if extubation is not specified as part of their scope of practice.

5.4 AFTER-HOURS PHYSIOTHERAPY SERVICES

In the current study majority of respondents reported offering an after-hours physiotherapy service to their ICUs. After-hours physiotherapy services are beneficial for patients that may deteriorate if left until the following day or after the weekend (Hough 2001). Weekend physiotherapy services are available to most ICUs in South Africa. Only half of the respondents were involved in training of physiotherapists in their hospital to ensure that they work safely in ICU after-hours. The study did not investigate how these physiotherapists were trained and if the physiotherapist training them was a senior physiotherapist. After-hours and weekend physiotherapy services in ICU are essential and it is encouraging that this seems to be the current practice in South Africa.

5.5 INTERACTION WITH THE MULTI-DISCIPLINARY TEAM IN ICU

Physiotherapists form part of the multi-disciplinary team in ICU and should be actively involved in the planning of patient management. Most of the respondents that attended ward rounds were from government, university affiliated or tertiary hospitals. Staff in these hospitals may be more academically orientated and inclined to involve members of the multidisciplinary team (MDT) in ward rounds. A minority of respondents in the current study attended morbidity and mortality meetings and most of these respondents were from government hospitals. This may be due to time limitations, staff shortages, physiotherapists not being involved in the multidisciplinary team and doctors may feel that it is not important for physiotherapists to attend morbidity and mortality meetings. Respondents working in private hospitals were less involved in ward rounds and morbidity and mortality meetings; this may be because of time limits or they may not be as involved in the MDT as compared to the respondents working in the government sector.

5.6 CONTINUOUS PROFESSIONAL DEVELOPMENT OF PHYSIOTHERAPISTS WORKING IN ICU

Continuous professional development is compulsory for all physiotherapists working in South Africa. Many professionals view CPD as a means of training and keeping up to date but instead they should see it as a life-long learning experience (Friedman and Phillips 2004). Attending courses assists physiotherapists to ensure that they are treating patients according to the latest evidence based practice. More than half of the respondents did not have a cardiopulmonary physiotherapy post-graduate qualification. Only 45.4% of the respondents had attended an ICU CPD lecture in the past 12 months and 31.5% had attended an ICU CPD lecture in the past 12-24 months. The attendance of a CPD programme should be encouraged particularly in the field in which the physiotherapist works.

Involvement in clinical student training encourages physiotherapists to ensure they are up to date with the latest evidence based practice. Respondents working in university affiliated hospitals had the highest rate of involvement in student training followed by government and tertiary hospitals with private hospitals having the least. Most of the respondents to this survey worked in private hospitals and this may account for the low percentage of physiotherapists involved with student training. A third of the respondents were involved in training of other members of the inter-professional team. Only 29.6% of the respondents were involved in presenting seminars on the role of physiotherapists in ICU in their hospital. Inter-professional training improves healthcare professionals' understanding and appreciation of the roles of the members of the MDT (Curran et al. 2007). It is important for other members of the inter-professional team to know the role of physiotherapists in ICU and their goals of management thus training the other members of the inter-professional team is vital.

Only 47.2% of the respondents were involved in training junior physiotherapists to ensure that they worked safely in ICU. Majority of the respondents in this study worked in private hospitals and may not have junior physiotherapists working with them. This may be the reason for many of the respondents not being involved in training of junior physiotherapists.

5.7 LIMITATIONS

Due to the poor response rate, this study carries a 66% non-response bias. A possible reason for the poor response rate could have been duplication of emails sent out to the participants. The secretary of the CPRG sent the questionnaire to all of its members however these members could have been government employed physiotherapists who had already been contacted regarding the study. Similarly some of the CPRG members who

work at Mediclinic, Life or Netcare hospitals could have been contacted already regarding the study.

Contacting the participants was a challenge as the researcher had to phone all the Mediclinic, Life, and Netcare hospitals with ICUs and enquire if they had physiotherapists working in their ICU in order to attain contact details of these physiotherapists. When contacting these hospitals the researcher phoned the unit manager of the ICUs of each hospital and not all the unit managers were prepared to give out the contact details of the physiotherapists servicing their ICUs. For the government hospitals the researcher had to rely on the head of department of physiotherapy to distribute the questionnaire to the relevant physiotherapists in their department.

Some of the treatment techniques may not have been appropriate for the respondent's patients for example IS and IPPB which can only be done on extubated patients. The respondents may have selected that they never use the technique because it was not suitable for their type of patients. The aim of positioning a patient was not stated in the questionnaire so it was not clear for what reason the respondents positioned their patients.

Some of the questions in this study may not have been clear to the respondents. The various aims of positioning a patient in bed were not stated. The questions regarding the adjustment of mechanical ventilator settings and weaning patients from MV may have been interpreted incorrectly by the respondents. The aim of these treatment techniques should have been more clearly stated to avoid incorrect interpretation by the respondents.

Most of the respondents to this study were from Gauteng and this may have created a bias. The researcher was unable to tell if there were multiple respondents from one hospital which might have also created a bias as the role of physiotherapists in ICU in a specific hospital would have been similar and access to resources such as IS, IPPB machines and IMT would have been the same. The years of experience of each respondent has not been investigated. Physiotherapists with more experience may be more involved in weaning and extubation but may not have participated in this survey. The respondents were not asked at which university they studied; if majority of the respondents studied at the same university it may have created a bias as they would have been taught the same assessment and treatment techniques.

Twelve percent of the respondents worked in ICU where more than half of their patients were paediatric patients. Depending on the age of the patients some of the treatment

techniques such as IPPB, IS, ACBT, the flutter device and deep breathing exercises might have not been appropriate and therefore may have influenced the results of this survey.

5.8 RECOMMENDATIONS FOR FUTURE STUDY

As mentioned above majority of the respondents of this study were from Gauteng. A future study with a more equal distribution of each of the provinces is recommended by involving the universities in each of the provinces to get into contact with their graduates and to enquire about their undergraduate curricula for ICU. Most of the respondents worked in private hospitals; a future study with a more equal distribution between government and private hospitals is recommended.

A more in-depth study into certain aspects of assessment techniques used in ICU with clearly stated aims should be done. In this study the aims of the phrases about positioning, mobilisation and adjustment of the mechanical ventilator were not clear; further research into these treatment techniques is recommended to obtain a clear idea of physiotherapists' use of these techniques.

In a future study the years of experience and where the respondent studied should be explored for more accurate data analysis.

A more in depth study into the physiotherapist’s role in rehabilitation in the ICU in South Africa is recommended.

Further investigation into after-hours and weekend physiotherapy services and how physiotherapists are prepared for these services is recommended. The type of patients that are treated over weekends or that qualify for after-hours call-out was not investigated in this study; further investigation is recommended.

CHAPTER 6

6. CONCLUSION

This study examined the scope of practice of physiotherapists working in ICU in South Africa. The respondents answered questions regarding the assessment and treatment techniques they use as well as their involvement in the MDT in ICU. The availability of physiotherapy services after-hours was also investigated.

Physiotherapists are first-line practitioners in South Africa and assessment of their patients is important for them to develop a treatment plan and to ensure that this treatment plan is safe and appropriate for their patient. This includes assessment of the patient's respiratory, cardiovascular, muscular, renal, haematological and neurological systems. Most of the respondents in this study conducted a multisystem assessment of their patients.

Physiotherapists are involved in treating patients in ICU with respiratory and musculoskeletal complications and to help reduce the incidence of these complications. A multimodal chest physiotherapy treatment plan includes percussions, vibrations, postural drainage, airway suctioning, MHI, IPPB, IS, ACBT, IMT, PEP therapy, deep breathing exercises and nebulisation. The composition of such a treatment plan should be informed by the needs of each patient. Early rehabilitation in ICU prevents complications of bed rest and reduces musculoskeletal complications in ICU. Passive movements, positioning of patients, strengthening exercises and mobilisation of patients are used to rehabilitate patients in ICU. Each patient's treatment should be based on the latest evidence-based practice to ensure that they receive the best treatment related to their condition.

Results from this study were compared to that of the studies by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005). There was a significant difference ($p < 0.05$) in the usage of IPPB/NIPPV, weaning patients from MV, adjustment of MV and IS between this study and the study by Van Aswegen and Potterton (2005) these techniques were used more frequently in the current study. The study showed a significant difference ($p < 0.05$) between the participants in the study by Norrenberg and Vincent (2000) and this study in the involvement in suctioning, extubation and adjustment of MV, these techniques were used more frequently in the current study. There was no statistical difference ($p > 0.05$) between this study and the study by Norrenberg and Vincent (2000) and Van Aswegen and Potterton (2005) for the remainder of the treatment techniques.

Physiotherapists who participated in this survey provide an after-hours and weekend service to patients in ICU who require immediate physiotherapy intervention to prevent deterioration of their condition. This practice is in line with evidence from the literature.

Although the response rate to this survey was poor, the questionnaire used in this study was content validated. Therefore its results could be used to develop preliminary clinical practice guidelines for physiotherapists working in ICU in South Africa.

REFERENCES

Agostini P, Singh S 2009 Incentive spirometry following thoracic surgery: what should we be doing? Physiotherapy 95 (2): 76 - 82

Ambrosino N, Jahan N, Vagheggini G 2011 Physiotherapy in critically ill patients. Portuguese Journal of Pulmonology 17 (6): 283 - 288

Anderson F A, Spencer F A 2003 Risk factors for venous thromboembolism. Circulation 107 (23): I9 - I16

Bailey P P, Miller R R, Clemmer T P 2009 Culture of early mobility in mechanically ventilated patients. Critical Care Medicine 37 (10): s429 - s435

Baldwin C E, Paratz J D, Bersten A D 2012 Muscle strength assessment in critically ill patients with handheld dynomometry: an investigation of reliability, minimal detectable change, and time to peak force generation. Journal of Critical Care 28 (1): 77 - 86

Berney S and Denehy L 2002 A comparison of the effects of manual and ventilator hyperinflation on static lung compliance and sputum production in intubated and ventilated intensive care patients. Physiotherapy Research International 7 (2): 100 - 108

Berney S, Haines K, Denehy L 2012 Physiotherapy in critical care in Australia. Cardiopulmonary Physical Therapy Journal 23 (1): 19 - 25

Branson R D 2007 Secretion management in the mechanically ventilated patients. Respiratory Care 52 (10): 1328 - 1347

Cader S A, De Souze Vale R G, Castro J C, Bacelar S C,Biehl C, Gomes M C V, Cabrera W E, Dantas E H M 2010 Inspiratory muscle training improves maximal inspiratory pressure and may assist weaning in older intubated patients: a randomised trial. Journal of Physiotherapy 56: 171 - 177

Cetti E J, Moore A J, Geddes D M 2006 Collateral ventilation. Thorax 61: 371 - 373

Chaboyer W, Grass E, Foster M 2004 Patterns of chest physiotherapy in Australian intensive care units. Journal of Critical Care, 19 (3): 145 - 151

Chang A T, Boots R J, Brown M G, Paratz J D, Hodges P W 2005 Ventilatory changes following head-up tilt and standing in healthy subjects. European Journal of Applied Physiology 95 (5-6): 409 - 417

Choi J S, Jones A Y 2005 Effects of manual hyperinflation and suctioning in respiratory mechanics in mechanically ventilated patients with ventilator-associated pneumonia. Australian Journal of Physiotherapy 51 (1): 25 - 30

Cirio S, Piaggi G C, De Mattia E, Nava S 2003 Muscle retraining in ICU patients. Monaldi Archives for Chest Disease 59 (4): 300 - 303

Clarke D E, Lowman J D, Griffin R L, Matthews H M, Reiff D A 2013 Effectiveness of an early mobilization protocol in a trauma and burns intensive care unit: A retrospective cohort study. Physical Therapy 93 (2): 186 - 196

Clini E and Ambrosino N 2005 Early physiotherapy in the respiratory intensive care unit. Respiratory medicine 99: 1096 - 1104

Condessa R L, Brauner J S, Saul A L, Baptista M, Silva A C, Vieira S R 2013 Inspiratory muscle training did not accelerate weaning from mechanical ventilation but did improve tidal volume and maximal respiratory pressures: a randomised trial. Journal of Physiotherapy 59 (2): 101 - 107

Curran V, Sargeant J, Hollett A 2007 Evaluation of an interprofessional continuing professional development initiative in primary health care. Journal of Continuing Education in the Health Professionals 27 (4): 241 - 252

De Jonghe B, Bastuji-Garin S, Durand M C, Malissin I, Rodrigues P, Cerf C, Outin H, Sharshar T, 2007 Respiratory muscle weakness is associated with limb weakness and delayed weaning in critical illness. Critical Care Medicine 35 (9): 2007 - 2015

Denehy L, Berney S 2001 The use of positive pressure devices by physiotherapists. European Respiratory Journal 17 (4): 821 - 829

Denehy L , Berney S 2006 Physiotherapy in the intensive care unit. Physiotherapy reviews 11: 49 - 56

Esquinas Rodriguez A M E, Scala R, Soroksky A, BaHammam A, de Klerk A, Valipour A, Chiumello D, Martin C Holland A E 2013 Clinical review: Humidifiers during non-invasive ventilation – key topics and practical implications. Critical Care 16 (1): 203 - 210

Filbay S, Hayes K, Holland A E 2012 Physiotherapy for patients following coronary artery bypass graft (CABG) surgery: Limited uptake of evidence into practice. Physiotherapy Theory and Practice 28 (3): 178 - 187

Fincham J E 2008 Response rates and responsiveness for surveys, standards and the journal. American Journal of Pharmaceutical Education 72 (2): 1 - 3

Fink J B 2007 Forced expiratory technique, directed cough and autogenic drainage. Respiratory care 52 (9): 1210 - 1223

Friedman A, Phillips M 2004 Continuing professional development: Developing a vision. Journal of Education and Work 17 (3): 361 - 376

Frownfelter D, Dean E 2006 Cardiovascular and pulmonary physical therapy: Evidence and practice 4th edition, Elsevier Publishers

Gosselink R, Bott J, Johnson M, Dean E, Nava S, Norrenberg M, Schönhofer B, Stiller k, Van de Leur H, Vincent J L 2008 Physiotherapy for adult patients with critical illness: recommendations of the European respiratory society and European society of intensive care medicine task force on physiotherapy for critically ill patients. Intensive Care Medicine 34: 1188 - 1199

Gosselink R, Clerckx B, Robeets C, Vanhullebusch T, Vanpee G, Segers J 2011 Physiotherapy in the intensive care unit. Netherlands Journal of Critical Care 15 (2): 66 - 75

Haas C F, Loik P S 2012 Ventilator discontinuation protocols. Respiratory Care 57 (10): 1649 - 1662

Haeffener M P, Ferreria G M, Barreto S S, Arena R, Dall'Ago P 2008 Incentive spirometry with expiratory positive airway pressure reduces pulmonary complications, improves pulmonary function and 6-minute walk distance in patients undergoing coronary artery bypass graft surgery. American Heart Journal 156 (5): 900e1 - 900e8

Hannekom S, Gosselink R, Dean E, Van Aswegen H, Roos R, Ambrosino N, Louw Q 2011 The development of a clinical management algorithm for early physical activity and mobilization of critically ill patients: synthesis of evidence and expert opinion and its translation into practice. Clinical Rehabilitation 25 (9): 771 – 787

Hart N, Cramer D, Ward S P, Nickol A H, Moxham J, Polkey M I, Pride N B 2002 Effect of pattern and severity of respiratory muscle weakness on carbon monoxide gas transfer and lung volumes. European Respiratory Journal 20: 996 - 1002

Health Professions Council of South Africa 2003 The South African medical and dental council. http://www.hpcsa.co.za/downloads/regulations/scopeofprofessionofphysiotherapy.pdf. (Accessed: 18 April 2012)

Hodgin K E, Nordon-Craft A, McFann K K, Mealer M L Moss M 2009 Physical therapy utilization in intensive care units: Results from a national survey. Critical Care Medicine 37 (2): 561 - 568

Hodgson C, Denehy L, Ntoumenopoulos G, Santamaria J, Carroll S 2000 An investigation of the early effects of manual hyperinflation in critically ill patients. Anaesthesia and Intensive Care 28 (3): 255 - 261

Hough A 2001 Physiotherapy in Respiratory Care: An evidence-based approach to respiratory and cardiac management. 3rd edition. pp 387-389. Nelson Thornes Ltd, United Kingdom

Jones A Y, Dean E 2004 Body position change and its effect of hemodynamic and metabolic status. Heart and Lung 33 (5): 281 - 290

Kacmarek R M, Stoller J K, Heuer A H 2013 Egan's Fundamentals of Respiratory Care. 10th edition. Elsevier Mosby, Missouri

Lewis L K, Williams M T, Olds T S 2012 The active cycle of breathing technique: A systemic review and meta-analysis. Respiratory medicine 106 (2): 155 - 172

Lou-Sole M, Byers J F, Ludy J E, Ostrow C L 2002 Suctioning techniques and airway management practices: Pilot study and instrument evaluation. American Journal of Critical Care 11 (4): 363 - 368

Maa S H, Hung T J, Hsu K H, Hsieh Y I, Wang K Y, Wang C H, Lin H C 2005 Manual Hyper Inflation Improves Alveolar Recruitment in Difficult-to-Wean Patients. Chest 128 (4): 2714 - 2721

Makhabah D N, Martino F, Ambrosino N 2013 Peri-operative physiotherapy. Multi-disciplinary Respiratory Medicine 8 (4): 1 - 6

Martin A D, Davernport P D, Franceshi A C, Harman E 2002 Use of inspiratory muscle strength training to facilitate ventilator weaning: a series of 10 consecutive patients. Chest 122 (1): 192 - 196

Maxwell L J, Ellis E R 2003 The effect of circuit type, volume delivered and "rapid release" on flow rates during manual hyperinflation. Australian Journal of Physiotherapy 49: 31 - 49

Moodie L, Reeve J, Elkins M 2011 Inspiratory muscle training increases inspiratory muscle strength in patients weaning from mechanical ventilation: a systemic review. Journal of Physiotherapy 57 (4): 213 - 221

Morrison L, Agnew J 2011 Oscillating devices for airway clearance in people with cystic fibrosis. The Cochrane Collaboration 1: 1 - 102

Naylor J M, Heard R, Chow C 2005 Physiotherapist attitudes and practices regarding head-down tilt and modified postural drainage in the presence of heart disease. Physiotherapy Theory and Practice 21 (2): 121 - 135

Needham D M 2008 Mobilizing patients in the intensive care unit: improving neuromuscular weakness and physical function. Journal of the American Medical Association 300 (14): 1685 - 1690

Nordon-Craft A, Moss M, Quan D, Schenkman M 2012 Intensive care unit-acquired weakness: Implications for physical therapist management. Physical Therapy 92 (12): 1494 - 1506

Norrenberg M, Vincent J L 2000 A profile of European intensive care unit physiotherapists. Intensive care medicine 26: 850 - 856

Ntoumenopoulos G, Presneill J J, McElholum M, Cade J F 2002 Chest physiotherapy for the prevention of ventilator associated pneumonia. Intensive Care Medicine 28 (7): 850 - 856

Ntoumenopoulos G 2008 Mucus on the move: Embed it or expel it – The patient, the clinician, and now the ventilator. Respiratory Care 53 (10) 1276 - 1279

Orman J, Westerdahl E 2010 Chest Physiotherapy with positive expiratory pressure breathing after abdominal and thoracic surgery: a systemic review. Acta Anaethesiologica Scandinavica 54 (3): 261 - 267

Padula C A, Yeaw E 2007 Inspiratory muscle training: Integrative Review of use in conditions other than COPD. Research and Theory for Nursing Practice: An International Journal 21 (2): 98 - 118

Patsaki I, Papadopoulus E, Sidiras G, Christakou A, Kouvarakos A, Markaki V 2013 The effectiveness of inspiratory muscle training in weaning critically ill patients from mechanical ventilation. Hospital Chronicles 8 (2): 86 - 90

Pawlik A J and Kress J P 2013 Issues affecting the delivery of physical therapy services for individuals with critical illness. Physical Therapy 93 (2): 256 - 265

Pedersen C M, Rosendahl M, Hjermind J, Egerod I 2009 Endotracheal suctioning of the adult intubated patient – what is the evidence? Intensive and Critical Care Nursing 25 (1): 21 - 30

Plani N, Bekker P, Van Aswegen H 2013 The use of a weaning and extubation protocol to facilitate effective weaning and extubation from mechanical ventilation in patients suffering from traumatic injuries: A non-randomized experimental trial comparing a prospective to retrospective cohort. Physiotherapy Theory and Practice 29 (3): 211 - 221

Pryor J A, Prasad S A 2008 Physiotherapy for Respiratory and Cardiac Problems. 4th edition. Churchill and Livingston, Edinburgh

Savci S, Sakinc S, Ince D I, Arikan H, Can Z, Buran Y, Kuralay E 2006 Active cycle of breathing techniques and incentive spirometry in coronary artery bypass graft surgery. Fizyoterapi Rehabilitasyon 17 (2): 61 - 69

Savian C, Chan P, Paratz J 2005 The effect of positive end-expiratory pressure level on peak expiratory flow during manual hyperinflation. Anethesia and Analgesia 100 (4): 1112 - 1116

Solomita M, Palmer L B, Daroowalla F, Liu J, Miller D, Le Blanc D S, Smaldone G C 2009 Humidification and secretion volume in mechanically ventilated patients. Respiratory Care 54 (10): 1329 - 1335

South African Medical and Dental Council 1976 Regulations defining the scope of the profession of physiotherapy. http://www.hpcsa.co.za/Uploads/editor/UserFiles/downloads/rules_reg_constitution/scope_of_profession_of_physiotherapy.pdf (Accessed: 13 January 2015)

Stiller K 2000 Physiotherapy in intensive care: towards an evidence-based practice. Chest 118 (6): 1801 - 1813

Stiller K 2013 Physiotherapy in intensive care: An updated systemic review. Chest 144 (3): 825 - 847

Tobin M J, Laghi F, Brochard L 2009 Role of the respiratory muscles in acute respiratory failure of COPD: lessons from weaning failure. Journal of Applied Physiology 107: 962 - 970

Van Aswegen H, Potterton J 2005 A pilot survey of the current scope of practice of South African physiotherapists in intensive care units. South African Journal of Physiotherapy 61 (1): 17 - 21

Van Aswegen H, Van Aswegen A, Du Raan H, Du Toit R, Spruyt M, Nel R, Maleka M 2013 Airflow distribution with manual hyperinflation as assessed through gamma camera imaging: a crossover randomised trial. Physiotherapy 99 (2): 107 - 112

Volman K M 2010 Introduction to progressive mobility. Critical Care Nurse 30 (2): S3 - S5

Westerdahl E, Lindmark B, Almgren S, Tenling A 2001 Chest physiotherapy after coronary artery bypass graft surgery – A comparison of three different deep breathing techniques. Journal of Rehabilitation Medicine 33 (2): 79 - 84

Westerdahl E, Lindmark B, Eriksson T, Friberg O, Hedenstierna G, Tenling A 2005 Deep breathing exercises reduce atelectasis and improve pulmonary function after coronary artery bypass surgery. Chest 128 (5): 3482 - 3488

Wiles L, Stiller K 2010 Passive limb movements for patients in an intensive care unit: A survey of physiotherapy practice in Australia. Journal of Critical Care 25 (3): 501 - 508

World Confederation of Physiotherapy. Policy statement: Description of physiotherapy. London, UK: WCPT; 2011 http://www.wcpt.org/sites/wcpt.org/files/files/PS_Description_PT_Sept2011.pdf. (Accessed: 20 April 2012)

APPENDIX A

- **QUESTIONNAIRE**

QUESTIONNAIRE

A questionnaire to establish the scope of practice of physiotherapists working in intensive care units in South Africa

Questionnaire code: ☐

Please tick applicable boxes, you may tick more than one box where indicated.

1. In which province do you work?
   - ❑ Gauteng
   - ❑ Free State
   - ❑ North-West
   - ❑ Northern Cape
   - ❑ Western Cape
   - ❑ Eastern Cape
   - ❑ Kwazulu Natal
   - ❑ Mpumalanga
   - ❑ Limpopo

2. What is the name of the hospital that you are currently working at?

   _____

3. What type of hospital do you work in? (You may tick more than one box)
   - ❑ University hospital
   - ❑ University affiliated hospital
   - ❑ Government hospital
   - ❑ Tertiary hospital
   - ❑ Quaternary hospital
   - ❑ Central hospital
   - ❑ Private hospital

4. How many intensive care units (ICU) are in the hospital in which you are currently working?
   - ❑ One
   - ❑ Two
   - ❑ Three
   - ❑ Four
   - ❑ Five
   - ❑ More than five

5. What is the total estimated amount of ICU beds in the hospital in which you work? _____

6. Select the type of ICU in which you currently work. (You may tick more than one box)
   - ❑ Medical
   - ❑ Surgical
   - ❑ Trauma
   - ❑ Cardiothoracic
   - ❑ Cardiac
   - ❑ Paediatric
   - ❑ Medico-surgical
   - ❑ Other _____

7. How many beds on average are being actively used (open for patient admission) in the ICU in which you work?

   - ❑ <6
   - ❑ 6-8
   - ❑ 9-12
   - ❑ 13-18
   - ❑ >18

8. What percentage of patients admitted to your ICU are paediatric patients?
   - ❑ 0%
   - ❑ <10%
   - ❑ 10-30%
   - ❑ >30%
   - ❑ 50-70%
   - ❑ >70%
   - ❑ 100%

9. How many physiotherapists are currently working in your ICU?
   - ❑ 1
   - ❑ 2
   - ❑ 3-4
   - ❑ >4

10. How many physiotherapists in your hospital work only in ICU?
   - ❑ 0
   - ❑ 1-2
   - ❑ 3-4
   - ❑ >4
   - ❑ All

11. How many physiotherapists work in ICU part-time (e.g. do ICU and ward work)?
   - ❑ 0
   - ❑ 1-2
   - ❑ 3-4
   - ❑ >4
   - ❑ All

12. How are patients in your ICU referred for physiotherapy? (You may tick more than one box)
   - ❑ Doctor referral
   - ❑ Physiotherapist self-screening
   - ❑ Nurses

13. Do physiotherapists in the ICUs at your hospital provide an after hour service to the ICU during the week?

   - ❑ Yes
   - ❑ No

   If you answered yes to question 13, please answer questions 14, 15 16 & 17. If you answered no, please move to question 18.

14. Do the physiotherapists who provide the service remain on the hospital premises during on-call service?

    ❑ Yes
    ❑ No

15. How is the physiotherapist contacted?
    ❑ Phone
    ❑ Pager

16. Are there specific criteria as to which patients would be referred for after hour call-outs in your hospital?

    ❑ Yes
    ❑ No

17. Who is allowed to refer patients for physiotherapy after hours? (You may tick more than one box)

    ❑ Nursing staff
    ❑ Doctors
    ❑ Consultants
    ❑ Registrars
    ❑ Interns

18. Do physiotherapists in the ICUs at your hospital provide a service to the ICU over the weekends?

    ❑ Yes
    ❑ No

    If you answered yes to question 18, please answer questions 19, 20 21, 22 & 23. If you answered no, please move to question 24.

19. How is the physiotherapist contacted?
    - ❑ Phone
    - ❑ Pager

20. Are there specific criteria as to which patients would be referred for physiotherapy over the weekend in your hospital?

    - ❑ Yes
    - ❑ No

21. When is this physiotherapy service provided?
    - ❑ Saturdays
    - ❑ Sundays
    - ❑ Saturdays and Sundays
    - ❑ Public holidays
    - ❑ All of the above

22. Who is allowed to refer patients for physiotherapy during the weekend? (You may tick more than one box)

    - ❑ Nursing sister
    - ❑ Physiotherapists
    - ❑ Doctors
    - ❑ Consultants
    - ❑ Registrars
    - ❑ Interns

23. Indicate how often you use the following methods of assessment for your ICU patients (Please tick the appropriate box for each assessment technique below):

Technique	**Never**	**Almost never**	**Sometimes**	**Fairly often**	**Very often**
ICU chart review					
Arterial blood gas analysis					
Dynamic and static lung compliance calculation					
Hypoxaemia calculation					
X-ray / CT scan					
Auscultation					
Strength of cough effort					
Thoracic expansion					
Percussion note to assess quality of lung tissue					
Respiratory muscle strength (maximal inspiratory pressure)					
Readiness for weaning (rapid shallow breathing index)					
Readiness for mobilization using specific criteria					
Peripheral muscle strength (dynamometry or Medical Research Council scale)					
Need for humidification					

24. Please indicate how often you use the following treatment modalities in ICU (Please tick the appropriate box for each treatment modality below):

Technique	Never	Almost never	Sometimes	Fairly often	Very often
Manual chest clearance techniques (percussions, vibrations, shaking)					
Postural drainage/ modified postural drainage					
Airway suctioning					
Manual hyperinflation (ambubagging)					
Intermittent positive pressure breathing (IPPB)					
Incentive spirometery					
Active cycle of breathing techniques					
Inspiratory muscle training (Threshold device/devices by other manufacturers)					
Flutter device					
Blow bottle					
Blowing up a glove					
Deep breathing exercises					
Nebulization					
Mobilizing a patient in bed					
Mobilizing a patient out of bed					
Positioning a patient in bed					
Positioning a patient out of bed					
Peripheral muscle strengthening exercises					
Adjustment of mechanical ventilation settings for respiratory muscle training					
Active involvement in weaning a patient from mechanical ventilation					
Implementation and supervision of non-invasive ventilatory support (CPAP,BiPAP)					

25. Are you involved with intubating patients?

- ❑ Yes
- ❑ No

26. Are you involved with extubating patients?

- ❑ Yes
- ❑ No

27. Are you involved with changing tracheostomy tubes?
    - ❑ Yes
    - ❑ No

28. Do you have time to attend ward rounds?
    - ❑ Yes
    - ❑ No

29. If yes, how often do you attend a ward round?
    - ❑ Daily
    - ❑ Weekly
    - ❑ Monthly

30. Do you attend Morbidity & Mortality (M&M) meetings held in your ICU?
    - ❑ Yes
    - ❑ No

31. Do you have any of the following post-graduate qualifications? (You may tick more than one box)

    - ❑ CPD certificate of cardiopulmonary physiotherapy course /workshop attendance
    - ❑ CPT1 APDL certificate
    - ❑ MSc degree (cardiopulmonary physiotherapy research)
    - ❑ PhD degree (cardiopulmonary physiotherapy research)

32. When last did you attend an ICU related CPD lecture?
    - ❑ In the past 12 months
    - ❑ 1-2 years ago
    - ❑ More than 2 years ago

33. Are you involved in physiotherapy student training?
    - ❑ Yes
    - ❑ No

34. Are you involved in training of any of the other inter-professional team members in your ICU?
    - ❑ Yes
    - ❑ No

35. Are you involved in training junior physiotherapists to ensure they work safely in ICU?
    - ❑ Yes
    - ❑ No

36. Are you involved in training all physiotherapists at your hospital/in your practice to work safely in ICU prior to them working after-hours/weekends in ICU?

    - ❑ Yes
    - ❑ No

37. Are you involved in presenting seminars on the role of physiotherapists in ICU in your hospital?
    - ❑ Yes
    - ❑ No

Thank you for taking time to complete this questionnaire.

APPENDIX B

- **ETHIC CLEARANCE CERTIFICATE**

R14/49 Miss Michele Lottering

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130131

NAME: (Principal Investigator) Miss Michele Lottering

DEPARTMENT: Department of Physiotherapy
Medical School

PROJECT TITLE: The Scope of Practice of Physiotherapists Who Work in Intensive Care in South Africa: A Questionnaire Based Survey

DATE CONSIDERED: 25/01/2013

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr H van Aswegen

APPROVED BY: Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 25/01/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Lottering
Principal Investigator Signature

Date 7/2/2013

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX C

- **PARTICIPANT INFORMATION SHEET**

Dear Colleague

I am a physiotherapy master's student at the University of the Witwatersrand and I am conducting research to establish the scope of practice of physiotherapists in intensive care units (ICU) in South Africa. In order to do this I need to collect data from physiotherapists working in ICU in South Africa. I would therefore like to invite you to participate in this electronic survey.

A previous study of similar nature was done in 2005 by Van Aswegen and Potterton. That was a preliminary study which was done seven years ago and no in-depth study has been done to follow-up on the pilot study. The aim of this survey is to establish the scope of practice of physiotherapists who work in ICU in South Africa on a wider scale.

Information obtained from the survey may be used to compare with results from international surveys on the profile of physiotherapists in ICU and could be used to develop clinical practice guidelines for the role of physiotherapy in ICU in South Africa.

I have adapted the questionnaire to be used in this survey from that used by Van Aswegen and Potterton (2005) in order to answer the objectives for this survey. If you decide to participate in this survey, answering the questionnaire will only take 10 minutes of your time. I would appreciate if you could go the electronic link below to answer the questionnaire.

https://www.surveymonkey.com/s/Y7GT8GK

Please feel free to contact me if you have any questions regarding the survey or questionnaire.

Kind regards,

Michele Lottering
084 208 0369