

https://dspace.org/

The physiotherapy management of thoracotomy patients: a survey of current practice in Gauteng

Schwellnus, Liezel Brunhilde

2015-09-17
http://hdl.handle.net/10539/18682

Downloaded from a DSpace repository. https://dspace.org/

THE PHYSIOTHERAPY MANAGEMENT OF THORACOTOMY PATIENTS: A SURVEY OF CURRENT PRACTICE IN GAUTENG

Liezel Brunhilde Schwellnus

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science in Physiotherapy

Johannesburg, 2015

DECLARATION

I, Liezel Brunhilde Schwellnus, declare that this research report is my own work. It is being submitted for the degree of Master 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.



Liezel Brunhilde Schwellnus

30th day of April 2015

DEDICATION

To the Lord for his inconceivable grace.

To my family for their continued support.

ABSTRACT

Introduction:

Physiotherapy treatment is an essential component in the management of patients after open thoracic surgery in order to prevent respiratory complications and improve shoulder and thoracic cage mobility (Reeve, 2008). To date, limited research has been done on patients who have had open thoracotomy surgery. The body of knowledge and evidence on physiotherapy management of thoracotomy patients need to be addressed. The aim of this research report was to establish which physiotherapy treatment modalities are used in the management of thoracotomy patients in Gauteng.

Methods:

A self-administered questionnaire was used to obtain the data for this descriptive, cross sectional study. A sample of convenience was used and questionnaires were distributed to all physiotherapists registered with the SASP (South African Society of Physiotherapy) in Gauteng. Ethical clearance was obtained from the University of the Witwatersrand Human Research Ethics committee. An expert panel established the content validity of the questionnaire. The provisional questionnaire was piloted electronically via survey monkey. Invitations for participation in the main study were sent out after amendments were made to the questionnaire following the pilot study. Data for the main study was collected over a period of two months.

Results:

The questionnaire was distributed to 1389 physiotherapists registered with the SASP in Gauteng. Three hundred and twenty three physiotherapists (23.3%) responded. Only 141 of the responders were eligible for inclusion in the study. Ninety-five respondents indicated that they only see thoracotomy patients while still in hospital, 25 said they see these patients only after discharge while 21 respondents treated these patients both during and after hospital stay. The majority of physiotherapists who treat thoracotomy patients were females between the ages of 23 to 69. Results indicated that pre-operative physiotherapy management was most commonly determined by the patients' risk profiles and consisted of information and respiratory techniques. Prophylactic post-operative management was high and in accordance with studies from Reeve et al (2007) and Agostini et al (2013). The modalities used most commonly were respiratory techniques with deep breathing exercise (97.6%: n=83), coughing (95.3%; n=81) and ACBT (82.4%: n=70), scoring highest. Exercise interventions used were early mobilistation (95.3%; n=81), trunk- (85.9; n=73) and upper limb mobility exercises (91.8%; n=78). Limited modalities focused on treating pain with OMT (11.8%; n=10) and

transcutaneous electrical nerve stimulation (12.9%; n=11), being the modalities of choice. Post-hospital discharge physiotherapy management was uncommon with only 32.6% (n=46) of respondents treating patients during this phase. During the first six weeks after discharge the main focus of treatment was on respiratory difficulties (64%; n=41). After six weeks the focus moved to treating pain (57.8%; n=37). Management choices during all phases of contact with patients undergoing open thoracotomies were influenced by personal experience and established practice protocols as mentioned in the questionnaire.

Conclusion:

High quality evidence regarding the management of patients after open thoracic surgery still seems to be limited when compared to other high risk surgery groups (Reeve, 2008). Considering this, it seems that physiotherapists in Gauteng are using the relevant techniques to prevent and manage postoperative pulmonary complications (PPCs) in patients that undergo open thoracic surgery. Pre- and post-operative techniques most commonly used were respiratory techniques and early mobilisation. Management choices seem to be predominantly affected by experience and established practice protocol. There is a lack in pain management for these patients both during and after hospital stay.

ACKNOWLEDGEMENTS

I would like to thank the following people and institutions who provided assistance in preparing this research report:

- Dr. R Roos - Supervisor
- Ms. V Naidoo - Co-supervisor
- SASP - Research grant
- Faculty research committee - Research grant
- Ms. J Reeve - Permission to use and alter original developed and validated questionnaire
- Dr. R Roos, Ms. V Naidoo, Ms. M Wilson and Ms. M Swansea - Content validation of the questionnaire
- Dr. E Venter - Assistance with SPSS and statistical analysis

TABLE OF CONTENTS

		Page
	Declaration	ii
	Dedication	iii
	Abstract	iv
	Acknowledgements	vi
	Table of Contents	vii
	List of Tables	xi
	List of Figures	xii
	List of Abbreviations	xiii
1.	**Chapter 1: Background and Need**	1
1.1	Introduction	1
1.2	Problem Statement	3
1.3	Research Question	3
1.4	Aim of Study	4
1.4.1	Objectives of the Study	4
1.5	Significance of the Study	4
2.	**Chapter 2: Literature Review**	5
2.1	Introduction	5
2.2	Definition of Thoracotomy	5
2.3	Indications for Thoracotomy	5
2.3.1	Pulmonary Procedures	6
2.3.2	Anterior Spinal Fusions	7
2.3.3	Valve Replacement Surgery	8
2.4	Incision Types used for Open Thoracotomy	8
2.4.1	Posterior Lateral Thoracotomy	9
2.4.2	Muscle Sparing Thoracotomy	9
2.4.3	Limited Anterior or Lateral Thoracotomy	10
2.5	Alternative to Open Thoracotomy	10
2.5.1	Video Assisted Thoracic Surgery (VATS)	11
2.6	Complications	12
2.6.1	Postoperative Pulmonary Complications (PPCs)	12

		Page
2.6.2	Non-Pulmonary Complications	13
2.7	General Principles of Post-Operative Care	15
2.7.1	Care of the Cardiovascular System	16
2.7.2	Care of the Respiratory System	16
2.7.3	Drainage and Obliteration of the Pleural Space	16
2.7.4	Control of Post-Operative Pain	16
2.8	Physiotherapy Management of a Patient that had an Open Thoracotomy Procedure	17
2.8.1	Pre-Operative Management	18
2.8.2	Post-Operative Management	19
2.8.2.1	Management during Hospital Stay	19
2.8.2.2	Post Discharge Management	22
2.9	Conclusion	24
3.	**Chapter 3: Methodology**	26
3.1	Study Design	26
3.2	Study Population	26
3.2.1	Source of Participants	26
3.2.2	Sample Selection and Size	26
3.2.2.1	Inclusion Criteria	26
3.3	Measuring Instruments	26
3.3.1	The Questionnaire	26
3.3.1.1	General Information	27
3.3.1.2	Service Provision	27
3.3.1.3	Pre-Operative Physiotherapy Management	27
3.3.1.4	Post-Operative Physiotherapy Management	27
3.3.1.5	Post Hospital Discharge Physiotherapy Management	27
3.3.2	Validity of the Questionnaire	28
3.3.2.1	Objectives of Expert Peer-Review Panel	28
3.3.2.2	Inclusion Criteria for the Expert-Peer-Review Panel	28
3.3.2.3	Methodology of Content Validation of Questionnaire	28
3.4	Procedure	29
3.4.1	Pilot Study	29
3.4.1.1	Objectives of the Pilot Study	29
3.4.1.2	Methodology of the Pilot Study	29

		Page
3.4.1.3	Results of the Pilot Study	30
3.4.1.4	Implications of the Pilot Study	30
3.4.2	Main Study	30
3.4.2.1	Objectives of the Main Study	30
3.4.2.2	Procedure	30
3.5	Ethical Considerations	31
3.6	Data Analysis	31
4.	**Chapter 4: Results**	32
4.1	Introduction	32
4.2	Sample Size	32
4.3	Objective 1: The Profile of Study Respondents	33
4.3.1	Age Distribution of the Study Population	33
4.3.2	Gender Distribution of the Study Population	33
4.3.3	Qualifications of the Study Population	34
4.3.4	Participation in Continuous Professional Development	35
4.3.5	Special Interest Groups of the South African Society of Physiotherapy	36
4.3.6	Employment Specifics	38
4.4	Objectives 2 and 3: Study Results Related to Physiotherapy Management Provided in Hospital	39
4.4.1	Pre-Operative Physiotherapy Management of Open Thoracotomy Patients	39
4.4.2	Post-Operative Management of Patients after Open Thoracic Surgery during Hospital Stay	42
4.5	Objectives 2 and 3: Study Results Related to Physiotherapy Management Provided After Discharge from Hospital	49
4.6	Objective 4: The Post-Operative Thoracotomy Complications after discharge from hospital that are Addressed from a Physiotherapeutic Point of View	52
4.6.1	Complications Addressed during the First Six Weeks following Discharge	52
4.6.2	Complications Addressed more than Six Weeks after Discharge	53
5.	**Chapter 5: Discussion**	55
5.1	Introduction	55
5.2	The Profile of Physiotherapists who Treat Patients after Open Thoracic Surgery	55
5.2.1	Age	55

		Page
5.2.2	Gender…….…….....	56
5.2.3	Qualifications and Continuous Professional Development……..	56
5.3	Physiotherapy Management Provided to Patients Before and After Open Thoracotomy Surgery during Hospital Stay and factors influencing management choices ……..….....	59
5.3.1	Pre-Operative Physiotherapy Management……	59
5.3.2	Post-Operative Physiotherapy Management……..	61
5.4	Physiotherapy Management Provided to Patients After Open Thoracotomy Surgery after Discharge from Hospital and factors influencing management choices ….....	66
5.5	Post-Operative Complications Addressed from a Physiotherapeutic Perspective……..……..……	67
6.	**Chapter 6: Conclusion, Limitations and Recommendations**.....	70
6.1	Conclusion…….…….....	70
6.2	Limitations of this Study.....	71
6.3	Recommendation.....	72
6.3.1	Clinical Recommendations. ……..……....	72
6.3.2	Recommendation for Future Research……..	73
7.	**References**…….….....	74
Appendix A	: The Physiotherapy Management of Post-Thoracotomy Questionnaire.....	81
Appendix B	: The Physiotherapy Management of Patients following Thoracic Surgery: A Survey…..…….……..……....	104
Appendix C	: Research Questionnaire: Reeve, Denehy and Stiller.....	112
Appendix D	: Permission Letter…….....	114
Appendix E	: Ethical Clearance Certificate….....	115
Appendix F	: Turn-it-In Report…….	116

LIST OF TABLES

			Page
Table 4.1	:	Response Rate of Respondents regarding the Management of Patients after Open Thoracic Surgery (N=323)…….....	33
Table 4.2	:	Gender distribution of study respondents (N=141)….....	33
Table 4.3	:	Highest Qualification of Study Population……..	34
Table 4.4	:	Influence on Choice of Pre-Operative Management Techniques……..	41
Table 4.5	:	Influence on Choice of Post-Operative Management Techniques…….	48
Table 4.6	:	Factors that Influence Choice of Treatment Techniques Post-Hospital Discharge (N=64)...……..….....	51

LIST OF FIGURES

			Page
Figure 4.1	:	Respondents that Completed One Year Certificate Courses (N=141).....	34
Figure 4.2	:	Respondents that were CPD Active during the Previous Year.....	35
Figure 4.3	:	Respondents who Attended CPD activities according to Physiotherapy special interest areas…….....	36
Figure 4.4	:	Respondents that Belong to a Special Interest Group (N=141).....	37
Figure 4.5	:	Results of Study Respondents' Membership with Special Interest Groups (N=117).....	37
Figure 4.6	:	Current Employment Status of Respondents.....	38
Figure 4.7	:	Work areas for physiotherapists treating Patients after Open Thoracic Surgery (n=141)…….....	39
Figure 4.8	:	Procedures used routinely during pre-operative assessment and treatment (n=65)…….....	40
Figure 4.9	:	Treatment Interventions used Routinely during Post-Operative Treatment (n=85)…….....	43
Figure 4.10	:	Mobility Interventions used Routinely during Post-Operative Treatment (n=85) ……..……....	44
Figure 4.11	:	Discharge Education used Post-Operatively…….....	45
Figure 4.12	:	Percentage of Study Population that Alters Management Interventions with Persistent Air Leaks (n=85)…….....	46
Figure 4.13	:	Altered Management Techniques for Patients with Persistent Air Leaks (n=50)...….....	47
Figure 4.14	:	Treatment Interventions used Routinely during Post Hospital Discharge Treatment…….....	50
Figure 4.15	:	Main Reasons for Referring Patients for Physiotherapy After Hospital Discharge (n=66).....	52
Figure 4.16	:	Main Reasons for Physiotherapy during the First Six Weeks following Discharge (n=64)…….....	53
Figure 4.17	:	Main Reasons for Physiotherapy More than Six Weeks after Hospital Discharge (n=64)…….....	54

LIST OF ABBREVIATIONS

ACBT	- Active cycle of breathing technique
CABG	- Coronary artery bypass grafts
CPD	- Continuous professional development
CPT	- Cardiopulmonary Physiotherapy
CPT1	- Cardiopulmonary Physiotherapy course
CPRG	- Cardio-Pulmonary Rehabilitation Group
CPTP	- Chronic post-thoracotomy pain
DBE	- Deep breathing exercises
FET	- Forced expiratory techniques
FEV1	- Forced expiratory volume in one second
FRC	- Functional residual capacity
FVC	- Forced vital capacity
HIV	- Human immunodeficiency virus
HPCSA	- Health Professions Council of South Africa
IASP	- International Association for the Study of Pain
ICU	- Intensive care unit
IMT	- Inspiratory muscle training
IPPB	- Intermittent positive pressure breathing
IS	- Incentive spirometry
LVRS	- Lung volume reduction surgery
MDR-TB	- Multi drug resistant Tuberculosis
MST	- Muscle sparing thoracotomy
NQF	- National Qualifications Framework
OMPTG	- Orthopedic Manipulative Physiotherapy Group
OMT	- Orthopedic Manual Therapy
OMT1	- Orthopedic Manual Therapy course
PEP	- Positive expiratory pressure
PLT	- Posterior lateral thoracotomy
PPCs	- Post operative pulmonary complications
PROSPECT	- Procedure specific postoperative pain management
PTPS	- Post-thoracotomy pain syndrome
RCT	- Randomised controlled trial

ROM	- Range of motion
SASP	- South African Society of Physiotherapy
SAQA	- South African Qualifications Authority
SIG	- Special interest group
SIGs	- Special interest groups
SPSS	- Statistical Package for the Social Sciences
SPT	- Sports physiotherapy
TB	- Tuberculosis
TENS	- Transcutaneous electrical nerve stimulation
UK	- United Kingdom
VAS	- Visual analogue scale
VATS	- Video assisted thoracic surgery
VC	- Vital capacity
WHO	- World Health Organization

CHAPTER 1

1. BACKGROUND AND NEED

1.1 INTRODUCTION

An open thoracotomy is a surgical incision in the chest wall to gain access to the pleural cavity and mediastinum in order to visualize, do a biopsy or treat a lesion (McGraw-Hill, 2002; Courtney et al, 2012). The indications for this kind of surgery are the resection of the whole, or part of the lung (segmentectomy, lobectomy, pneumonectomy) due to malignancies or benign diseases which include chronic lung infections, bronchiectasis, tuberculosis, emphysema and pneumoconiosis (Weber, Stammberger and Inci, 2001). Patients presenting with trauma related chest injuries might also undergo an emergency thoracotomy in order to apply internal fixations to broken ribs or to manage injuries sustained (Bartlett, 1998; Hunt et al, 2006). A lesser known use of this type of incision is for anterior spinal fusions in scoliosis-patients (Burd, Pawalek and Lenke, 2002). More recently open thoracotomy is also used for non-sternotomy approaches for valve procedures (minimally invasive procedures) (Sharony, Grossi and Saunders, 2006). Post operatively patients often present with complications associated with major surgery. These complications include pulmonary and non-pulmonary complications (Courtney et al, 2012). Pulmonary complications include, but are not limited to atelectasis, consolidation, pulmonary collapse, decreased mucociliary clearance, abnormal gas exchange, and a decrease in functional residual capacity (FRC) (Burd et al, 2002; Reeve, 2008; Agostini, 2009; Reeve et al, 2010; Reid et al, 2010). Non-pulmonary complications include sepsis, cardiovascular distress (Khuri, Daley and Henderson 1995), hemorrhage, (Khuri, Daley and Henderson, 1995; Burd et al, 2002) pain (Khuri, Daley and Henderson, 1995; Khan et al, 2000; Reid et al, 2010), arrhythmias (Pipanmekaporn et al, 2014), decreased exercise tolerance and functional capacity (Reid et al, 2010; Arbane et al, 2011).

Open thoracotomy is widely regarded as one of the most painful surgical procedures (Bethencourt and Holmes, 1988, Khan et al, 2000); some of the reasons being:

1. Forceful retraction of the ribs during surgery which causes pressure on the intercostal nerves, causing acute intercostal neuritis;
2. Damage to intercostal articulations;
3. Costochondral dislocation;

4. Costovertebral damage;
5. Muscular damage to latissimus dorsi, serratus anterior, pectoralis major and intercostal muscles, and
6. Movement of the incision site due to breathing, coughing and moving (Hughes and Gao, 2005; Hopkins and Rosenzweig, 2012).

Management of thoracotomy patients take place by means of a holistic team approach which include a cardiothoracic surgeon, intensive care nurse, physiotherapist and dietician (Numan et al, 2012). Depending on the reason for the thoracotomy, other role players may include physicians, cardiologists and oncologists (Numan et al, 2012). Management is centered on cardiovascular and respiratory support, as well as maintenance of renal function, nutritional state and pain management.

Physiotherapy treatment post-thoracotomy usually focuses on prevention of pulmonary complications during the acute recovery phase and improvement of thoracic and shoulder mobility, focusing on the recovery of shoulder range of motion (ROM), muscle strength and function before hospital discharge (Reeve, Denehy and Stiller, 2007; Arbane, Tropman and Jackson, 2011; Agostini, Reeve and Drommand, 2013). Physiotherapy treatment modalities include airway clearance techniques such as deep breathing exercises (DBE), incentive spirometry (IS), active cycle of breathing technique (ACBT), manual chest clearance techniques e.g. percussions and body positioning (Reeve, Denehy and Stiller, 2007; Orman and Westerdahl, 2010; Reeve et al, 2010; Agostini et al, 2013). Improvement of thoracic- and shoulder-mobility is managed with shoulder exercise-programmes and thoracic cage exercises (Reeve, Denehy and Stiller, 2007; Reeve et al, 2010). There is currently limited evidence to support some of the routinely utilised pulmonary treatment techniques in the prevention of post-operative complications; however they are still widely used in practice (Reeve, 2008; Reeve et al, 2010). Pain is mainly managed by analgesics during the acute phase (Hopkins and Rosenzweig, 2012; Khelemskey and Noto, 2012) and in limited cases with Transcutaneous electrical nerve stimulation (TENS) (Fiorelli et al, 2012; Sbruzzi et al, 2012).

To date, only limited studies could be found which reported on the physiotherapy treatment provided to patients after open thoracic surgery (Reeve, Denehy and Stiller, 2007; Reeve et al, 2010; Agostini, Reeve and Drommand, 2013; Arbane et al, 2014). These studies were mainly conducted on low risk elective patients with cancer and in a minority of patients with respiratory diseases (Reeve, Denehy and Stiller, 2007; Reeve et al, 2010; Agostini, Reeve and

Drommand, 2013). They confirmed the use of respiratory techniques and mobility exercises while patients are still in hospital, but identified lack of pain management techniques from a physiotherapy perspective, both during the acute phase and post hospital discharge (Reeve, Denehy and Stiller, 2007; Agostini et al, 2013). Improvement of thoracic mobility and post-operative management for pulmonary rehabilitation and pain management through physiotherapy treatment is rarely taken into consideration after discharge of the patient (Reeve, Denehy and Stiller, 2007; Agostini et al, 2013). No studies could be found which focused on physiotherapy management of thoracotomy patients falling in high risk groups, e.g. those with the human immunodeficiency virus (HIV), tuberculosis (TB) and malnutrition. Similarly, no studies could be found which reported on the physiotherapy management for non-elective thoracotomy patients after trauma. Thoracic surgery in developing countries are however more common in non-cancer patients, with 60% of these patients presenting with severe lung infections (Pipanmekaporn et al, 2014).

Post hospital discharge medical management includes antibiotics, any medication pertaining to the reason for the thoracotomy (e.g. Rifafour for treating tuberculosis), and pain management with analgesics as the main concern (Numan et al, 2012). Follow up appointments are booked depending on the surgeon's preference (Shields, 2005) as well as the level of health at discharge.

1.2 PROBLEM STATEMENT

Physiotherapy treatment is an essential component in the management of patients undergoing open thoracic surgery in order to prevent postoperative complications. Due to the limited available evidence, best practice guidelines regarding management, during all post-operative phases, to address postoperative complications are not available. Due to the high prevalence of TB and trauma cases in South Africa it is likely that open thoracotomies are more prevalent. It therefore needs to be established which physiotherapy treatment techniques and modalities are currently being used to address post-operative complications, in order to compare them to current literature.

1.3 RESEARCH QUESTION

Which physiotherapy treatment modalities and techniques are currently being used in the management of thoracotomy patients in Gauteng?

1.4 AIM OF STUDY

The aim of this study is to establish which physiotherapy treatment modalities and techniques are used in the management of thoracotomy patients in Gauteng.

1.4.1 Objectives of Study

The objectives of the study are:

1. To establish the profile of physiotherapists managing thoracotomy patients;
2. To determine the physiotherapy treatment modalities and techniques which are used to manage thoracotomy patients both during hospital stay and after discharge as out patients;
3. To determine the factors that influence the choice of modalities and techniques used to treat thoracotomy patients; and,
4. To determine which post-operative complications are addressed from a physiotherapeutic point of view.

1.5 SIGNIFICANCE OF STUDY

This study will enable us to describe the current treatment modalities and techniques being used by South African physiotherapists when treating patients who have undergone a thoracotomy procedure. Additionally, it will highlight the physiotherapists' reasons for choosing specific treatment modalities and techniques as well as uncover possible differences in treatment options. It will also enable comparison of physiotherapeutic interventions used in South Africa, to internationally published literature. Similar studies have been done in Australia and the United Kingdom (UK), and therefore it is important to repeat this study in South Africa as there is a large group of patients falling in a high risk group locally as indicated *supra*. Furthermore, a large group of patients receive non-elective open thoracic surgery due to trauma (Von Oppell et al, 2000). These limited available studies on open thoracic surgery were mainly done on low risk elective patients. The study will investigate the current treatment modalities and techniques used to treat thoracotomy patients and which factors influence the choice of said modalities and techniques used. Furthermore this study will allow us to determine which post-operative complications are addressed from a physiotherapeutic perspective, and will assist in highlighting the areas where education and interventions are needed to address discrepancies in areas of neglect.

Chapter 2 consists of an in-depth discussion of the literature on the current surgical and physiotherapeutic management, as well as on the complications associated with patients receiving an open thoracotomy.

CHAPTER 2

2. LITERATURE REVIEW

2.1 INTRODUCTION

Sources used to review the literature included Cochrane, Medline, PubMed and Pedro databases. The following key words were used in the search strategy to generate the literature: open thoracotomy, complications, management and physiotherapy. During management of a patient who had an open thoracotomy, several factors need to be considered. The literature discussed in this chapter is structured using the following subheadings to provide the background to the study:

2.2 Definition of thoracotomy
2.3 Indications for thoracotomy
2.4 Incision types used for open thoracotomy
2.5 Alternative to open thoracotomy
2.6 Complications following a thoracotomy procedure
2.7 General principles of post-operative care
2.8 Physiotherapy management of a patient who had an open thoracotomy procedure
2.9 Conclusion

2.2 DEFINITION OF THORACOTOMY

An open thoracotomy is a surgical incision in the chest wall to open and gain access to the thoracic cavity in order to explore, do a biopsy or treat a lesion (McGraw-Hill, 2002; Courtney et al, 2012). The Merck Manual (2013) defines an open thoracotomy as a procedure done to evaluate and treat pulmonary problems when non-invasive procedures are non-diagnostic or unlikely to be definitive.

2.3 INDICATIONS FOR THORACOTOMY

There are several reasons which warrant the need to open the thoracic cavity (Doan et al, 2014). Thoracotomy is used to gain access to perform the following procedures: pulmonary procedures (Doan et al, 2014), anterior spinal fusions (Burd et al, 2002) and valve replacement surgery (Sharony, Grossi and Saunders, 2006). A less common indication includes hiatus hernia repairs. Because open thoracotomy is an incision used to perform such an array of different internal procedures, it is difficult to establish the prevalence thereof. However a study

done in 2007 indicated that 56.5% of units across New Zealand reported up to five open thoracic procedures per week for pulmonary procedures (Reeve, Denehy and Stiller, 2007). Similar results were reported by Agostini et al (2013), indicating 52% of units across the UK treat five open thoracic procedures per week after different types of pulmonary resections.

Calligaro et al (2014) stated that thoracic surgery is considered a critical part of management of TB but especially in multi-drug resistant TB (MDR-TB). The aim of the surgery is to remove lung cavities which may contain active organisms to prevent ongoing disease from spreading when these patients are reintegrated into the community. The World Health Organization (WHO) reported that 1.8 million people die annually from TB (Peter et al; 2012). In 2013, South-Africa reported more than 250 000 new pulmonary TB cases (World Health Organization Global Tuberculosis report, 2013). In addition the WHO indicated that MDR-TB is on the rise especially in Africa with 500 000 new MDR-TB cases being reported bi-annually (Bryant et al, 2013; Calligaro et al, 2014).

Penetrating chest wounds are very common in South Africa (Von Oppell et al, 2000). Von Oppell et al (2000) reported that between 1982 and 1997 up to a thousand patients were admitted to Groote Schuur Hospital annually with penetrating thoracic injuries. In 2009 Nordberg et al (2009) estimated the average in-patient cost of a gunshot wound patient at $US385 per day with state hospitals treating more than 127 000 of these cases per year. Although Clarke et al (2011) reported, in their study of 1186 patients, that only 9% of penetrating thoracic trauma patients required emergency thoracic surgery, (this could be higher depending on the type of trauma, for instance injuries prevalent in areas with a higher crime rate) one could not dismiss the high frequency of open thoracotomies in the trauma patient population.

Even with the statistics of the prevalence of open thoracotomy not being available, the author is of the opinion that it is likely that open thoracotomies are more prevalent in South-Africa. This is due to the high prevalence of TB, MDR-TB and trauma cases added to the normal case load of thoracotomies performed for other reasons.

2.3.1 **Pulmonary Procedures**

Thoracotomy incision is used to perform several types of pulmonary procedures to treat respiratory diseases. These diseases can lead to diminished quality of life and an increase in patient morbidity (Owen, 2013). If untreated they can lead to life threatening sequelae including

empyema and sepsis. The procedures include pneumonectomy, lobectomy, segmentectomy, and pulmonary wedge resections (Bao, Ye and Yang, 2014).

Pneumonectomy is the removal of the whole lung and is performed after end-stage lung destruction. End-stage lung destruction can either be caused by benign diseases including pulmonary tuberculosis, invasive opportunistic infections, emphysema with severe hyperinflation and chronic suppurative lung diseases, or malignant infiltrations of the lung (Owen, 2013).

Lobectomy is the removal of a full lobe of the lung due to damage caused by benign or malignant diseases, and is the standard surgical treatment for stage one lung cancer (Bao, Ye and Yang, 2014). Bao et al (2014), concluded that segmentectomy, together with resection of associated hilar lymph nodes, is as effective as lobectomy in patients with stage 1 tumours smaller than 2cm in diameter.

Segmentectomy is the limited resection of lung tissue and, in contrast to lobectomy, is less commonly used to excise malignant lesions. As this type of resection lacks supporting data and is still considered controversial and associated with poor rates of cancer-specific- and overall-survival rates (Bao, Ye and Yang et al, 2014). A meta-analysis by Bao et al (2014) concluded that the poor survival rates associated with segmentectomies might be due to a different type of limited resection, namely non-anatomical pulmonary wedge resection.

Pulmonary wedge resection is the limited, non-anatomical resection of a piece of lung tissue, that does not allow for effective dissection of the associated hilar lymph nodes (Bao et al, 2013). This type of resection is usually reserved for patients without the reserves to tolerate a lobectomy (Grogan and Jones, 2008).

2.3.2 **Anterior Spinal Fusions**

Anterior thoracotomy is often used to gain access to the thoracic cavity in order to perform anterior spinal fusions (Burd et al, 2002). This thoracotomy approach offers advantages over posterior paraspinal access during deformity corrections like scoliosis. These include: less bulky anterior instrumentation, saving of motion segments, better spreading of forces across each segment of the spine, and in the long term, a decrease in degenerative changes to the spine. Further advantages of the thoracotomy approach include the saving of para-spinal musculature and a decrease in back pain (Burd et al, 2002).

2.3.3 **Valve Replacement Surgery**

Since the first minimally invasive valve repair via thoracotomy in 1996, this approach has progressively been gaining popularity. Previously, full median sternotomy was the standard approach for valve surgery, but anterior thoracotomy has been found to be an excellent alternative in order to gain access to the cardiac valves.

Mihaljevic et al (2004), in a study of a thousand cases of valvular surgery via minimally invasive procedures, found decreased cardio pulmonary bypass time and shorter aortic cross clamp time in the minimally invasive group. This resulted in a statistically significant decrease in the incidence of cerebral complications compared to the full sternotomy group. In addition they reported shorter length of hospital stay with a corresponding decreased burden on the available healthcare resources.

Rodrigues et al (2014) reported similar results with a decreased duration of intensive care stay when comparing anterior thoracotomy for aortic valve replacements with the standard full sternotomy approach. Minimally invasive valve surgery via thoracotomy seems to be associated with comparable results together with less cost and higher patient comfort due to limited surgical trauma (Mihaljevic et al, 2004; Rodrigues et al, 2014). Other advantages to this approach were reported by El-Fiky et al (2000) as better cosmetic results, shorter operating time, less blood loss and no risk of sternal infection.

Mihaljevic et al (2004) concluded that this approach allows for all types of complex valve procedures without additional risk. The main concern with this approach remains the limited exposure of some structures.

2.4 **INCISION TYPES USED FOR OPEN THORACOTOMY**

Access to the thoracic cavity with open thoracotomy can be done using several different types of incisions. The three basic approaches include posterior lateral thoracotomy (PLT), muscle sparing thoracotomy (MST) and limited anterior- or lateral thoracotomy (Shields, 2005; The Merck Manual, 2013). Entry into the cavity is most frequently gained through the fifth intercostal space but the fourth to seventh intercostal spaces can also be used (Bethencourt, 1998; Shields, 2005; Athanassiadi, 2007). The incision is made in the lower part of the intercostal space to prevent damage to the neurovascular bundle that runs just inferior to the rib (Shields, 1996). The type of incision used is mostly guided by the surgeon's preference and

by the exposure required. Post-operative recovery potential and cosmesis are other important factors that are considered (Athanassiadi, 2007).

Although no specific written definitions for each type of thoracotomy incision exist, the incisions are described according to their relationship to the latissimus dorsi muscle.

2.4.1 **Posterior Lateral Thoracotomy**

PLT is the most common incision used to perform open thoracotomy and widely regarded as the standard incision used for pulmonary procedures for the past ninety years (Athanassiadi, 2007). This incision gives easy and speedy access to the chest cavity and can be extended if better visualisation is needed. It results in excellent exposure of the lung, hilum, pleurae and mediastinum (Merck manual, 2013). Although the total operating time has been found to be similar to that of MST in a prospective trial by Athanassiadi (2007), the time spent to open the chest is faster than the MST, making it the incision of choice for trauma cases.

The PLT incision has the patient positioned in a full lateral decubitus position with the arm elevated and secured on an arm board. The bed is tilted 30 degrees in the midsection in order to lift the thorax and allow better opening of the intercostal spaces which in turn might assist in decreased damage to the intercostal nerves. The skin incision is designed to allow upward retraction of the scapula. The incision starts in front of the anterior axillary line at the anterior border of the latissimus dorsi muscle and passes three to six centimeters below the scapula tip and extends posteriorly and cephalad, ending midway between the anatomical posterior midline and the medial border of the scapula. During the PLT the Latissimus dorsi muscle is always cut across its full width to gain access. Sometimes other big chest muscles including serratus anterior, rhomboids and trapezius might also be split during opening of the chest (Shields, 2005). Bethencourt (1988) found that PLT leads to marked post-operative pain and disability with impairment of major muscles in the back and shoulders. Athanassiadi (2007) confirmed that PLT resulted in an increased prevalence of shoulder muscle dysfunction compared to MST but that pulmonary function was not influenced by the type of incision.

2.4.2 **Muscle Sparing Thoracotomy**

The MST incision was devised to produce less post-operative pain and reduction in soft tissue injuries (Athanassiadi et al, 2007). Although MST gives less and possibly compromised access to the chest cavity (Athanassiadi, 2007), several authors have noted that the procedure can rapidly and easily be converted to a muscle splitting approach if better visualisation is required

(Bethencourt, 1988; Athanassiadi, 2007). A retrospective study by Khan et al (2000) indicated that conversion to muscle splitting is rarely needed.

The MST incision has the patient in a similar intra-operative position as the PLT but the patient is slightly tilted posterior from the full lateral position (Bethencourt, 1988) with the arm raised higher than the head than with PLT (Martinez-Barenys et al, 2011). During entry into the thoracic cavity the lattisimus dorsi and serratus anterior muscles are spared through slow dissection of skin and muscle flaps (Bethencourt, 1988). It was postulated that this incision would decrease post-operative pain and complications and as a result improve functional recovery. Khan et al (2000) found that MST resulted in 24% better shoulder adductor strength than PLT but no difference in acute or chronic wound pain. A randomised clinical trial by Athanassiadi (2007) found that MST was superior to PLT regarding intra operative blood loss, and post-operative chest drainage volume but concluded that acute and chronic pain and morbidity were similar for PLT and MST.

The single definite advantage of MST over PLT involves the preservation of chest wall musculature. The benefits however are twofold as the use of MST leads not only to better cosmetic results, but the intact muscle can later be used if needed in repairing complications like bronchopleural fistulas (Athanassiadi, 2007).

2.4.3 **Limited Anterior or Lateral Thoracotomy**

A smaller incision than the PLT is made when using this approach and gives good access to the anterior structures in the pleural cavity. The patient is positioned supine with the arm padded and tucked to the side or placed over the patient on an arm rest. The skin incision begins just lateral to the sternal edge and follows the infra-mammary crease up to the anterior axillary line. The dissection is carried down to the chest wall dividing the pectoralis major and minor, and the medial edge of the serratus anterior muscles (Shields, 2005).

As indicated above the advantages include a smaller incision site together with good visualization of anterior pleural structures. It is however, a limited incision and therefore not applicable to all surgical interventions.

2.5 **ALTERNATIVE TO OPEN THORACOTOMY**

In the early 1990's reports about the use of the thoracoscope to perform pulmonary surgery emerged (Grogan and Jones, 2008). Definitions and techniques were standardised to give rise

to what we now commonly refer to as VATS (video assisted thoracic surgery) (Grogan and Jones, 2008). This type of surgery was developed as an alternative to open thoracotomy in order to try and reduce trauma during surgery as well as post-operative morbidities (Ohmori et al, 2013).

2.5.1 **Video-assisted Thoracic Surgery (VATS)**

According to Grogan and Jones (2008) the initial techniques used during VATS varied and made comparison to open thoracotomy difficult. Efforts to standardise techniques have however resulted in more meaningful comparison due to uniform procedures. Limited trials are available and most data is in the form of both case studies (Weber et al, 2001) and small retrospective studies (Sawada et al, 2009; McElney et al, 2013).

Weber et al (2001) found that VATS was better when comparing operating times than open thoracotomy but not statistical significant. This was confirmed by Sawada et al (2009) when they concluded that although open thoracotomy is more invasive than VATS the choice of procedure does not seem to have an influence on the short and long term outcomes.

Comparison of complications after VATS and open thoracotomy have been shown to have similar patterns but VATS is associated with a reduced rate (Grogan and Jones, 2008; Erus et al, 2014). Major considerations when deciding which procedure to use is firstly the possibility of tumour seeding and spreading of infection with VATS (Weber et al, 2001) and secondly the fact that VATS surgery missed 2-3% of lymph nodes during resection in cancer patients (Grogan and Jones, 2008). The causes for high conversion rates of VATS to open thoracotomy should also be considered. Weber et al (2001) reported a conversion rate of 15.9% in a study of 64 patients. Reasons for conversion is not mainly dependent on surgical skills (Rocco et al, 2014). Other common reasons for conversions include lymph node metastasis (Weber et al, 2001), parenchymal or pleural scarring and adhesions (Weber et al, 2001; Grogan and Jones, 2008), hemorrhage (Grogan and Jones, 2008) and tuberculosis (Weber et al, 2001). The latter resulting in a 50% conversion rate (Weber et al, 2001). This is very relevant in South-Africa especially when considering the TB statistics and management mentioned in section 2.3.

A retrospective study by McElney et al (2013) showed that even with VATS as a surgical option, 40.5% of patients still received first choice elective open thoracotomy lobectomies and that the remaining 59.5% VATS group presented with a 9.4% conversion rate to open procedures. VATS is however considered an acceptable alternative to open thoracotomy in

certain populations, for example in patients with stage 1 non-small cell lung cancer (Grogan and Jones, 2008) or bronchiectasis (Weber et al, 2001). The choice to use the challenging VATS procedure and the evaluation of the patient's eligibility ultimately resides with the surgeon (Weber et al, 2001; McElney et al, 2013).

2.6 COMPLICATIONS

Patients receiving thoracic surgery are deemed a high risk surgical population due to their increased possibility of complications after surgery (Owen et al, 2013; Mans, Reeve and Elkins, 2014). Major complications have been reported as high as 38% (Reeve, Denehy and Stiller, 2007; Owen et al, 2013). Post-operative complications lead to increased mortality, morbidity and length of hospital stay (Agostini et al, 2011; Owen et al, 2013; Mans, Reeve and Elkins, 2014). Complications will be discussed under the following headings:

2.6.1 Postoperative Pulmonary complications (PPCs)

2.6.2 Non-pulmonary complications

2.6.1 Postoperative Pulmonary Complications (PPCs)

Pulmonary complications have been defined by O'Donohue (1992: p174) as "…a pulmonary abnormality that produces identifiable disease or dysfunction that is clinically significant and adversely affects the clinical course". Co-morbidities that increase the risk for developing pulmonary complications after surgery include smoking, obesity, diabetes mellitis, underlying lung disease, pre-existing cardiovascular disease, poor exercise tolerance and advanced age (Reid et al, 2010; Pipanmekaporn et al, 2014). Further risks for pulmonary complications include extended mechanical ventilation period (Mans, Reeve and Elkins, 2014) and a longer surgical procedure duration (Pipanmekaporn et al, 2014).

Post thoracotomy pulmonary complications have been stated to have an incidence of 15%-59% (Agostini et al, 2009; Reid et al, 2010; Owen et al, 2013). This significant variation can be due to different definitions and measurement tools used to determine and describe the complications (Agostini et al, 2009). The different diagnostic tools that are used comprise of radiological-, haemodynamic- and clinical findings (Reid et al, 2010; Mans, Reeve and Elkins, 2014), including the presence of fever and purulent secretion.

These complications include but are not limited to pneumothorax, atelectasis, pleural effusions, pneumonia (Burd et al, 2002), FRC and a reduction in vital capacity (VC) of up to 15%-40% (Doan et al, 2014). Reid et al (2010) recorded the following percentages for specific pulmonary

complications: atelectasis (95%), lung collapse (40.5%), and consolidation (57.1%). Although atelectasis (the most frequent complication) was not considered a serious complication, it was considered an early identifier of significant lung collapse at a later stage and a major contributor to ventilation/perfusion mismatch resulting in hypoxemia (Reid et al, 2010; Doan et al, 2014).

After major surgery, of which open thoracic surgery forms part, patients present with high levels of pain (Athanassiadi et al, 2007; Reid et al, 2010; Mans, Reeve and Elkins, 2014) and altered respiratory mechanics (Doan et al, 2014; Mans, Reeve and Elkins, 2014). These may not only lead to a reduction in maximal inspiratory pressure, but also impede on physiotherapy treatment, (Athanassiadi et al, 2007; Reid et al, 2010) predisposing these patients to post-operative pulmonary complications (Mans, Reeve and Elkins, 2014). Elevated pain levels may lead to decreased mobility and chest expansion. This in turn might amplify the incidence of complications due to decreased coughing effort and secretion clearance, which can lead to infection and progressive atelectasis (Reid et al, 2010).

2.6.2 **Non-Pulmonary Complications**

Owen et al (2013) cited medical complications of 64% and surgical complications of 20%. With the most common major complication being cardiac arrhythmias in 17% of patients. Pipanmekaporn et al (2014) did a retrospective review of one university hospital and confirmed the most common cardiovascular complications as arrhythmias and myocardial ischemia. Of the 719 patients included in this study, all of whom received thoracic surgery for non-cancerous lesions, 6.7% presented with cardiovascular complications. Risk factors for developing cardiovascular complications include a longer operating time, intra-operative hypotension, intra-operative blood loss, advanced age and diabetes. No association could be found between the development of cardiovascular complications and the type of surgery or the surgical approach. They concluded that appropriate pre-operative screening and evaluation of patients are needed to identify cardiovascular risk factors. Morbidity and mortality rates can be reduced if medical interventions are applied to optimise the patient's condition before surgery.

Owen et al (2013) stated post pneumonectomy empyema and bronchopleural fistulas are two of the most dreaded surgical complications after open thoracic surgery and have been associated with high morbidity and mortality rates. The incidence of post pneumonectomy empyema was reported between 5% and 41.2%. Hemorrhage leading to reoperation was only reported in 6% of patients.

In a review by Doan et al (2014), acute post-operative pain after thoracotomy was said to be moderate to severe and described as stabbing, shocking and burning. The pain usually presented in and around the incision area but can refer several rib levels up or down from the surgical site. The reason for acute post-surgical pain is attributed to multiple factors including trauma from the skin incision, inflammation of chest wall structures including acute costochondritis, rib injuries and damage to the pleurae. Post-surgical acute pain is also associated with the stress response due to an increase in catecholamine and catabolic hormone secretions. This in turn results in tachycardia, hypertension, hyperglycemia and an increase in coagulability contributing to deep venous thrombosis and ischemia of the myocardium (Doan et al, 2014).

Post-operative ipsilateral shoulder pain and dysfunction was reported to be commonly associated with open thoracotomy, especially with the MST approach as the arm needs to be raised higher than the head to allow a better surgical view (Martinez-Barenys et al, 2011; Ohmori et al, 2013; Doan et al, 2014). Martinez-Barenys et al (2011) reported that up to 62.5% of post-thoracotomy patients have some degree of shoulder pain. Ohmori et al (2013) supported this high incidence of shoulder pain with a 52.9% incidence of shoulder pain in a group of 70 patients after MST. In the Ohmori et al (2013) study, 70% of patients reported pain in the infraspinatus and supraspinatus regions with 43.2% also presenting with trigger points and myofascial involvement of said areas after MST. However, Martinez-Barenys et al (2011) reported that phrenic nerve infiltration supplied significantly better shoulder pain alleviation than suprascapular nerve block, suggesting a visceral origin of shoulder pain rather than myofacial. Considering the anatomy and that the suprascapular nerve only innervates motor supply to the supraspinatus and infraspinatus muscles and sensory innervation to the posterior part of the shoulder, nerve block of suprascapular nerve might not decrease pain produced by these muscles or reduce anterior shoulder pain, typically reported after thoracic surgery. Supraspinatus and infraspinatus trigger points cause both anterior and posterior shoulder pain whereas phrenic nerve refer pain to the 3rd,4th and 5th cervical dermatomes also causing anterior shoulder pain (Simons and Travell, 1999; Moore, Dalley and Agur, 2010). The explanation for shoulder pain after thoracotomy is ascribed to diaphragmatic irritation and referral from the phrenic nerve, although musculoskeletal causes have not been investigated in full and can therefore not be excluded (Hirayama et al, 2003; Ohmori et al, 2013). Although shoulder pain seems to be a temporary problem as 89% of patients with shoulder pain report

full resolution by discharge (Martinez-Barenys et al, 2011), it can still be severe and debilitating and can contribute to the development of other complications.

Khan et al (2000) determined that all patients in their retrospective study suffered varying degrees of long term post-surgical pain and that 50% of patients still used analgesics one year and longer after surgery. They postulated that most of the post-thoracotomy pain was likely to be induced by the rib spreader causing pressure, crush and stretch injuries on the intercostal nerves and that some of the pain may be due to trauma to joints, ligaments and paraspinal muscles. Karmakar and Ho (2004) reported that 30% of patients still experienced pain four to five years after surgery.

Post thoracotomy pain is defined by the IASP (International Association for the Study of Pain) (1986) as pain not relating to metastasis or other identifiable causes that recur or persist along a thoracotomy scar for at least two months following surgery. It is commonly described as post-thoracotomy pain syndrome (PTPS) (Hopkins and Rosenzweig, 2012; Doan et al, 2014) or chronic post-thoracotomy pain (CPTP) (Yarnitsky et al, 2008). Yarnitsky et al (2008) reported a 58% (36/62 patients) incidence of PTPS in their study. However a prospective study by Guastella et al (2011) found that from the 54 patients evaluated, 49 still had pain two months after surgery and that a staggering 38 patients still had pain after six months, indicating a minimum incidence of 70% of chronic post-surgical pain. Of these only 29% could definitely be ascribed to neuropathic pain.

Both CPTP and PTPS are described as burning and stabbing (Doan et al, 2014). Allodynia and abnormal pseudo-motor activities are often part of the symptom list and indicate a change in conduction and central processing (Bogduk, 2009; Doan et al, 2014). The pain is usually elicited with movement including coughing and with palpation of the scar. In severe cases pain might even be present at rest and in inclement weather. Furthermore, both CPTP and PTPS lead to significant impairment of quality of life with 50% of patients reporting sleep disturbances, 60% activity limitation and 38% depression and anxiety (Doan et al, 2014). Risk factors for developing PTPS include the female gender, pre-operative pain and extensive surgery (Doan et al, 2014).

2.7 GENERAL PRINCIPLES OF POST-OPERATIVE CARE

According to Shields (2005) the post-operative care of the thoracic surgery patient is divided into four main categories namely; care of the cardiovascular system, care of the respiratory

system, drainage and obliteration of the pleural space and control of post-operative pain. Shields (2005) made the following brief comments:

2.7.1 Care of the Cardiovascular System

Fluid management is of utmost importance to prevent intravascular fluid overloading that may result in heart failure. Careful and intensive monitoring of the patient, including central venous pressures, are suggested to evaluate cardiac oxygen consumption and to recognise early signs of arrhythmias and ischemia. Electrolytes need to be observed and abnormalities should be treated aggressively in order to prevent rhythm disturbances due to hypokalemia and arterial hypoxemia (Shields, 2005).

2.7.2 Care of the Respiratory System

Attention is focused on prevention of pulmonary complications. Full pulmonary function testing and blood gas readings need to be considered in the case of dyspnea, as it is a predictor of mortality. The patient should be taught to generate an effective cough with necessary support. Proper positioning of the patient is important to allow gravity to assist in keeping the diaphragm depressed. Physical therapy is considered a vital part of the post-operative regime to assist with secretion clearing. Prolonged intubation and ventilation might be considered in patients who have abnormal blood gas values or who struggle with respiratory insufficiency due to impaired pulmonary function after extremely long procedures. Decreased FRC is considered the most significant cause of post-operative morbidity (Shields, 2005).

2.7.3 Drainage and Obliteration of the Pleural Space

Due to the normal negative pressure in the pleural space all patients undergoing a thoracotomy are left with some degree of pneumothorax and the potential to develop a residual pleural space. Drainage tubes are placed *in situ* to afford evacuation of air, blood and other accumulated fluids from the pleural space. The site of drain incision is determined by the surgeon’s preference (Shields, 2005).

2.7.4 Control of Post-Operative Pain

During the last decade, following the awareness that uncontrolled pain contributes to most post-operative complications, major advances have been made in the control of post-operative pain (Shields, 2005). Several high quality studies have compared different interventions in pain management strategies including epidural vs systemic analgesia (Tiippana et al, 2014), cryoanalgesia vs parenteral opiates (Moorjani et al, 2001), paravertebral vs epidural

catheterisation (Gulbahar et al, 2010), gabapentin vs normal analgesia (Grosen et al, 2014). However, no agreement has been reached on the ‘gold standard’ of pain management.

A review by Joshi et al (2014) stated that adequate management of acute pain does not only lead to a decrease in complications in the early period after surgery but may have long term consequences in preventing chronic pain. Although the intensity of acute pain does not always directly correlate with the intensity and incidence of long term post-operative pain, it was suggested to use preventative analgesia in order to avoid central centralisation. Benefits of optimal pain control are not disputed, with massive advances especially in analgesic pharmacology. Hence, even with clinical guidelines available, pain management remains a major challenge. This might be due to the generic approach of suggesting the same set of guidelines for pain control after any type of surgery. Joshi et al (2014) suggested a procedure specific pain management (PROSPECT) approach to overcome this problem. PROSPECT recommends multimodal analgesic strategies after all surgical procedures including thoracotomy. Multimodal analgesic suggests a combination of analgesics with different mechanisms and action sites. It is common clinical practice to use three or more analgesics of which opioids form part of, but limited data is available (Joshi et al, 2014).

The management of PTPS is multimodal and include pre-emptive strategies, regional techniques, pharmacology, intra-operative strategies, and non-pharmacologic strategies of which physiotherapy forms part (Doan et al, 2014).

2.8 PHYSIOTHERAPY MANAGEMENT OF A PATIENT THAT HAD AN OPEN THORACOTOMY PROCEDURE

The aim of physiotherapy management is to minimise and to help with quick resolution of post-operative complications (Reid et al, 2010). Several peri-operative interventions are utilised (Mans Reeve and Elkins, 2014) to reverse atelectasis and decrease secretion retention (Agostini et al, 2009). Management strategies available for physiotherapy all emerged from international studies and up to date no relevant studies could be found regarding physiotherapy management specific to this population of patients in South Africa. Management of the open thoracotomy patient will be discussed under the following headings:

2.8.1 Pre-operative management

2.8.2 Post-operative management

2.8.1 Pre-Operative Management

In two similar surveys done by Reeve et al (2007) and Agostini et al (2013) to ascertain the service provision by physiotherapists to patients after open thoracic procedures, pre-operative care was indicated to be provided by 35% and 87% of physiotherapists respectively. This included a face-to-face assessment of patients and the teaching of the following respiratory manoeuvers: huffing and coughing (89%), DBE (70%) ACBT (63%), IS (27%) and pre-operative pulmonary rehabilitation (23.9%-45%). The Reeve et al study (2007) used a purposed designed questionnaire that was distributed to the senior physiotherapist at 40 identified cardiothoracic surgical facilities across the UK. A response rate of 78% (n=31) was obtained. Agostini et al (2013) distributed an adapted form of the questionnaire to the senior physiotherapists to 57 thoracic unit across Australia and New Zealand and reported a response rate of 81% (n=46). Both studies sought information regarding pre- and post-operative service provision as well as physiotherapy management after discharge from hospital. Factors which influenced service provision were also ascertained.

Mans et al (2014) reported in a systematic review and meta-analysis that pre-operative inspiratory muscle training was effective in preventing post-operative pulmonary complications (PPCs). Inspiratory muscle training is implemented by applying resistance during inspiration in order to increase muscle strength and endurance. The results indicated that pulmonary function was significantly improved in the early post-operative period leading to a 50% reduction in pulmonary complications. Length of hospital stay was not statistically affected by this intervention but a mean reduction of 1.7 days could certainly be considered clinically important. They concluded that when considering cost and effort of implementing inspiratory muscle training as routine, they would preferably recommend clinicians to implement this intervention only for high risk patients.

A small study by Reid et al (2010) found no significant difference when pre-operative education was added to standard care between the treatment and control group. They reported that the addition of only pre-operative education to normal hospital care did not alter the incidence or pattern of post-thoracotomy pulmonary complications. The education strategy followed in this study included information and demonstration on deep breathing exercises, splinted coughing, shoulder range of motion exercises and ankle pumps to prevent thrombosis. A summary of all the information was given to each patient in the form of a pamphlet. They

suggested that a more active rehabilitation programme should be included together with the pre-operative education.

Although studies done in other major surgery groups (abdominal and coronary artery bypass grafts (CABG)) have found that tailored pre-operative physiotherapy interventions drastically reduced post-operative pulmonary complications (Hulzebos et al, 2006; Dronkers et al, 2008), literature relating to open thoracic surgery in this regard is sparse. Unsurprisingly, physiotherapists indicated that their pre-operative management was primarily influenced by personal experience (Reeve et al, 2007; Agostini et al, 2013).

2.8.2 **Post-Operative Management**

Inspiratory and expiratory muscle weakness have been demonstrated to be present up to twelve weeks after cardiothoracic surgery (Mans, Reeve and Elkins, 2014). Respiratory muscle weakness has been shown to be a predisposing factor to post-surgical pulmonary complications (Mans, Reeve and Elkin, 2014). As stated *supra* physiotherapy is considered to prevent the incidence of both pulmonary and other complications associated with decreased mobility. Post-operative physiotherapy management will be discussed under:

2.8.2.1 Management during hospital stay

2.8.2.2 Post discharge management

2.8.2.1 **Management during hospital stay**

Agostini et al (2013) and Reeve et al (2007) both reported that 97% of physiotherapists indicated that they see all patients post-thoracotomy (Reeve, Denehy and Stiller, 2007; Agostini et al, 2013). Prophylactic treatment was rendered by 63%-81% of physiotherapists across New Zealand and the UK, irrespective of the patient's presentation (Reeve, Denehy and Stiller, 2007; Agostini et al, 2013). However, post-operative physiotherapy may not add benefit - except for early mobilisation - in reducing complications, as emerged in other high risk surgery groups (Mackay et al, 2005). It still needs to be determined if this level of early stage prophylactic intervention is necessary in the open thoracic surgery population (Reeve, Denehy and Stiller, 2007). A high percentage (80.4%) of respondents indicated that they already started treatment on the first day after surgery providing respiratory physiotherapy, and mobilising patients (Reeve, Denehy and Stiller, 2007). Respiratory techniques commonly utilised by physiotherapists during post-operative management were indicated as the following: coughing (97%), DBE (90%), forced expiratory techniques (FET) (84%), ACBT (71%), IS (35%) and sniff (23%) (Agostini et al, 2013). Incentive spirometry, although still widely used,

was demonstrated by Gosselink et al (2000) to have no benefit in preventing post-thoracotomy pulmonary complications. An older study by Weiner et al (1997) reported that although the reduction in post-surgical complications was not documented, IS resulted in faster improvement of lung function after surgery. Mobilising activities that were routinely instituted by the physiotherapist included sitting out of bed (90%), early assisted mobilisation (71.7%), marching next to bed (13%), shoulder range of motion exercises (93.5%) and mobility exercises of the thorax (73.9%) (Reeve, Denehy and Stiller, 2007; Agostini et al, 2013).

Agostini et al (2009) conducted a systematic review on the use of incentive spirometry following thoracic surgery. There seems to be conflicting evidence about the effectiveness of incentive spirometry with some for (Varela et al, 2006) and some against (Gosselink et al, 2000) the use of said devises. Agostini et al (2009) concluded that the minimal amount of available literature does support the effectiveness of post-operative physiotherapy with or without incentive spirometry when compared to no physiotherapy input. Incentive spirometry mimics the physiological requirements for lung re-expansion with deep breathing exercises, namely a slow and long inspiration with an inspiratory hold at the end. The incentive spirometry device offers added benefit of visual feedback. This in turn can encourage patient compliance as it allows measurement of effort and can lead to improved technique.

In a randomised controlled trial (RCT) done by Reeve et al (2010) to determine the incidence of PPCs after pulmonary resection via thoracotomy, 76 participants were enrolled in their single blind trial. It was a parallel group comparison with 42 patients allocated to the treatment group and 34 to the control group. The treatment group received daily respiratory interventions that included deep breathing exercises, coughing exercises and progressive shoulder and thoracic cage mobility exercises, until discharge. The control group received only standard medical and nursing care involving a clinical pathway. Both groups were subjected to early ambulation instituted by different members of the health team, which included sitting out of bed and walking. Although the treatment group could mobilise over ten meters significantly earlier than the control group, this did not translate to a reduction of PPCs or length of hospital stay. The results from this study indicated that targeted post-operative physiotherapy did not decrease the incidence of PPCs or length of stay when compared to a ‘no physiotherapy’ group. Care needs to be taken when extrapolating these results to other populations, as the group had a much lower rate of PPCs (3.9%) than the 15%-46% reported by other authors (Reid et al, 2010; Owen et al, 2013). This might indicate the possibility of an accidental low risk group of patients, or possibly the Hawthorne effect on nursing staff and patients alike. The

latter leading the observers to improve or modify their behaviour in response to change in their environment or being observed, leading to temporary increases in productivity.

Reeve et al (2010) conducted a randomised trial on 76 patients to determine the efficacy of a supervised post-operative shoulder exercise program to decrease pain and increase function and quality of life. The results indicated significant reductions in total pain scores at discharge as well as at the one and three month follow up in the experimental group. The latter also fared significantly better when comparing scores from the Shoulder Pain and Disability index, a recognised standardised outcome measure. Range of motion, muscle strength and quality of life however did not show statistically significant differences between the treatment and control group. Though quality of life did not show statistical significant changes between groups, the fact that the experimental group scored 4.8 points higher on the physical component at three month follow-up is clinically significant. The clinical relevance of the rest of the results need to be considered if it is taken into account that most of the patients (both groups) returned to their pre-operative levels at the three month follow up.

Early exercise intervention was tested in two randomised trials by Arbane et al (2011, 2014) to assess the effect on improvement of quality of life, muscle strength and exercise tolerance. Although strength training has been shown to limit muscle strength decline, no effect was found on quality of life at four weeks post-operative. All subjects returned to their pre-operative base line scores regardless of intervention or not. This is in contrast to studies done by Spruit et al (2006) and Cesario et al (2007) which reported significant improvement in exercise tolerance in the experimental groups, although both studies subjected the experimental groups to more intensive, lengthier interventions with higher cost implications.

Acute post-operative pain management is not considered the physiotherapists domain, with pharmacological analgesia being the option of choice as discussed in section 2.7.4. However, Fiorelli et al (2012) demonstrated that TENS is effective in reducing acute pain during the first five days post thoracotomy. They assigned 25 patients to the TENS group, which received 30 minutes of stimulation every four hours for 48 hours. For the consecutive days, up to the 5th post-operative day, stimulation was limited to twice a day for 30 minutes. The 25 patients assigned to the control group received the same periods of therapy, with a TENS unit that looked identical and also displayed the same operating lights, but received no electrical current. Transcutaneous electrical nerve stimulation has been used to treat acute and chronic pain since the 1970’s and its’ effectiveness to treat post-surgical pain has been shown in

several surgical populations including abdominal surgery (Dronkers et al, 2008). Results from Fiorelli et al's (2012) study indicated reduced cytokine levels, a significant decrease in visual analogue scale (VAS) scores, reduced analgesic consumption and better recovery rates of forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) in the experimental TENS group. Several studies concurred regarding the efficacy of TENS for management of post-thoracotomy pain (Erdogen et al, 2005; Solak et al, 2007; Fiorelli et al, 2012). This is in contradiction to Benedetti et al (1997) who reported that TENS was not effective for pain control in patients undergoing PLT. This could be due to different parameters and techniques used in the older study. Although results may seem conflicting, most indicate benefit to the patient and is furthermore considered to have limited or no side-effect, compared to drug therapy making it a viable option for pain control.

Despite evidence that might in some instances indicate otherwise, post-operative service provision after thoracotomy is still deemed beneficial by thoracic surgeons (Varela, 2010). Varela (2010) also cautioned that results indicating post-operative physiotherapy as ineffective should be evaluated with care, and not be used by hospital administrators as 'evidence based' justification to incorporate savings. He concluded that while in some countries health facilities have abundant personnel to help with early patient ambulation and coughing, in others instituting these activities would solely be the responsibility of the physiotherapist.

2.8.2.2 **Post discharge management**

Physiotherapeutic interventions provided to patients after discharge are reported to be infrequent (Reeve et al, 2007, Agostini et al, 2013). Reeve et al (2007) reported that more than half of respondents indicated not supplying post discharge pulmonary rehabilitation. This, regardless of the evidence emerging that post discharge pulmonary rehabilitation is of benefit to the patient, even though it needs to be mentioned that all the available studies have been done in the cancer population. A great concern is the fact that relatively few respondents offered assessment or management of ongoing problems after discharge. The limited number of respondents offering post discharge management indicated the use of scar tissue mobilisation, thoracic mobility exercises and TENS.

Hirayama et al (2003) treated a series of eight patients that still had pain 14 days after posterolateral thoracotomy. They postulated that due to the limited shoulder and thoracic cage movement post-surgery, muscles shortened and caused further restriction in range of motion. The treatment was aimed to decrease muscle tension and ultimately, pain. The patients

received weekly treatments for three consecutive weeks that consisted of stretching and pressure friction. The muscles that were targeted during the treatment included latissimus dorsi, serratus anterior, rectus abdominus, external oblique and pectoralis major. Passive movements were used to measure and reassess range of motion and a 10 point visual analogue scale (VAS) for pain. Serratus anterior was found to be the most painful and restricted muscle after open thoracotomy. The results indicated a VAS reduction from 10 on the VAS (10/10) pretreatment to 4-6/10 after the treatment - an increase in range of motion was not tabulated. All eight patients were on oral non-steroidal anti-inflammatories before and during the treatment period. This case series showed significant reduction in pain measured with the VAS and alludes to the possibility that manual therapy has the potential to assist in longer standing reduction in post-thoracotomy pain, especially if used concomitantly with analgesics.

Reeve et al (2010) reported on the efficacy of a post-operative shoulder rehabilitation programme. This study, as discussed under 2.8.2.1 *supra*, administered an active physiotherapeutic program during hospital stay. After discharge, continued management of shoulder pain and dysfunction was left to the patient. Patients received an exercise sheet and diary from the physiotherapist on discharge from hospital and was expected to continue on their own. This approach of exercise advice at discharge with no outpatient follow up, is consistent with the management across Australia, New Zealand and the UK. (Reeve et al, 2007; Agostini et al, 2013).

Acupuncture as an alternative pathway to obtain optimal analgesia was tested by Deng et al (2008). Needles are widely known and used as a complementary treatment during pain management. Although the needles in this study were applied by acupuncturists, physiotherapists are qualified to apply needles using the ‘dry needling’ technique in South Africa (South African Society of Physiotherapists, 2012). The study only measured pain with the brief pain inventory (BPI) on day 10, 30, 60 and 90. They found no significant benefit to the acupuncture group in alleviating pain at any stage of measurement. This is in contrast with results from a RCT done by Kotani et al (2001) on patients receiving abdominal surgery. They reported greater pain control in the experimental group. Severe pain at rest on day one post-operative was present in only 47% of patient’s in the experimental group (acupuncture) vs 72% in the control group (no acupuncture). Furthermore patients in the experimental group had 25% less need for morphine during the first four post-operative days. Supporting the efficacy of acupuncture, a meta-analysis by Linde et al (2001) indicated that acupuncture can be

beneficial in the treatment of acute and chronic pain. Although results are conflicting or inconclusive there seems to be a group of physiotherapists that have good clinical results for pain relief after thoracotomy with dry needling in practice.

Transcutaneous electrical nerve stimulation, as discussed in 2.8.2.1 *supra*, is also utlised by physiotherapists to manage ongoing post-thoracotomy pain after discharge (Reeve et al, 2007).

2.9 CONCLUSION

There are several different incision types for open thoracotomy including PLT, MST and limited anterior or lateral thoracotomy. Open thoracotomy access to the chest is used for an array of internal procedures for example spinal fusions, cardiac valve replacements and pulmonary procedures like lobectomies. An alternative to open thoracotomy is VATS.

Post-operative care after open thoracotomy incisions include support of the cardiovascular and respiratory systems, as well as drainage of the pleural space and pain control. Non-pulmonary and pulmonary complications are high in this surgical group and prevention is of high priority in this phase.

There is conflicting evidence as to the efficacy of pre-operative physiotherapy interventions in the open thoracic surgery patient. Pre-operative physiotherapy provision seems to match the evidence available as the percentage of patients receiving interventions before surgery vary. Physiotherapy supplied to a high or low risk patient during hospital stay is mainly focused on preventing respiratory complications. Even though most studies do not show a huge/significant advantage of physiotherapy, it is still supplied to most patients and is deemed necessary by thoracic surgeons. Post discharge physiotherapy appears to be of little concern to the medical team as most interventions are discontinued at discharge, leaving the patient vulnerable to develop functional disabilities and chronic pain.

It is evident from the literature review that available evidence for physiotherapy management does not reflect the unique South African population. It is therefore imperative to determine which physiotherapy treatment modalities and techniques are currently being used in the management of thoracotomy patients in Gauteng to give a glimpse of current practice in South Africa.

Chapter 3 consists of a discussion/lay out of the methodology used to design and conclude the study.

CHAPTER 3

3. METHODOLOGY

3.1 STUDY DESIGN

This was a descriptive, cross sectional study using a self-administered questionnaire.

3.2 STUDY POPULATION

3.2.1 Source of Participants

The population for the study comprised of all physiotherapists registered with the South African Society of Physiotherapists (SASP) working in the Gauteng province.

3.2.2 Sample Selection and Size

A sample of convenience was used and included the 1389 physiotherapists registered with the SASP in Gauteng province.

3.2.2.1 Inclusion criteria

The following individuals were included:

- Physiotherapists working in the Gauteng province, registered with the SASP
- Physiotherapists involved in the treatment of thoracotomy patients

3.3 MEASURING INSTRUMENTS

The measuring instrument used in this study was a self-administered questionnaire. The details of the questionnaire will be outlined below.

3.3.1 The Questionnaire

A self-administered questionnaire was used to obtain the data (Appendix A). The questionnaire was developed with the aid of the current available international literature and by adapting the standardised questionnaire used by Reeve, Denehy and Stiller (2007) and Agostini, Reeve and Dramond (2013) (Appendix B) in similar studies done in New Zealand and the United Kingdom with permission from the author MS J. Reeve (Appendix C).

The questionnaire comprised of the following sections:

3.3.1.1 **General information**

Section one of the questionnaire collected demographic data of participants including age, gender, highest qualifications, previous continuous professional development (CPD) activities attended and employment information.

3.3.1.2 **Service provision**

Section two consisted of questions enquiring about the amount of thoracotomy patients seen by each participant. It also included questions regarding types of surgery undertaken in the unit participants worked in and average length of stay of patients.

3.3.1.3 **Pre-operative physiotherapy management**

Section three comprised of questions that aimed to collect information on the percentage of patients seen pre-operatively, the procedures routinely used by physiotherapists during pre-operative care and the procedures used to educate patients. Participants were also questioned on how much their patient management was influenced by a list of factors (Appendix A). Likert scale responses were used in this question.

3.3.1.4 **Post-operative physiotherapy management**

Section four comprised of questions relating to the care given to patients post-surgery while still in hospital. Questions included the frequency of treatment, day of commencement of treatment and procedures routinely used during post-operative care. Participants were also questioned on the post-operative day that they started with certain type of mobility exercises and what influenced their post-operative patient management.

3.3.1.5 **Post hospital discharge physiotherapy management**

Section five included questions on the frequency respondents referred and/or treated patients after hospital discharge. Information was collected to ascertain what the main reason was for treatment post hospital discharge as well as the treatment interventions utilised during this period.

Participants were given an opportunity to comment, share any concerns and ask questions before they completed the survey.

The questionnaire went through a content validation process as set out in section 3.3.2.

3.3.2 **Validity of the Questionnaire**

The content validity of the questionnaire was established through an expert peer-review panel.

3.3.2.1 **Objectives of expert peer-review panel**

- To determine the content validity of the questionnaire
- To omit unnecessary questions in order to reduce the length of the questionnaire.

3.3.2.2 **Inclusion criteria for the expert peer-review panel**

- Physiotherapist registered with the Health Professions Council of South Africa (HPCSA);
- Physiotherapist qualified for five years or longer;
- Physiotherapists who, on a regular basis treat patients who had a thoracotomy procedure, and
- Supervisors of the study

3.3.2.3 **Methodology of content validation of questionnaire**

Physiotherapists meeting the inclusion criteria were invited to participate in the review process. Eight experts were invited to participate in the content validation of the questionnaire but due to other obligations four declined.

The expert peer-review panel was comprised of four physiotherapists with experience in both academic and clinical fields.

The expert panel comprised of the following members

- Dr. R Roos – Qualifications include: BSc Physiotherapy; MSc Physiotherapy (Traumatology); Cardiopulmonary Physiotherapy course (CPT1) and Orthopedic Manual Therapy course (OMT1). Dr. Roos is a member of the Cardio-Pulmonary Rehabilitation Group (CPRG) and has 18 years of experience treating patients with cardiopulmonary impairments.

- Ms. V Naidoo – Qualifications include: BSc Physiotherapy; MSc Physiotherapy (Orthopedic Manual Therapy (OMT)) and OMT1. Ms Naidoo is a member of the Orthopedic Manipulative Physiotherapy Group (OMPTG) and has 18 years of experience treating patients with a primary focus on orthopedic patients but also general cardiopulmonary impairments.

- Ms. M Wilson – Qualifications include: Diploma Physiotherapy and OMT1. Ms Wilson is a member of the CPRG group and have been treating patients with cardiopulmonary impairments for 36 years.

- Ms. M Swansea – Qualifications include: BSc Honours and BSc Physiotherapy. Ms Swansea has been qualified as a physiotherapist for 25 years with a main focus on treating patients with cardiopulmonary impairments.

A draft of the questionnaire was sent out to each expert prior to the discussion in order to have each expert familiarise themselves with the questionnaire. The expert panel convened at a meeting on 27 May 2014 at The University of the Witwatersrand Physiotherapy Department, which was facilitated by the researcher. Each question was discussed to determine both the content validity and the clarity of the question. Input and suggestions were incorporated into the questionnaire and unnecessary questions were omitted to reduce the length of the questionnaire. The amended questionnaire was emailed to all experts for further review. The additional suggestions made by the experts were included. The provisional questionnaire was converted to a Survey Monkey format and piloted to test the practical application thereof, after all experts were satisfied with the content.

3.4 PROCEDURE

3.4.1 Pilot Study

3.4.1.1 Objectives of the pilot study

- To test the practical application of the questionnaire;
- To determine the amount of time it takes to complete the questionnaire, and
- To determine if any ambiguity exists.

3.4.1.2 Methodology of the pilot study

A total of 12 physiotherapists who met the inclusion criteria of the study were asked to complete the questionnaire. A link to the Survey Monkey questionnaire was emailed to each individual and they had one week to complete the questionnaire online. They were asked to provide feedback via email as to how long it took to complete and any problems that they encountered while completing the questionnaire.

3.4.1.3 **Results of pilot study**

Feedback included one spelling mistake in question 29 and a question logic problem associated with on-line questionnaires. The question logic option did not skip the pre-operative and post-operative physiotherapy management sections for participants that indicated that they do not treat post thoracotomy patients during hospital stay. Time indication varied from three minutes for a participant that did not treat post thoracotomy patients to 20 minutes for participants that treated post thoracotomy patients both during hospital stay and post hospital discharge. Amendments were made after analysing results and prior to the commencement of the main study.

3.4.1.4 **Implications of the pilot study**

No significant amendments were made to warrant the pilot participants to be excluded from the study.

3.4.2 **Main Study**

The aim of the research report was to establish which physiotherapy treatment modalities and techniques were used in the management of thoracotomy patients in Gauteng.

3.4.2.1 **Objectives of main study**

- To establish the profile of physiotherapists managing thoracotomy patients;
- To determine the physiotherapy treatment modalities and techniques which were used to manage thoracotomy patients both during hospital stay and after discharge, as an outpatient;
- To determine the factors that influence the choice of modalities and techniques used to treat patients undergoing a thoracotomy; and
- To determine which post-operative complications were addressed from a physiotherapeutic point of view.

3.4.2.2 **Procedure**

The questionnaire was loaded on to Survey Monkey and a link was created. Permission was obtained from the operational manager of the SASP to distribute the questionnaire link to their members registered in Gauteng via bulk email (appendix D). A request for a reminder email was submitted at the same time and again two weeks after the original email was sent out. The request for a reminder email was only granted three weeks after the first email was sent out. The questionnaire was redistributed via email. Participants were given a month to reply from

the first email being sent out. In order to increase the reply rate, the special interest groups (SIGs) of the SASP were targeted after this month. The chairpersons of the Cardio-Pulmonary Rehabilitation Group, Orthopedic Manipulative Physiotherapy Group and Pain SIGs were contacted to obtain permission to email the Survey Monkey link to access the questionnaire to their members registered in Gauteng. The decision to include the OMPTG and Pain SIGs was made because of the possibility that these might be the physiotherapists that treat patients presenting with complications at an outpatient level. The link was emailed and respondents were given one month to complete the questionnaire. Each participant was requested to complete the questionnaire only once, even if they received multiple emails.

3.5 ETHICAL CONSIDERATIONS

Ethical clearance was applied for, and granted by the University of the Witwatersrand Human Research Ethics Committee (Number M140414) prior to commencement of the pilot study and the main study (Appendix E). Participants were informed that completing the questionnaire would be considered as consent to participate in the study. No identifying information was obtained during the completion of the questionnaire to ensure confidentiality and all information obtained will remain confidential. Results of the study will be made available to the participants on request and via journal publication.

3.6 DATA ANALYSIS

The SPSS Statistics 22.0 statistical software was used to analyse the data from this study. Categorical parameters were summarised using frequencies and percentages. Means and standard deviations were determined for the demographic factors of age and years qualified.

Chapter 4 consists of an in depth analysis of data according to objectives set out in section 3.4.2.1.

CHAPTER 4

4. RESULTS

4.1 INTRODUCTION

In this chapter the sample and the results relating to each one of the four research objectives will be discussed.

The results will be given under the following subheadings:

4.2 Sample size

4.3 Objective 1: The profile of study respondents

4.4 Objectives 2 and 3: Study results related to physiotherapy management provided in hospital

4.5 Objectives 2 and 3: Study results related to physiotherapy management provided after discharge from hospital

4.6 Objective 4: The post-operative thoracotomy complications that are addressed from a physiotherapeutic point of view

4.2 SAMPLE SIZE

There were 1389 physiotherapists registered with the SASP in Gauteng at the time data collection commenced. The questionnaire was distributed to all registered physiotherapists. Three hundred and twenty three participated in the study, which translates to 23.3%. One hundred and forty one respondents (10.2%) met the inclusion criteria. Non-participation could be attributed to emails not being delivered, subject of email leading to biased participation and general unwillingness to participate in a time consuming non-profit activity. The poor response rate could furthermore be due to individuals refraining from participation due to the fact that they don't treat this kind of patients and thus the study did not pertain to them. Of the 323 respondents, 43.7% (n=141) indicated that they treated patients who received open thoracic surgery. Table 4.1 shows the distribution of physiotherapists who treat and don't treat patients after open thoracic surgery.

Table 4.1: Response rate of respondents regarding the management of patients after open thoracic surgery (N=323)

	Frequency (n)	Percent (%)
Physiotherapy management during hospital stay only	95	29.4
Physiotherapy management after hospital discharge only	25	7.7
Physiotherapy management during hospital stay and after hospital discharge	21	6.5
Do not treat patients who had thoracic surgery	176	54.5
Sub-total	317	98.1
Non-response to question posed	6	1.9
Total N (%)	323	100.0

Because the objectives of this study was based on physiotherapists that treat open thoracic surgery patients, the remainder of the results will mainly focus on these respondents feedback (n=141).

4.3 OBJECTIVE 1: THE PROFILE OF STUDY RESPONDENTS

4.3.1 Age Distribution of the Study Population

The age analysis of the study population of 141 participants (physiotherapists who treat patients after open thoracic surgery) revealed a mean age of 35.9 years (± 11.1). The youngest participant was 23 years old and the oldest participant was 69 years old.

4.3.2 Gender Distribution of the Study Population

Table 4.2 indicates the gender distribution of the study respondents who treat patients who received open thoracic surgery.

Table 4.2: Gender distribution of study respondents (N=141)

Gender	n (%)
Male	6 (4.3)
Female	135 (95.7)
Total N (%)	141 (100.0)

Analysis of the study population of 141 respondents showed 95.7% (n=135) percent were female and 4.3% (n=6) male.

4.3.3 Qualifications of the Study Population

The mean number of years of being qualified for the study population (N=141) was 13.4 (± 11.1) years, with the minimum being 1 year and the maximum 48 years since qualification.

The highest qualifications, as recognised by the South African Qualifications Authority (SAQA), acquired by respondents are listed in table 4.3.

Table 4.3: Highest qualification of study population (N=141)

	N	n (%)
Diploma in Physiotherapy	141	9 (6.4)
Bachelor in Physiotherapy	141	113 (80.1)
Masters in Physiotherapy	141	17 (12.1)
Doctorate in Physiotherapy	141	2 (1.4)
Total		141(100.0)

Of the respondents who treat patients after the latter have had open thoracic surgery, 80.1% (n=113) had a Bachelor degree in Physiotherapy with a National Qualifications Framework (NQF) level of seven and or eight.

Figure 4.1 shows the distribution of post graduate course qualifications of the study population (N=141). These courses included OMT1, CPT1, SPT (Sports physiotherapy), Pain, Dry needling and other courses not directly relevant to the study.

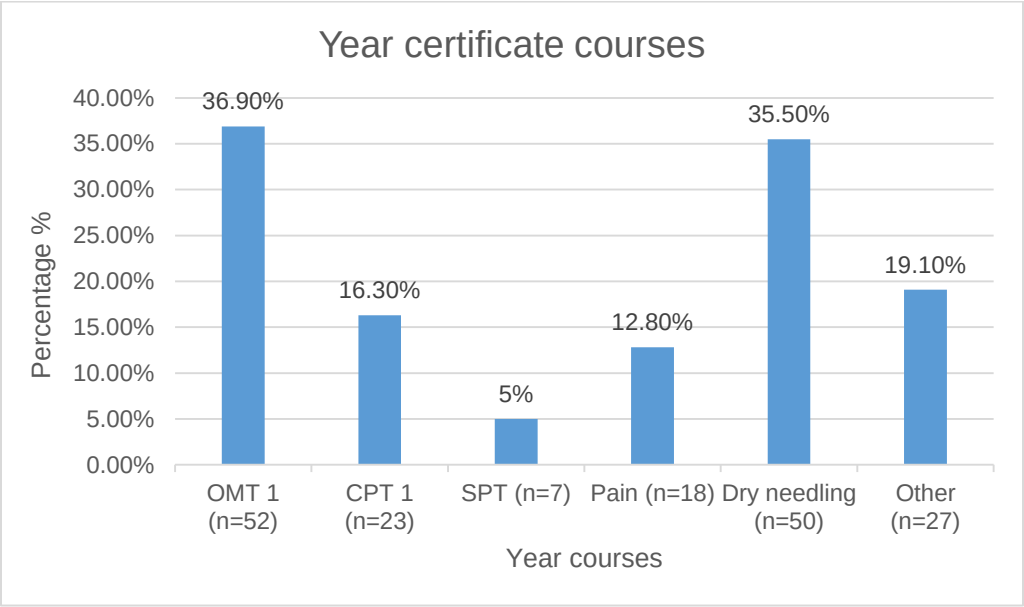


Figure 4.1: Respondents that completed one year certificate courses (N=141)

The year courses that were done by most respondents were OMT1 and Dry needling with 36.9% (n=52) and 35.5% (n=50) respectively. In total 177 course choices were marked, indicating that some respondents did two-or more- year certificate courses. Courses specified under 'other' included woman's health and neurology, as well as respondents indicating that they completed the year's course work but not the examination process.

4.3.4 Participation in Continuous Professional Development

It is compulsory for physiotherapists registered with the HPCSA to obtain 30 CPD points per year. Figure 4.2 indicates the participation of the study population in CPD activities during the last year.

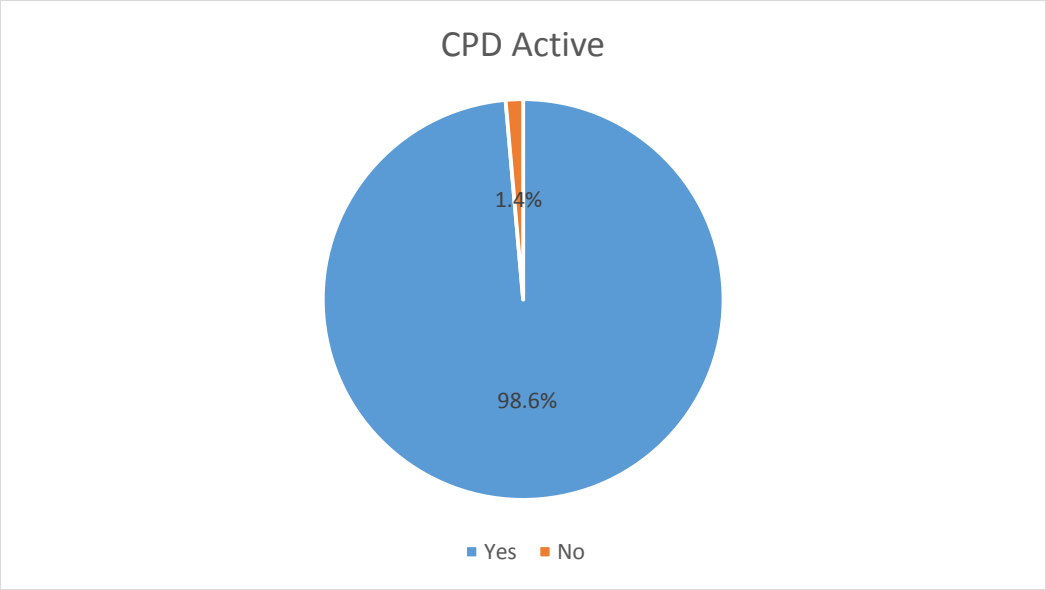


Figure 4.2: Respondents that were CPD active during the previous year (N=141)

Of the 141 respondents 98.6% (n=139) participated in CPD activities in one or more physiotherapy fields during the previous year. Only 1.4% (n=2) did not comply with HPCSA regulations.

The number of respondents who attended CPD activities during the last year according to the different special interest areas are shown in figure 4.3.

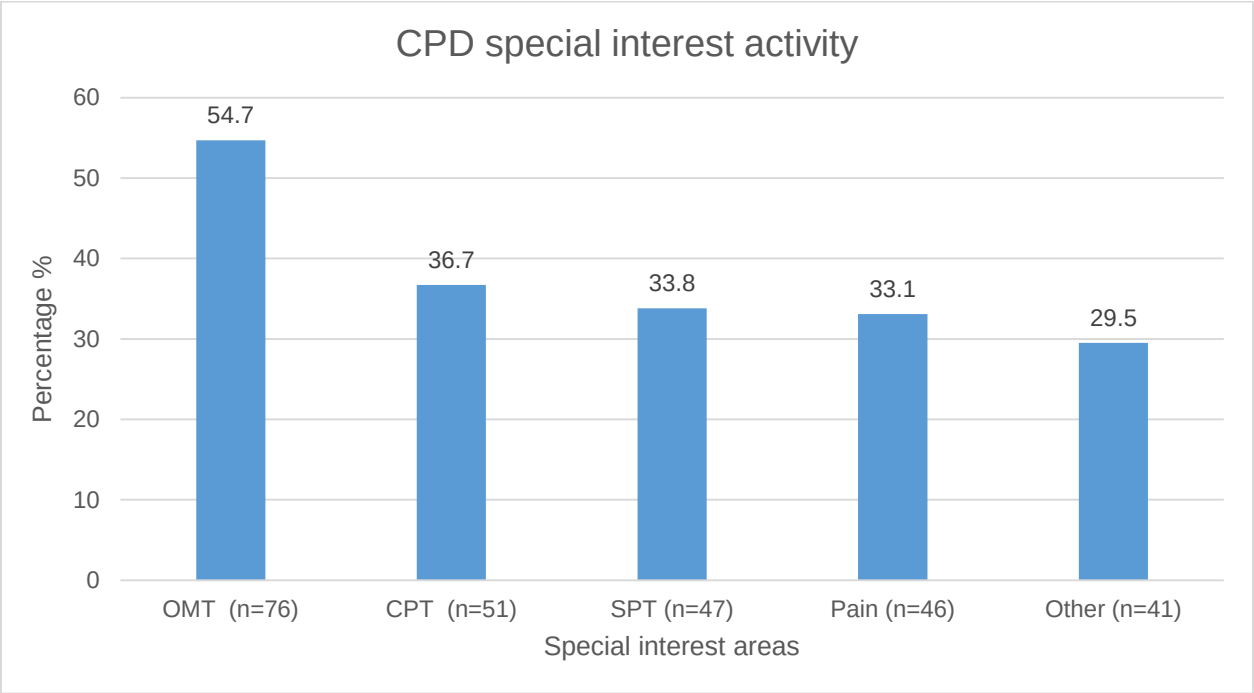


Figure 4.3: Respondents who attended CPD activities according to physiotherapy special interest areas

Of the respondents who treated thoracotomy patients, 54.7% (n=76) completed activities in OMT for the purposes of CPD. The other areas of special interest attracted similar participation, percentages ranging from 29.5% to 36.7%. Two hundred and sixty one responses were marked by the study population (N=141), indicating that several respondents stayed active/current in more than one field. While 82.3% of respondents (n=116) indicated that they treat patients during hospital stay (see table 4.1), only 36.7% (n=51) obtained CPD points in the CPT area whereas 32.6% (n=46) indicated that they treat patients after hospital discharge (see table 4.1) but 54.7% (n=76) obtained CPD points in the OMT field.

4.3.5 Special Interest Groups of the South African Society of Physiotherapy

The SASP has different special interest groups (SIGs) to which members can belong. These correlate with the different areas of special interest in which physiotherapists can do their CPD activities. Figure 4.4 shows the distribution of respondents (n=141) between those that belong to a special interest group and those that do not.

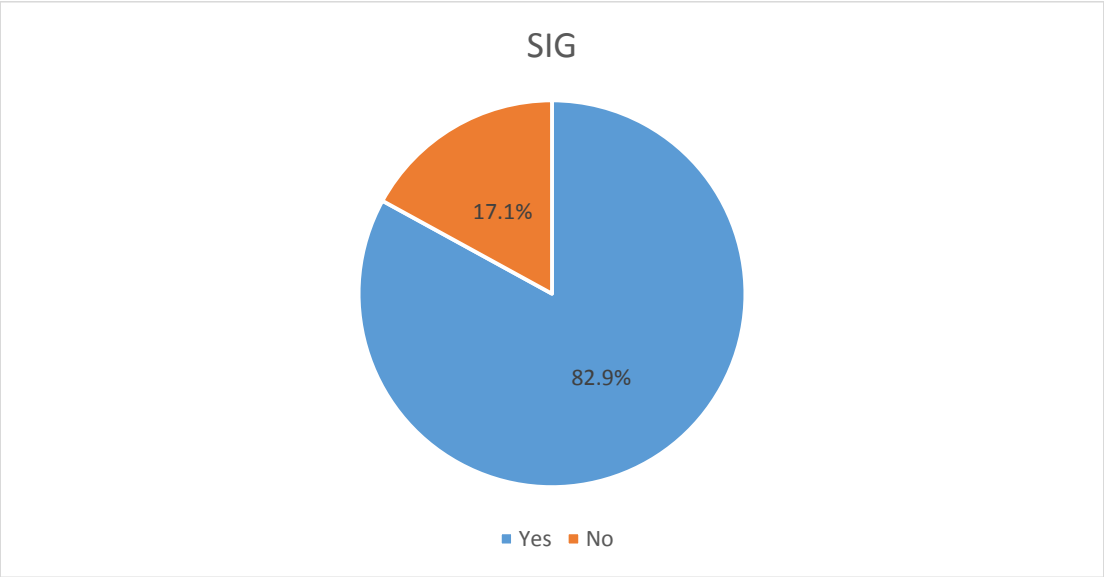


Figure 4.4: Respondents that belong to a special interest group (N=141)

In total 82.9% (n=117) of respondents indicated that they belonged to an SIG. These 117 respondents marked a total of 207 SIG memberships indicating that many of the 117 respondents belong to more than one SIG.

Figure 4.5 shows the breakdown of SIG memberships of study respondents.

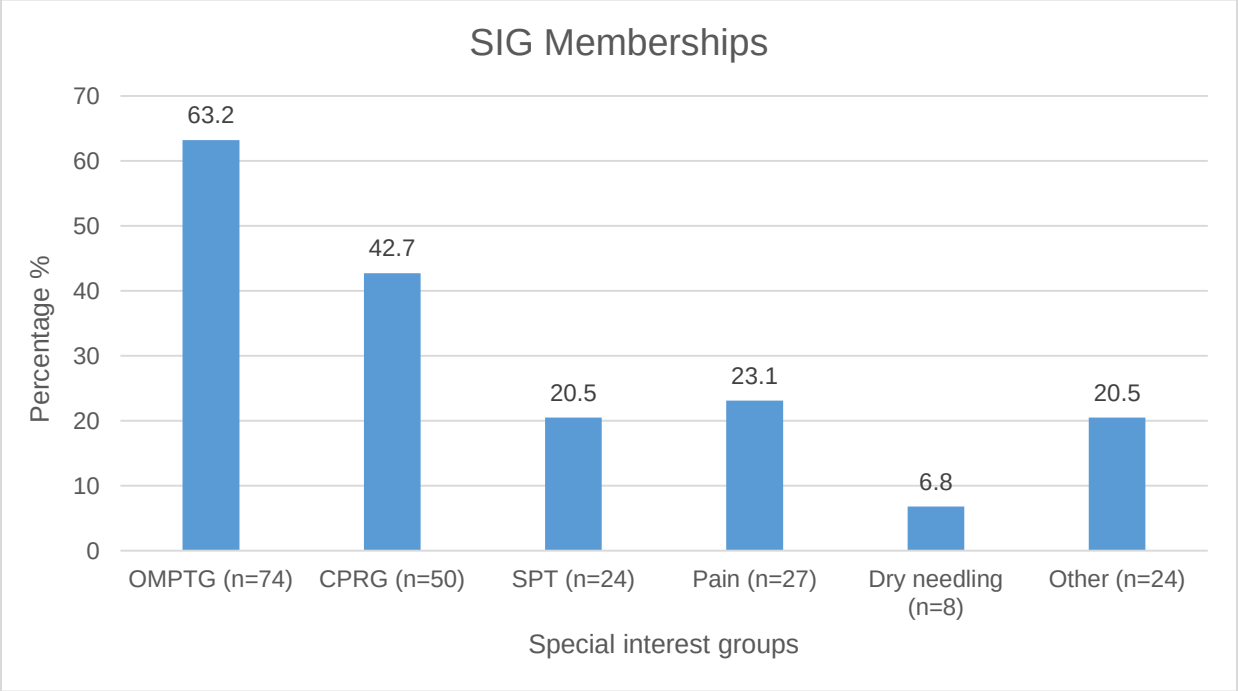


Figure 4.5: Results of study respondents' membership with special interest groups (N=117)

The majority of respondents indicated that they hold a current membership with the OMPTG (63.2%). The second largest SIG representation in the study population was the CPRG with 42.7 percent of respondents being members. Even though the majority of physiotherapists belonged to these two SIGs the ratio was skewed with the majority (63.2%; n=74) of physiotherapists being active OMPTG members and only 32.9% (n=46) of physiotherapists indicated that they treated open thoracotomy patients after hospital discharge (see table 4.1). The remaining special interest groups were represented between 6.8% and 23.1%.

4.3.6 Employment Specifics

Respondents that treated patients after open thoracic surgery were asked to indicate what their current employment entailed. The distribution of employment is depicted in figure 4.6.

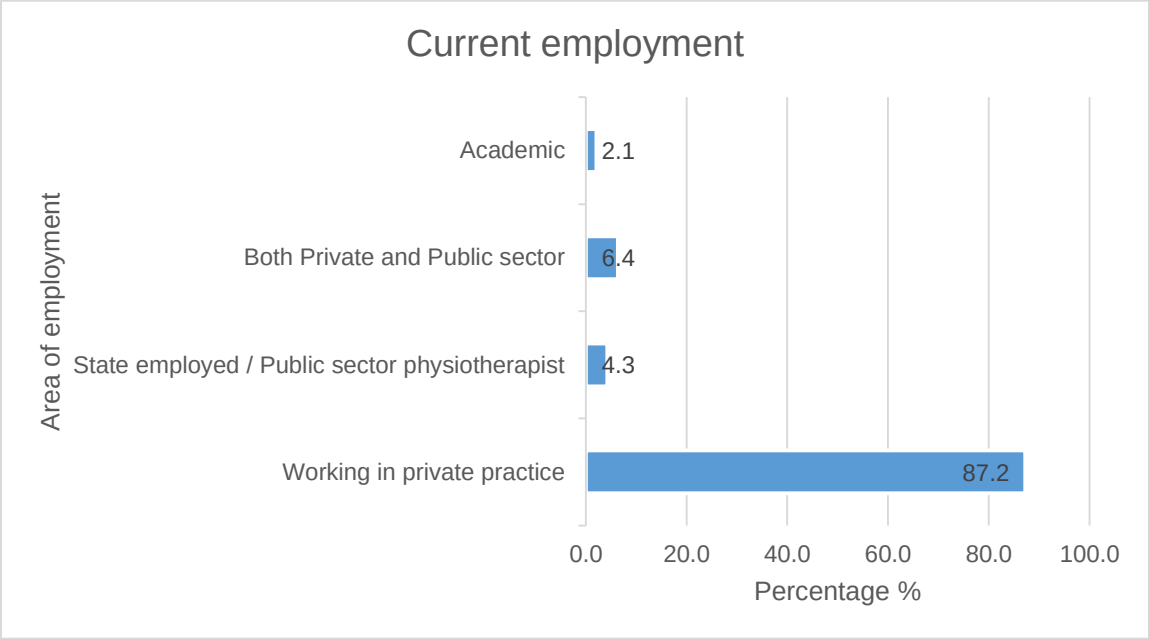


Figure 4.6: Current employment status of respondents (N=141)

The majority of the study population indicated that they work only in private practice (87.2%; n=123), with a small percentage indicating that they serve both private and public (6.4%; n=9).

Figure 4.7 shows the division into work areas where the study population came in contact with patients after they received open thoracic surgery.

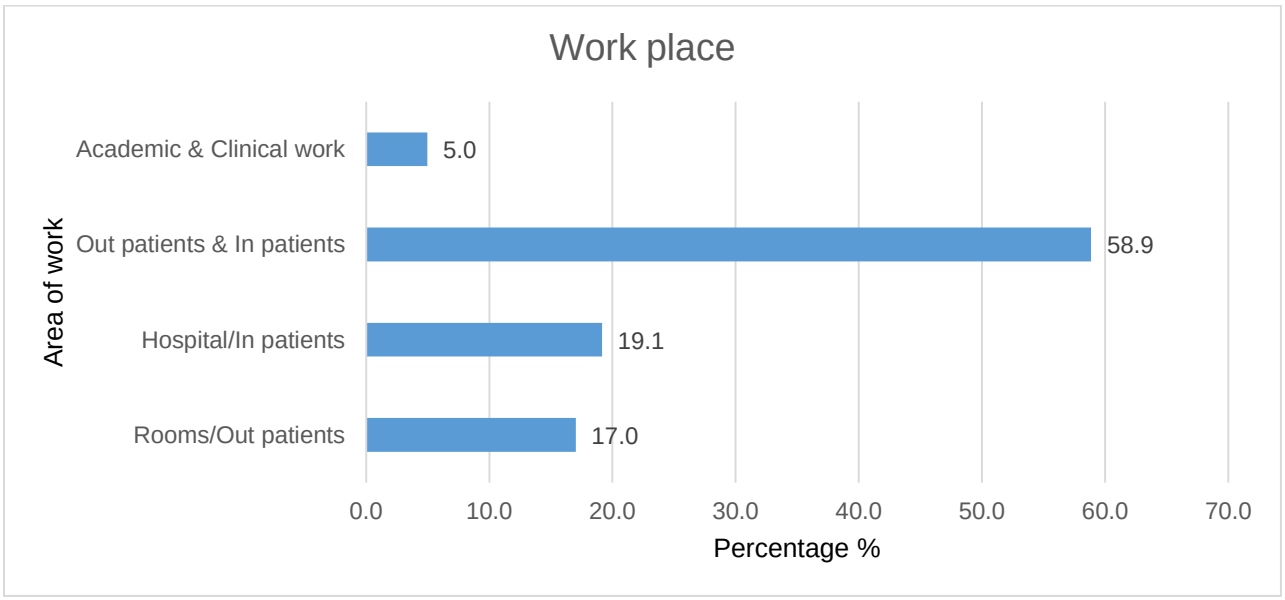


Figure 4.7: Work areas for physiotherapists treating patients after open thoracic surgery (n=141)

In figure 4.7 above, 58.9% (n=83) of the study population indicated that they work in a "rooms and hospital setting", but only 14.9% (n=21) indicated that they treat patients who received open thoracic surgery in both settings (see table 4.1). Respondents who indicated their current work involved only rooms work (17.0%; n=24), correspond with the 17.7% (n=25) that indicated that they only see patients, who received open thoracotomies, after hospital discharge (see table 4.1). No question was posed to further differentiate between public and private sector physiotherapists in this regard.

4.4 OBJECTIVES 2 AND 3: STUDY RESULTS RELATED TO PHYSIOTHERAPY MANAGEMENT PROVIDED IN HOSPITAL

In this section the results, relating to the second and third research objectives, will be discussed. Therefore the treatment modalities used to manage patients that received open thoracic surgery during hospital stay, and the factors that influence the choice of these modalities, will be presented.

4.4.1 Pre-Operative Physiotherapy Management of Open Thoracotomy Patients

Figure 4.8 indicates the percentage of respondents who routinely used specified evaluation and treatment techniques during management of patients that have to undergo open thoracic surgery.

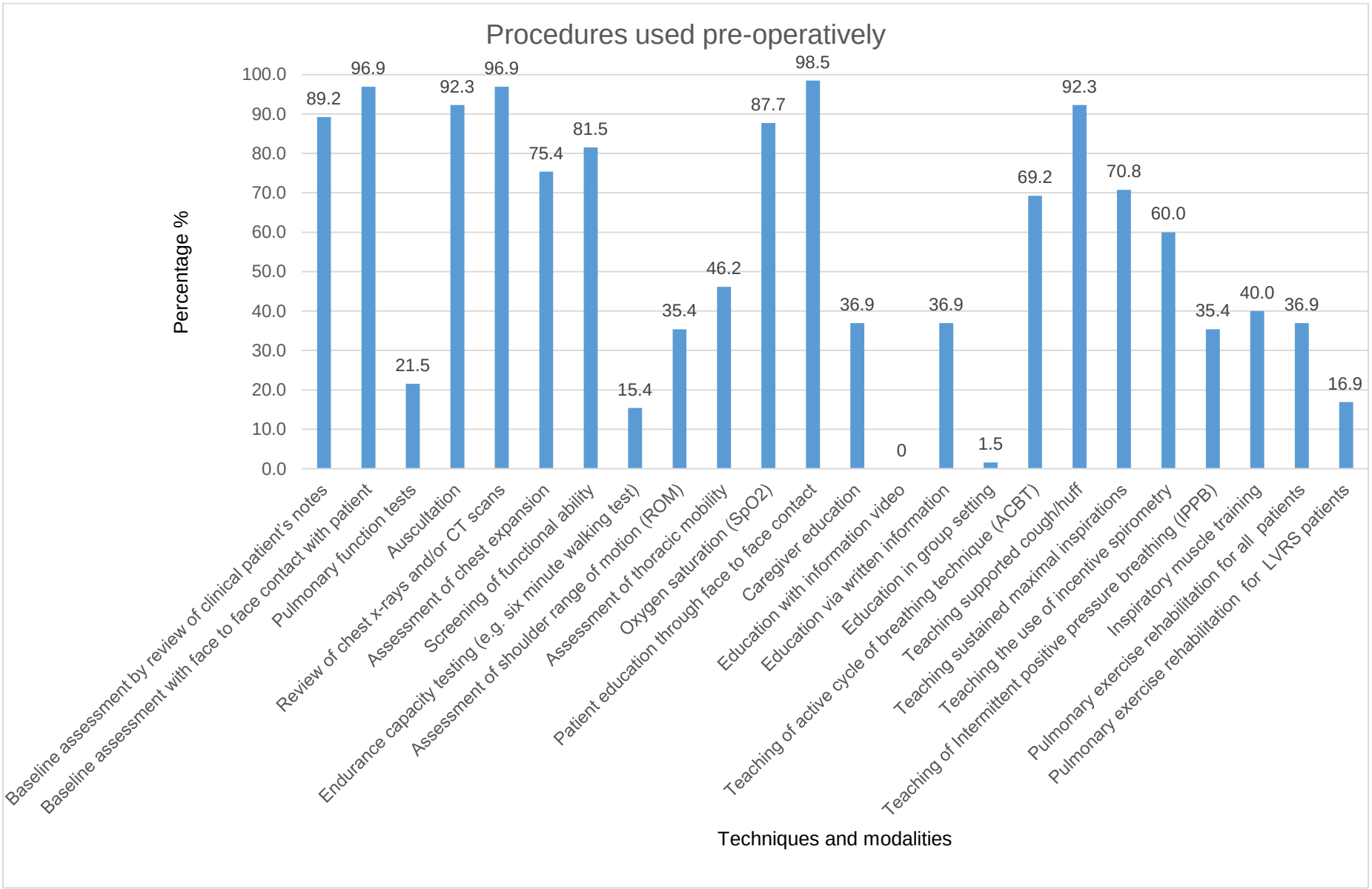


Figure 4.8: Procedures used routinely during pre-operative assessment and treatment (n=65)

Of the twenty-four pre-operative evaluation and treatment options assessed in this study, the procedures most often used to evaluate a patient pre-operatively were through face-to-face contact (96.9%; n=63), review of x-rays (96.9%; n=63) and auscultation (92.3%; n=60). Pre-operative treatment mainly consisted of face-to-face education (98.5%; n=64) and teaching of supported coughing- and huffing techniques both with 92.3% (n=60) of respondents indicating that they used these procedures on a routine basis. The lowest priorities pre-operatively seem to be pulmonary function testing (21.5%; n=14), endurance capacity testing (15.4%; n=10) and pulmonary exercise rehabilitation for LVRS patients (16.9%; n=11). Other education options used as routine, range from 0% to 36.9%. When asked to indicate which proportion of patients are seen pre-operatively, 37.5% (n=27) of respondents said they treat all patients pre-operatively but the majority of 55.6% (n=40) indicated that only 'some' patients are seen - determined by risk factors.

Table 4.4 shows the factors indicated to influence the choice of treatment techniques as indicated in figure 4.8.

Table 4.4: Influence on choice of pre-operative management techniques

	N	1 No influence at all	2	3 Neutral	4	5 Very influential
		n (%)				
Personal experience	64	4(6.3)	0(0.0)	8(12.5)	18(28.1)	34(53.1)
Undergraduate education	64	4(6.3)	11(17.2)	20(31.3)	15(23.4)	14(21.9)
Literature recommendations	64	2(3.1)	12(18.8)	18(28.1)	22(34.4)	10(15.6)
Established practice protocol	65	2(3.1)	4(6.2)	9(13.8)	28(43.1)	22(33.8)
Limited Resource (e.g. lack of equipment)	64	21(32.8)	16(25.0)	14(21.9)	10(15.6)	3(4.7)
Financial considerations (e.g. medical benefits)	65	21(32.3)	16(24.6)	14(21.5)	6(9.2)	8(12.3)
Limited staff numbers	65	32(49.2)	16(24.6)	11(16.9)	4(6.2)	2(3.1)
High or low caseload	63	23(36.5)	19(30.2)	13(20.6)	7(11.1)	1(1.6)

The number of participants that completed this section varied and therefore the n-value differs for different choices. The two factors that were most influential in the choice of evaluation and treatment techniques routinely used pre-operatively, were personal experience and established practice protocol, 81.2% (n=52) and 76.9% (n=50) respectively. Undergraduate education and

literature recommendations seemed to affect a marginal group in their choice with the majority of respondents indicating a neutral effect (31.3%; n=20 and 28.1%; n=18 respectively).

4.4.2 Post-Operative Management of Patients after Open Thoracic Surgery during Hospital Stay

One hundred and sixteen (116) respondents indicated that they treat patients after open thoracic surgery during hospital stay, (see table 4.1). Of these, 76.7% (n=89) indicated that all patients are treated post-operatively by a physiotherapist. Forty-seven respondents (55.3%) said that they provide prophylactic interventions after assessment of the patient regardless of the patient's presentation.

Figure 4.9 shows the percentage of respondents who routinely used specific treatment techniques to manage patients that received open thoracic surgery during hospital stay.

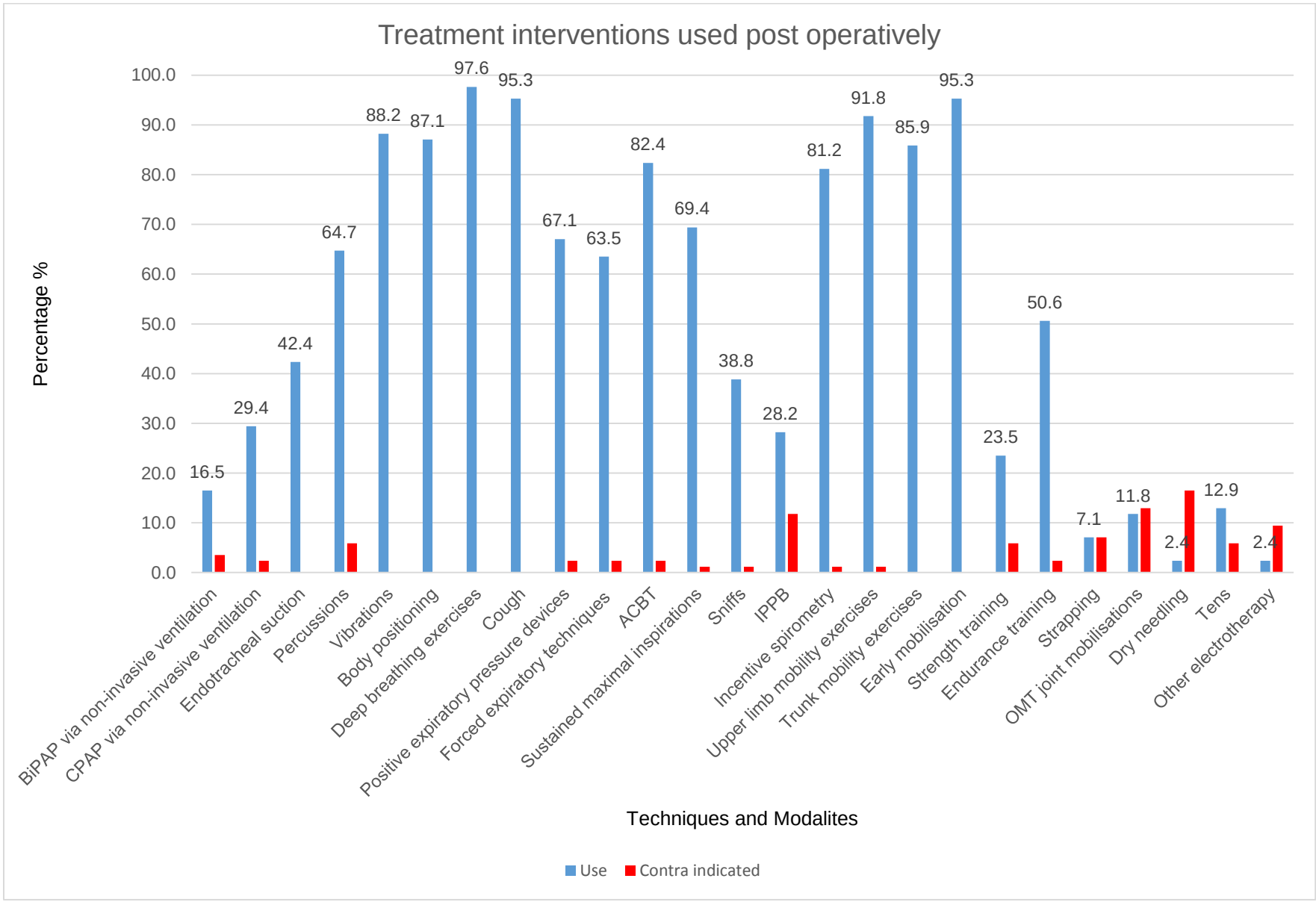


Figure 4.9: Treatment interventions used routinely during post-operative treatment (n=85)

The three treatment modalities used by most respondents to treat open thoracotomy surgery patients, were: DBE (97.6%; n=83), coughing (95.3%; n=81) and early mobilisation (95.3%; n=81). The chosen treatment techniques that were considered as contra-indications by the respondents included: intermittent positive pressure breathing (IPPB), OMT joint mobilisations, dry needling and electrotherapy.

Figure 4.10. indicates the percentage of respondents using different modalities of early mobilisation.

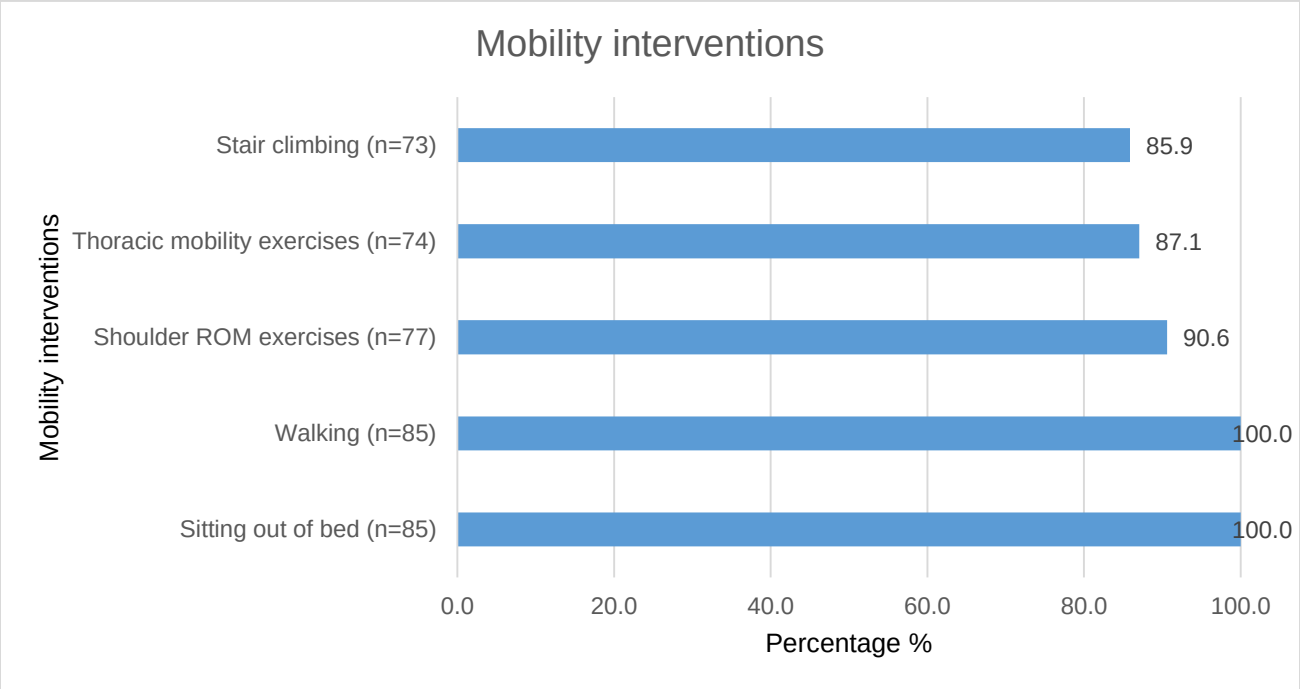


Figure 4.10: Mobility interventions used routinely during post-operative treatment (n=85)

All early mobility interventions scored high (above 85%) on modalities used routinely during post-operative treatment of patients who received an open thoracotomy. Stair climbing was utilised the least, with only 85.9% (n=73) respondents indicating routine use.

Figure 4.11 shows the different education modalities used before the patients were discharged from hospital.

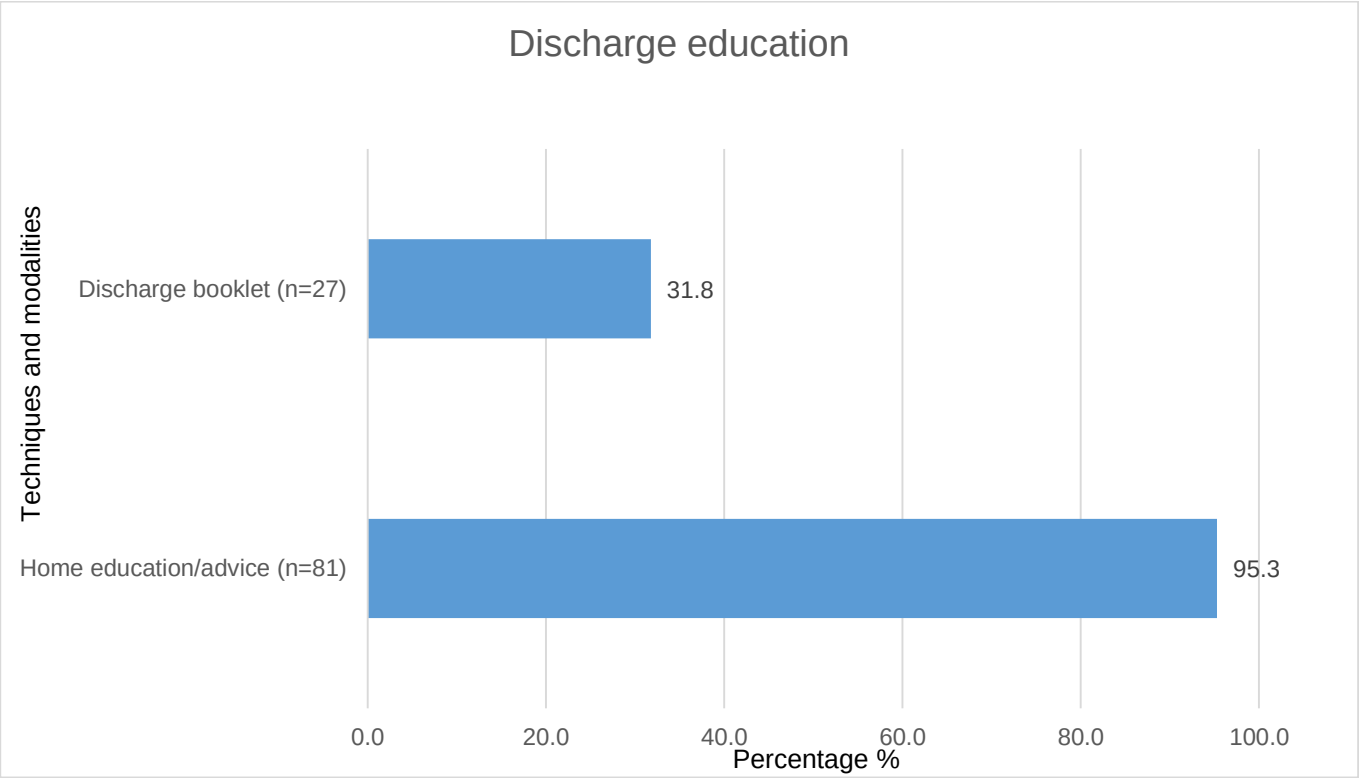


Figure 4.11: Discharge education used post operatively (n=85)

Education before discharge, was given through verbal face-to-face (home education/advice) contact with the patient, by 95.3% (n=81) of respondents. A small number (31.8%; n=27) of respondents made use of discharge booklets to communicate information during this phase.

Figure 4.12 indicates the percentage of respondents who changed their management strategies if a patient presented with a persistent air leak.

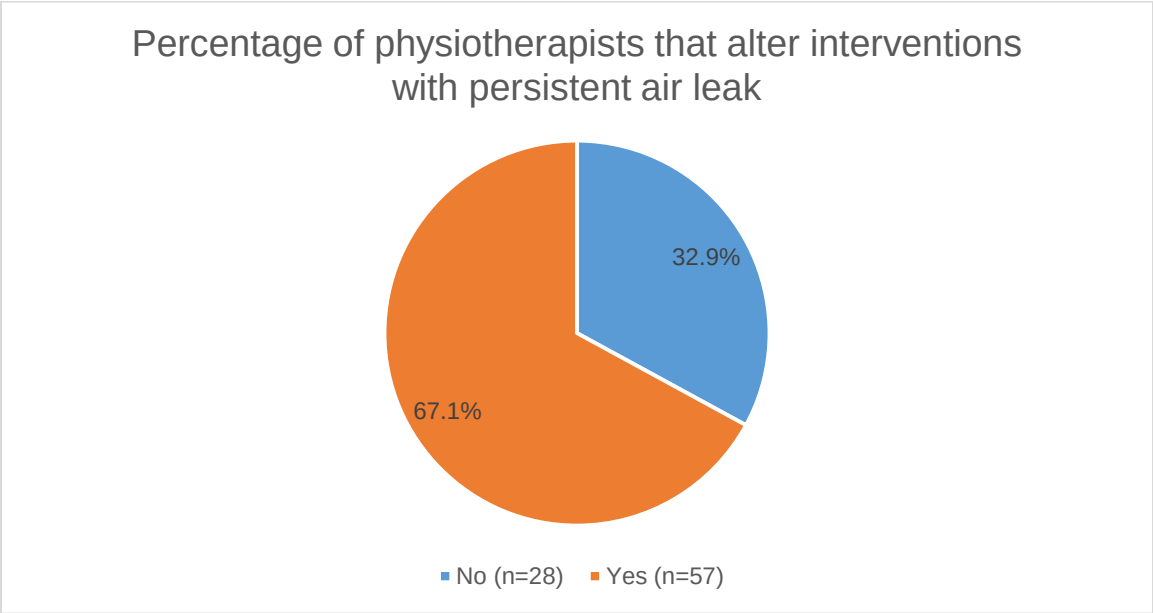


Figure 4.12: Percentage of study population that alters management interventions with persistent air leaks (n=85)

Fifty-seven respondents (67.1%) indicated that they altered their management strategy when a patient presented with a persistent air leak.

Figure 4.13 shows the number of respondents and the changes incorporated in their management when treating the aforementioned patients.

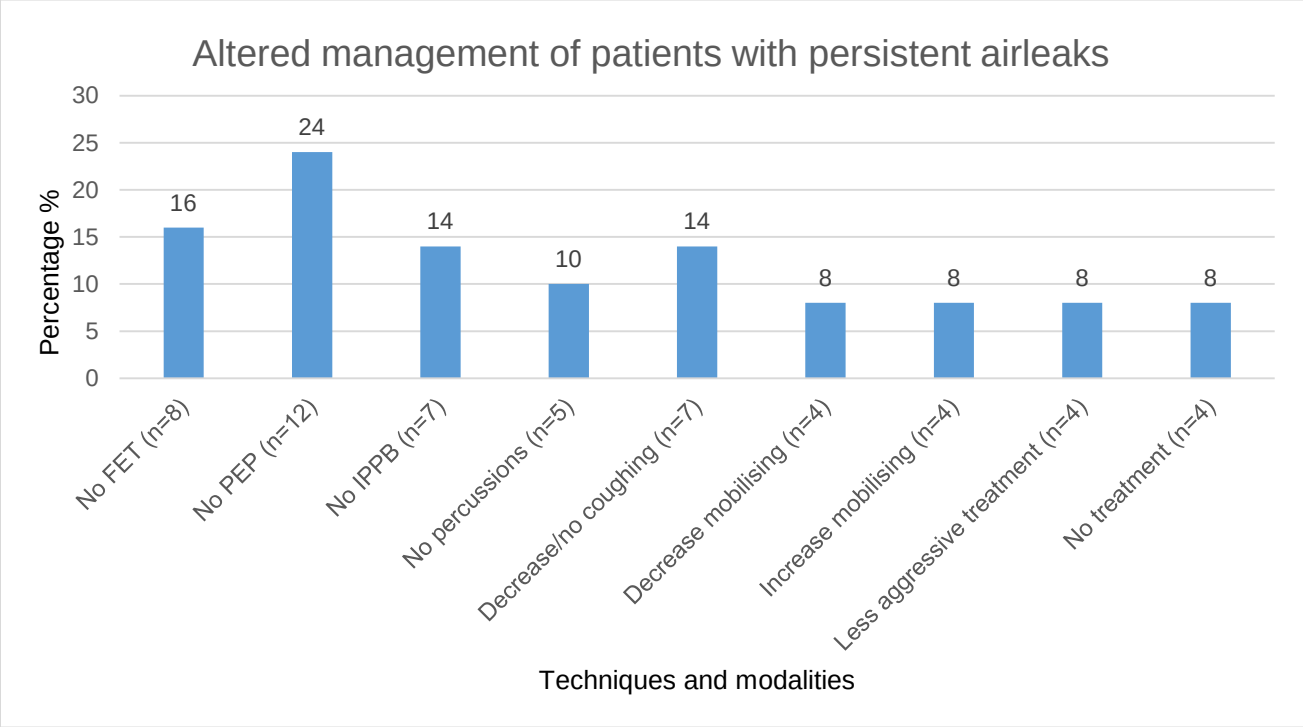


Figure 4.13: Altered management techniques for patients with persistent air leaks (n=50)

Although 57 respondents indicated that they alter their treatment for patients with persistent air leaks, only 50 participants responded to the question in the survey asking how they alter their techniques. The change that most respondents introduced in their altered management strategies, was to decrease positive expiratory pressure through omitting FET, positive expiratory pressure (PEP) and IPPB from their treatment and decreasing coughing.

Table 4.5 shows the factors indicated to influence the choice of treatment techniques as indicated in figure 4.13.

Table 4.5: Influence on choice of post-operative management techniques (N=85)

	N	1 No influence at all	2	3 Neutral	4	5 Very influential
		n (%)				
Personal experience	85	4(4.7)	4(4.7)	8(9.4)	19(22.4)	50(58.8)
Undergraduate education	85	4(4.7)	8(9.4)	31(36.5)	24(28.2)	18(21.2)
Literature recommendations	85	1(1.2)	9(10.6)	24(28.2)	36(42.4)	15(17.6)
Established practice protocol	85	0(0.0)	3(3.5)	18(21.2)	32(37.6)	32(37.6)
Limited Resource (e.g. lack of equipment)	85	22(25.9)	27(31.8)	21(24.7)	10(11.8)	5(5.9)
Financial considerations (e.g. medical benefits)	85	24(28.2)	22(25.9)	21(24.7)	11(12.9)	7(8.2)
Limited staff numbers	85	34(40.0)	23(27.1)	14(16.5)	8(9.4)	6(7.1)
High or low caseload	85	33(38.8)	23(27.1)	13(15.3)	10(11.8)	6(7.1)

The factors that were most influential in the choice of treatment techniques, routinely used post-operatively, were: personal experience (81.2%; n=69), established practice protocol (75.2%; n= 64) and literature recommendations (60.0%; n=51.). Physical limitations did not seem to be influential at all, where most respondents indicated no or neutral effect when considering their treatment modalities. Although table 4.1 indicates that 95 respondents treat patients only during hospital stay and 21 respondents treated patients during and after hospital stay only 85 respondents completed the question pertaining to the reason for their management choices.

Other data obtained which may be of interest to the reader, not directly related to the objective of this study, rendered the following results: the majority of respondents indicated that they treated elective pleural surgery (54.6%; n=77) and elective pulmonary resections (52.5%; n=74) with traumatology sequelae third in line at 31.2% (n=44). More than 43% (n=61) of respondents indicated that they treated patients that received open thoracic surgery in the cardiothoracic intensive care unit (ICU). Sixty percent (60.0%; n=51) said that they commenced treatment on the first post-operative day with 68.3% (n=56) treating the patients twice a day.

4.5 OBJECTIVES 2 AND 3: STUDY RESULTS RELATED TO PHYSIOTHERAPY MANAGEMENT PROVIDED AFTER DISCHARGE FROM HOSPITAL

In this section the results relating to the second and third research objectives will be discussed, namely the physiotherapy treatment modalities used to manage patients who received open thoracic surgery after discharge from hospital, as well as the factors that influenced the physiotherapists' choice of these modalities.

Twenty-five respondents (17.7%) indicated that they treat patients that received open thoracotomies only after discharge from hospital and 21 (14.9%) respondents indicated that they see open thoracotomy patients during hospital stay and after discharge.

Figure 4.14 shows the percentage of respondents who routinely use specified treatment techniques, to manage patients who received open thoracic surgery after hospital discharge, as well as the modalities they deemed contra-indicated.

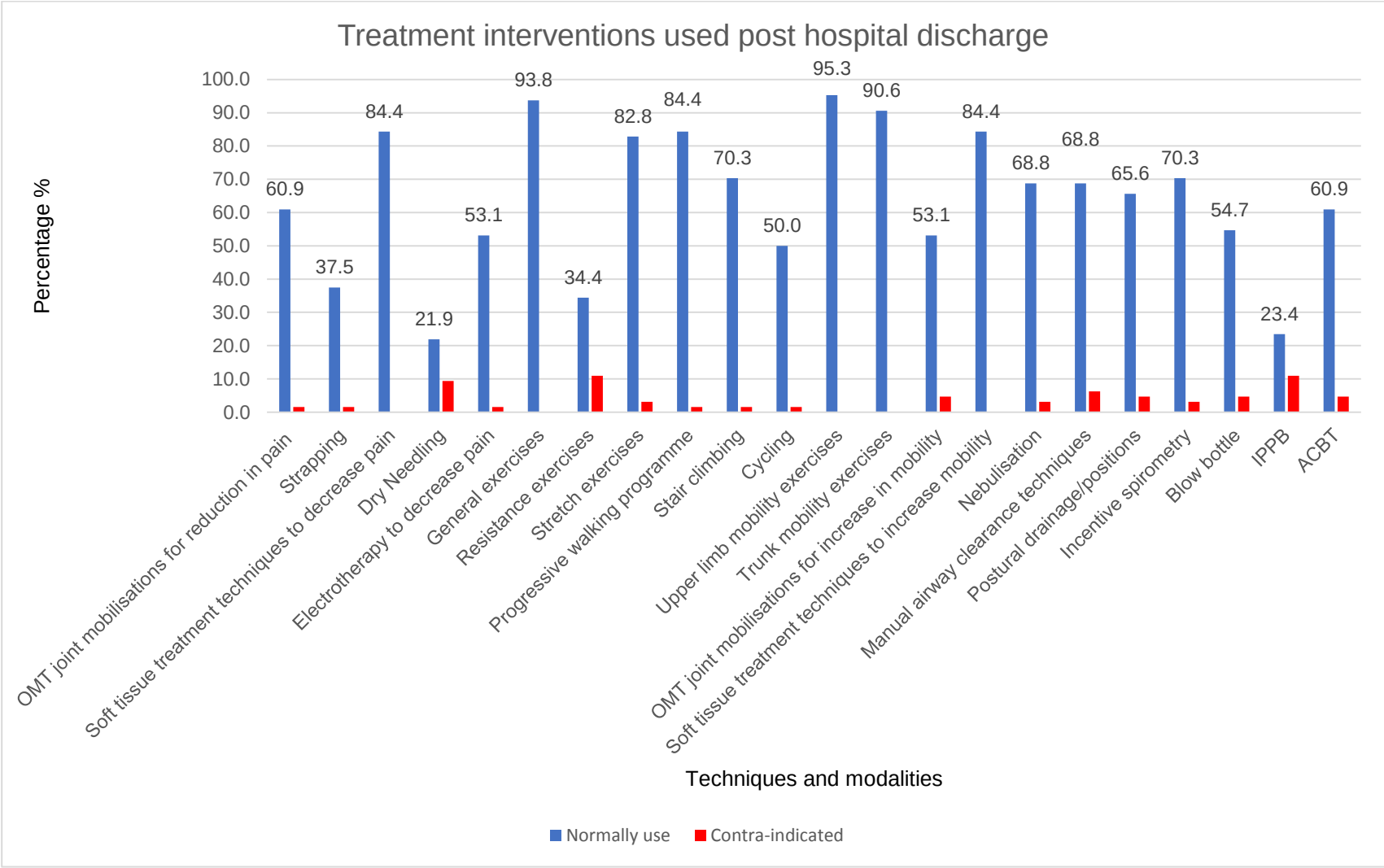


Figure 4.14: Treatment interventions used routinely during post hospital discharge treatment (n=64)

The treatment techniques routinely utilised to manage these patients after hospital discharge, all scoring above 90% were: general exercises (93.8%; n=60), upper limb mobility exercises (95.3%; n=61) and trunk mobility exercises (90.6%; n=58). Pain management was addressed through OMT (60.9%; n=39), strapping (37.5%; n=24), soft tissue techniques (84.4%; n=54), and electrotherapy (53.1%; n=34). The three modalities mostly indicated as contra-indicated when evaluating post-hospital discharge management were: dry needling (9.4%; n=6), resistance exercises (10.9%; n=7) and the use of IPPB (10.9%; n=7).

Table 4.6 indicates the reasons that influence the choice of treatment techniques after hospital discharge as set out in figure 4.14.

Table 4.6: Factors that influence choice of treatment techniques post-hospital discharge (N=64)

	N	1 No influence at all	2	3 Neutral	4	5 Very influential
		n (%)				
Personal experience	64	2(3.1)	12(18.8)	26(40.6)	13(20.3)	11(17.2)
Undergraduate education	64	5(7.8)	0(0.0)	12(18.8)	17(26.6)	30(46.9)
Literature recommendations	64	0(0.0)	8(12.5)	23(35.9)	19(29.7)	14(21.9)
Established practice protocol	64	5(7.8)	7(10.9)	19(29.7)	19(29.7)	14(21.9)
Limited Resource (e.g. lack of equipment)	64	18(28.1)	15(23.4)	19(29.7)	9(14.1)	3(4.7)
Financial considerations (e.g. medical benefits)	64	18(28.1)	12(18.8)	13(20.3)	9(14.1)	12(18.8)
Limited staff numbers	64	32(50.0)	15(23.4)	9(14.1)	4(6.3)	4(6.3)
High or low caseload	64	28(43.8)	18(28.1)	11(17.2)	3(4.7)	4(6.3)

To guide their choice in post-hospital discharge management techniques, respondents indicated that undergraduate education was very influential (46.9%; n=30). Personal experience (37.5%; n=24), literature recommendations (51.6%; n=33) and established practice protocol (51.6%; n=33) were also influential in selecting the treatment choices.

Other data obtained on post-hospital discharge treatment of patients who received open thoracic surgery, which may be of interest to the reader, presented the following results: referral of patients after hospital discharge for further management was equally distributed between the doctor, the hospital managing physiotherapist and the patients themselves. Fifty one percent of respondents (n=36) indicated that they see the patients during their first week

after discharge, with 19.7 % (n=14) seeing the patient only more than six weeks after discharge.

4.6 OBJECTIVE 4: THE POST-OPERATIVE THORACOTOMY COMPLICATIONS AFTER DISCHARGE FROM HOSPITAL THAT ARE ADDRESSED FROM A PHYSIOTHERAPEUTIC POINT OF VIEW

Figure 4.15 shows the reasons for referral of hospital patients to continue with physiotherapy after being discharged.

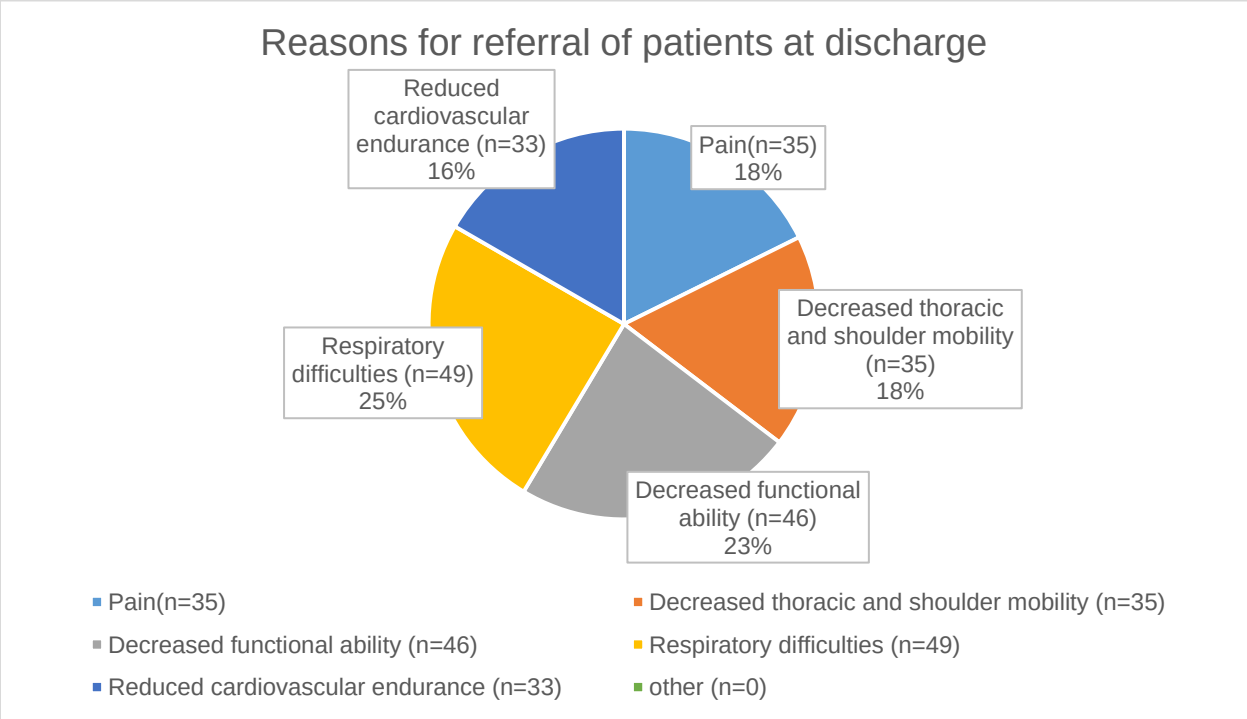


Figure 4.15: Main reasons for referring patients for physiotherapy after hospital discharge (n=66)

The main reasons for referring patients after hospital discharge to continue with physiotherapy treatment were respiratory difficulties (74.2%; n=49) and decreased functional ability (69.7%; n=46).

4.6.1 Complications Addressed during the First Six Weeks following Discharge

Figure 4.16 indicates the reasons for rendering physiotherapy to patients after open thoracotomy procedure during the first six weeks after discharge from hospital.

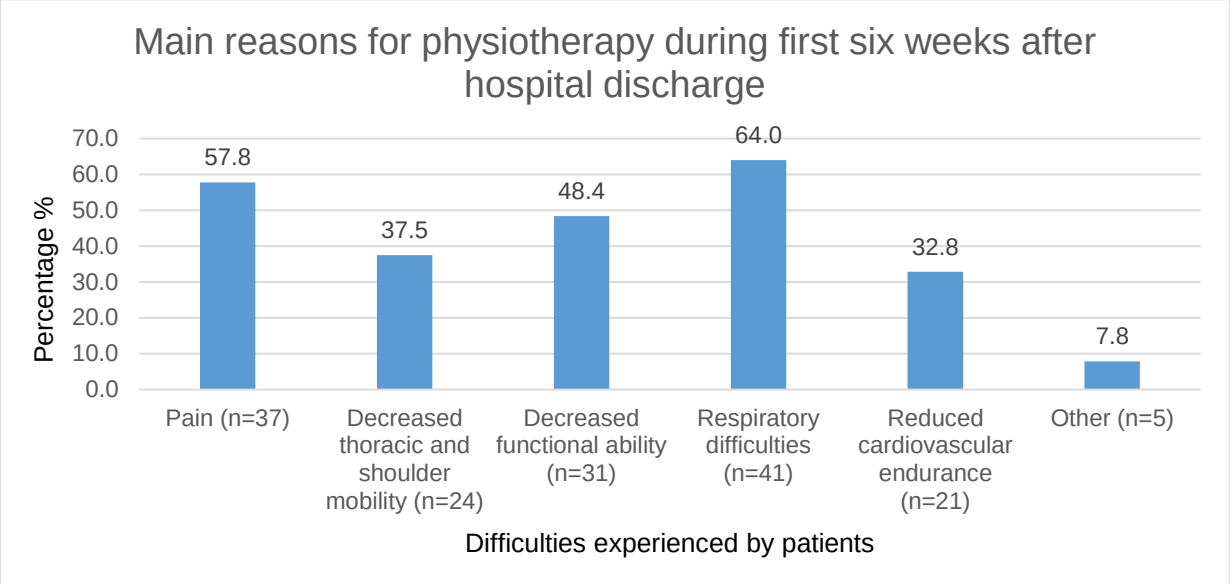


Figure 4.16: Main reasons for physiotherapy during the first six weeks following discharge (n=64)

The reasons for physiotherapy treatment during the first six weeks after discharge from hospital in the majority of patients were for respiratory difficulties (64.0%; n=41) and pain (57.8%; n=37).

4.6.2 Complications Addressed more than Six Weeks after Discharge

Figure 4.17 shows the reasons for continued physiotherapy more than six weeks after discharge from hospital.

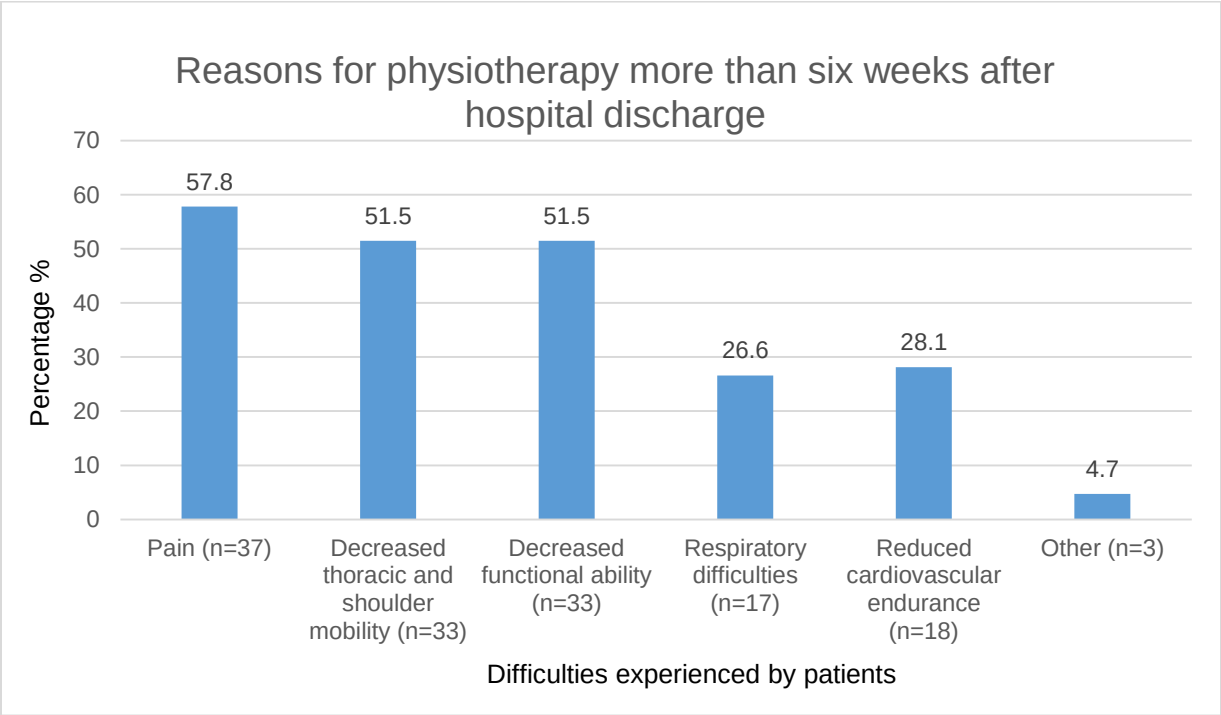


Figure 4.17: Main reasons for physiotherapy more than six weeks after hospital discharge (n=64)

The main reason for continued physiotherapy more than six weeks after discharge from hospital was due to 'pain' (57.8%; n=37). 'Decreased functional ability' and 'thoracic and shoulder mobility' were equally implicated by 51.5% (n=33) of respondents as reasons for physiotherapy at such a late stage after surgery.

Chapter 5 will consist of a discussion of the data presented in chapter 4.

CHAPTER 5

5. DISCUSSION

5.1 INTRODUCTION

The purpose of this chapter is to discuss the results of this study and it will be done under the following subheadings:

5.2 Profile of physiotherapists who treat patients after open thoracic surgery

5.3 Physiotherapy management provided to patients before and after open thoracotomy surgery during hospital stay and factors influencing management choices

5.4 Physiotherapy management provided to patients after open thoracotomy surgery after discharge from hospital and factors influencing management choices

5.5 Post-operative complications addressed from a physiotherapeutic perspective

5.2 THE PROFILE OF PHYSIOTHERAPISTS WHO TREAT PATIENTS AFTER OPEN THORACIC SURGERY

Significant information could not be found in the two similar studies done in Australia and the UK by Reeve et al (2007) and Agostini et al (2013), to be able to compare the profile of physiotherapists that treat patients after open thoracotomy with findings from the current study. The studies done in Australia by Reeve et al (2007) and the UK by Agostini et al (2013) distributed a limited amount of questionnaires only to the senior therapists in identified cardiothoracic units throughout these countries. This current study was however open to physiotherapists of all professional levels and focused on the management of open thoracotomies done in any unit (e.g. cardiothoracic and spinal) of the heath-care system in Gauteng. Therefore the current study provides a better indication of the profile of all levels of physiotherapists involved in treating patients after open thoracotomies.

5.2.1 Age

The youngest respondent to the study was 23 years old and the oldest was 69. The mean age of respondents was calculated as 35.9 years (±11.1). According to the South-African government services the retirement age for woman remained at 60 years of age for 2013 and 2014 (Trading economics, December 2014). Although the ‘normal’ retirement age is considered by most to be between 60 and 65, the Basic Conditions of Employment Act does

not prescribe an age at which employees must retire and it is up to the employer to prescribe the retirement age for its employees (Finweek, 2013). In public sectors and bigger institutions the prescribed retirement age is between 63 and 65 but in smaller private sector businesses, employees are often allowed to continue their duties, as long as they are not a danger to patients and can cope with the mental and physical demands of the job/profession (Finweek, 2013).

5.2.2 Gender

The Australian study by Reeve et al (2007), as well as the UK study by Agostini et al (2013), did not include discussion of gender distribution. The gender distribution for this study revealed that 96% (n=135) of the respondents were female. This is in line with the fact that more female physiotherapists are qualified and registered with the SASP. Career choices are often divided along gender lines according to Öhman et al (2001) and, except for medicine, health professions seem to be favoured by females. Öhman et al (2001) also reported that 75% of physiotherapists in Sweden were female.

5.2.3 Qualifications and Continuous Professional Development

The mean number of years of being qualified by the study population was 13.49 (±11.1). A Bachelor degree was the highest qualification obtained by 80% (n=113) of respondents. Only 13% (n=19) of respondents had post-graduate qualifications. Possible explanations for the lack of further qualifications based on empirical research by the researcher, include the fact that a higher qualification does not necessarily warrant a higher salary in private practice, as most physiotherapists seem to do the same duties, and remuneration is usually not based on experience, seniority or qualifications. Furthermore only a small percentage of people are willing to make the sacrifice to complete a costly and time-consuming activity where the maximum possible advantage in private practice might only be for personal growth. As the studies by Reeve et al (2007) and Agostini et al (2013) only distributed questionnaires to the senior physiotherapist of each identified cardiothoracic unit, as indicated before, results could not be compared as more information about qualifications wasn't supplied.

Physiotherapists have the possibility of completing one year certificate courses presented by the SIGs of the SASP. There are currently several year courses being presented on a bi-annual basis, which include OMT1, CPT1 and Pain. These courses are not recognised by SAQA due to the fact that they are not presented by registered education institutions. They are however all one year certificate courses, consisting of 120 hours of training and a final

examination run by the South African Society of Physiotherapy (SASP). These courses render an excellent way of continuous professional development (CPD) (to comply with the HPCSA's compulsory CPD points system). Of the 141 respondents 36.9% (n=52) completed the OMT1 course. One of the reasons for the high percentage of respondents that completed OMT1 might be the fact that it is the longest running year course, being presented since the seventies. Over the years more participants were able to complete OMT, when compared to the CPT1 course (16.3%; n=23) that has only been presented since 2009. Dry needling also had a high participation rate of 35.5% (n=50). This might be due to the fact that it allows respondents to complete different modules over any period of time and the examination is not mandatory. The fact that no less than 177 of these year courses were completed by the 141 respondents, indicated a willingness to continue with their professional development.

After qualifying as a physiotherapist it is compulsory to obtain 30 CPD points per year as per the governing body's (HPCSA) requirements (Health Professions Council of South Africa, 2013). The majority of respondents (98%; n=139) indicated that they participated in some form of CPD activity during the previous year. OMT was the special interest of choice out of five choices with 54.7% (n=76) of respondents completing CPD activity in this field. Continuous professional development points can be obtained in any field of interest but it is advisable to stay up to date with current concepts in the field of physiotherapy practice that one is involved in. Considering that 82.3% (n=116) of respondents indicated that they treat patients after open thoracotomy procedures during hospital stay, one would expect the CPD activities to be done in the CPT special interest field. However, only 36.7% (n=51) of respondents obtained CPD points in the CPT field. Similarly, only 32.6% (n=46) of respondents indicated that they treat open thoracotomy patients after hospital discharge, but 54.7% (n=76) obtained CPD in the OMT field of interest. Reasons for this skewed representation might include the following:

Physiotherapists are trained at an undergraduate level in cardiopulmonary and manual therapy field and are competent to work in both fields, independent of their post graduate CPD activities;

Although it is mandatory to obtain CPD points, it is not mandatory to obtain points in the current field of practice;

Courses in some fields of interest are presented more regularly, and

The relatively high cost of courses is possibly another reason why physiotherapists attend CPD accredited courses only in one special interest field per year.

Regardless of all the hurdles mentioned above, the 141 respondents registered 261 responses, indicating that several physiotherapists do indeed stay active with professional development in more than one field.

Registered members of the SASP, have the opportunity to belong to SIGs. A total of 117 (82.9%) respondents belonged to one or more SIG. As stated in chapter 4 these SIGs correlate with the different areas of special interest available to physiotherapists. There are currently 14 SIGs within the SASP. Special interest groups allow members to stay up to date with changes in a specific field. Some SIGs have free access to academic journals to allow members the opportunity to be informed about the most recent advances in research. Special interest groups also organise relevant courses which their members can attend, usually at reduced prices. These SIGs often develop into the main contact of physiotherapists with the Physiotherapy Society. The reason for not belonging to an SIG could be linked to the cost involved, especially for younger physiotherapists with very current up to date undergraduate training. When analysing the SIG membership, 63.2% (n=74) belonged to the OMPTG, 42.7% (n=50) to the CPRG and 23.1% (n=27) to the Pain group. Although one would expect physiotherapists to belong to an SIG relevant to their field of practice, it is totally up to the members to decide to which group/s they prefer to belong. The ratio of the number of members belonging to the OMPTG and CPRG, when compared to the areas of treating patients after open thoracic surgery, was inversed. However, in order to be able to assess if physiotherapists belong to SIGs in relation to their field of work, one would need to know what ratio of patients are treated per day in the area of interest.

In summary for this section the majority of physiotherapists who treat thoracotomy patients were females between the ages of 23 to 69 with a Bachelor degree being the highest qualification for 80%. Respondents seem serious about continuous professional development with 98% completing CPD activities in the previous year and 82.9% keeping up to date via SIGs.

Section 5.3 will discuss the findings of the study related to the physiotherapy management of patients during hospital stay.

5.3 PHYSIOTHERAPY MANAGEMENT PROVIDED TO PATIENTS BEFORE AND AFTER OPEN THORACOTOMY SURGERY DURING HOSPITAL STAY AND FACTORS INFLUENCING MANAGEMENT CHOICES

Although there were 141 participants to the current study, participants were diverted to different sections in the questionnaire, pertaining to the management rendered to these patients. Participants could also choose not to answer a question. As a result of this the response rate to specific questions fluctuates.

5.3.1 Pre-Operative Physiotherapy Management

Of the 72 respondents, 27 (37.5%) reported that all patients were seen pre-operatively. However, the majority (n=40), indicated that only some patients were seen pre-operatively and that this was determined after assessing risk factors. Only 6.9% (n=5) reported that no patients were seen pre-operatively. The results are in line with results reported by Reeve et al (2007) where 34.8% of physiotherapists assessed all patients pre-operatively and 41.3% had only had contact with some patients, also determined by risk assessment. The study by Reeve et al (2007) did however report a higher percentage (23.9%) of physiotherapists who did not treat any patients pre-operatively with reasons supplied by participants as lack of time, insufficient supportive evidence of effectiveness and the fact that information was supplied by other means. Unfortunately the five respondents who indicated that they never treat patients pre-operatively, did not provide a reason for this– thus the reasons remain unknown. Reasons could however include the above-mentioned three reasons, but could also be because in a South-African setting a high percentage of patients receive emergency open thoracotomy incisions after trauma (Clarke et al, 2011). However, even in the event of elective open thoracic surgery, another reason could be due to several medical aids not granting permission for admission on the day before surgery. As surgery is most commonly scheduled for early mornings, it leaves insufficient time for a pre-operative evaluation or treatment. Furthermore, patients might already have received their pre-medication rendering the patient incapable of receiving information on the day of surgery.

Of the 65 respondents who indicated the techniques they use when they see patients pre-operatively, the three evaluation techniques used most regularly were face to face contact with the patient (96.9%; n=63), review of x-rays (96.9%; n=63) and chest auscultation (92.3%; n=60). Agostini et al (2013) also reported a high percentage (77%) of face to face evaluation with patients pre-operatively, but information about other evaluation techniques was not

supplied in their article. The current study is therefore important, as it provides more in-depth information regarding evaluation techniques used by physiotherapists when assessing patients in order to determine risks and eligibility for pre-operative treatment, before open thoracic surgery.

Pre-operative treatment techniques that scored highest in this study were face to face education (98.5%; n=64), teaching supported coughing (92.3%; n=60), huffing (92.3%; n=60) and ACBT (69.2%; n=45). This is in line with results from Agostini et al (2013) reporting that the techniques most commonly used pre-operatively were DBE (70%), huffing and coughing (89%) and teaching of ACBT (63%). Reasons these might be most routinely used, could be the relative ease with which they can be taught, the fact that they can be taught in limited time, as well as low cost involved, due to the fact that no equipment is needed.

Thoracotomy patients fall in the high risk surgery group (Owen et al, 2013; Mans, Reeve and Elkins, 2014) with the presence of PPCs in up to 59% of these patients (Agostini et al, 2009; Reid et al, 2010, Owen et al, 2013). Reid et al (2009) reported that the most common PPCs seen in this patient population include atelectasis, consolidation and poor cough effort due to pain leading to secretion retention. Although evidence for the effectiveness for pre-operative physiotherapy interventions for thoracotomy patients has not yet been established it was found to drastically reduce PPCs in other high risk surgery groups (Hulzebos et al, 2006; Dronkers et al, 2008),. The finding in this study thus shows that respondents are using relevant techniques that might minimise PPCs.

A meta-analysis by Mans et al (2014) concluded that pre-operative inspiratory muscle training (IMT) was effective in reducing post-operative complications, leading to an increase in early post-operative lung function. However, only 40% (n=26) of respondents in this study indicated the routine pre-operative use of this technique. Reeve et al (2007) also reported minimal usage of pre-operative inspiratory muscle training with only one respondent using this intervention routinely. The possible reasons for the poor utilisation of this technique could be the effort, time and cost associated with implementation, as well as the possible lack of knowledge of respondents regarding the effectiveness of IMT in reducing PPCs in thoracotomy patients (Mans et al, 2014).

Even though a study by Reid et al (2010) suggested that pre-operative education was not sufficient to prevent post-operative complications except when paired with active pre-operative

rehabilitation, the latter was only utilised by 36.9% (n=24) of respondents supplying pre-operative care in this study. This was indeed higher than the study conducted by Reeve et al (2007) (23.9%) but in line with results reported by Agostini et al (2013) (45%). It is possible that this evidence only became known during the 2010 study by Reid et al (2010) and might be the influence behind the different results in the later studies. Even though active pre-operative rehabilitation is used by a larger group of physiotherapists in these later studies by Reid et al (2010) and Agostini et al (2013), it is still not utilised to its full potential. This might be due to the limited pre-operative time frame in which it can be implemented, as well as the cost involved. This is especially relevant in a developing country with limited national health care where it was reported in 2011 that 84% of South-Africans did not have medical aid cover (B.H.F. Southern Africa, 2011).

The factors identified in this study that affected physiotherapists when choosing which techniques to use to manage patients pre-operatively, were personal experience (81.2%; n=52) and established protocols (76.9%; n=50). This was also the case in the Reeve et al (2007) and Agostini et al's (2013) study where personal experience was indicated as the primary influence when choosing pre-operative management techniques. This trend, to base management on experience and established protocols, might be due to the limited available evidence to support pre-operative management. A combination of the above mentioned factors, place a tremendous responsibility on practice owners and educators to stay informed about new developments, even though they may be limited, in order to ensure that established protocols are in line with the latest evidence.

5.3.2 **Post-Operative Physiotherapy Management**

One hundred and sixteen respondents indicated that they treat patients who have received open thoracotomy incisions after surgery but while still in hospital. Of these only 76.7% (n=89) indicated that they see all patients post-operatively in hospital. Forty-seven (55.3%) respondents said that they provide prophylactic treatment regardless of the patients' presentation. These results are lower than Agostini et al's (2013) study which reported that 97% of physiotherapists provided routine assessment for patients' on post-operative day one, with 81% continuing prophylactic treatment regardless of patient presentation. The results from this study are however closer in line with a study conducted at an earlier stage by Reeve et al (2007) which pointed out that 63% of respondents continued to treat patients prophylactically, irrespective of assessment findings. There is not an abundance of evidence available to guide physiotherapists regarding post-operative care after thoracotomies. Evidence from a cross-

sectional study by Varela et al (2006) suggested that post-operative physiotherapy appears to have no influence on the incidence of pneumonia and overall morbidity. Perhaps physiotherapists prefer to err on the side of caution, thus leading to a high percentage of prophylactic treatments without evidence to back it up.

The treatment modalities which scored high under routine use during post-operative management included DBE (97.6%; n=83), coughing (95.3%; n=81) and ACBT (82.4%; n=70). This is comparable to Agostini et al (2013) where DBE, coughing and ACBT scored 90%, 97% and 71% respectively. Reeve et al (2007) also indicated DBE and coughing as the two top choices for post-operative management. Results in the Reeve et al (2007) and Agostini et al (2013) studies also showed similar high values in utilising FET (76% and 84% respectively) with the current study only reaching a value of 63.5% (n=54). Similar reasons could apply, for both post-operative and pre-operative choices with easy, time efficient and cost-effective techniques ranking highest.

After thoracic surgery patients present with similar decrease in FRC and VC like patients undergoing other types of major surgery, for example abdominal or cardiac surgery (Reeve, 2008). Due to the fact that patients in major surgery groups present with similar complications (Owen et al, 2013: Mans et al, 2014) it would be safe to assume that, even though evidence in thoracic surgery is limited, the evidence in other major surgery groups regarding effectiveness of post-operative techniques, could be considered relevant until other evidence emerges. It was recommended by Reeve (2008) and Denehy (2008) that both pre- and postoperative physiotherapy interventions should continue, until more high quality evidence to guide management becomes available. The techniques chosen by participants in this study are therefore in line with this recommendation, as well as standard physiotherapy care, to prevent and manage PPCs.

Incentive spirometry was shown to lead to faster post-operative recovery of lung function (Weiner et al, 1997), however, conflicting evidence remain for the effectiveness in preventing PPCs (Gosselink et al, 2000; Varela et al, 2006). Regardless of this evidence IS was widely chosen as a routine intervention in this study scoring 81.2% (n=69). This is much higher than the Reeve et al (2007) and Agostini et al (2013) studies (32.6% and 35% respectively). The reason for high utility of IS in this study could be that the patient can continue, without the physiotherapist being present, making it cost and time effective in a country where healthcare to all is limited (B.H.F. Southern Africa, 2011).

Treatment modalities utilised during post-operative management seem to vary considerably in this study, which was the same conclusion drawn in both the Reeve et al (2007) and Agostini et al (2013) studies. These variable results could be due to therapists maintaining personal preference and experience, regardless of literature. Although it was not a factor assessed with the questionnaire, a further reason could also be surgeons' preference of management. South-African physiotherapists do not have first line practitioner status in hospitals, as they do when functioning in an out-patient setting. They are therefore obliged to adhere to the primary care specialist's instructions (South African Society of Physiotherapy, 2014).

More than 95% of respondents used early mobilisation routinely as part of their post-operative management plan. There is a growing body of evidence to support the use of early mobility interventions and their effectiveness in combatting the development of PPCs (Pasquina et al, 2003; Mackay et al, 2005; Das-Neves-Pereira, 2009). It is therefore a positive finding that respondents in the current study utilised early mobilistation, as it demonstrates that an evidence-based practice is implemented.

In the current study, sitting out of bed was utilised by 100% of respondents on a routine basis, where only 34.8% of physiotherapists used this as routine in the Reeve et al (2007) study. This might be in line with Varela's (2010) editorial comment which suggested that in some countries, health care personal are abundant and nursing staff routinely attend to the mobilisation of patients. In developing countries like South Africa, staff numbers are limited with a higher patient load per staff member, and patient mobility often becomes the sole responsibility of the physiotherapist (Varela, 2010). Due to the fact that physiotherapists fulfil this role routinely in South-Africa, it is possible that other staff members might refrain from assisting patients, 'as it is someone else's job'. Furthermore mobilising patients does place a burden on the nursing staff, as patients must be observed to prevent possible falls, and this also deters some from mobilising patients. Physiotherapists therefore often provide the only active mobilisation periods in a 24 hour day, as patients are not allowed to mobilise independently in ICU. What was interesting to notice was that, even though rigorous exercise is deemed safe in this population (Varela et al 2006; Agostini et al, 2013), stair climbing was used the least (85.9%) of the mobilisation options. This might be due to patients being discharged soon after having reached a level of safety to ambulate outside of ICU.

Upper limb mobility exercises were routinely used in post-operative management by 91.8% (n=78) of respondents in this study. The findings of the current results regarding the use of upper limb mobility exercises were important, considering that Reeve et al (2010) indicated significant reductions in total pain scores of patients at discharge, when including active shoulder exercises during management of patients after open thoracotomy surgery. Shoulder exercises were also commonly used in the Reeve et al (2007) and Agostini et al (2013) studies indicating the wide spread belief among physiotherapists that these are beneficial.

Fifty seven respondents indicated (67.1%) that they altered their management in patients with persistent air leaks. An air leak is a continuous bubbling of the underwater drain and usually indicates a lung laceration, or bronchopleural fistula with a sinus tract, or an opening between the lung and the pleural space, leading to the constant escape of air (Sarkar et al, 2010). The change most commonly incorporated in the treatment plan by those respondents supplying information on said adjustments, was the exclusion of positive expiratory pressure techniques. These techniques included FET, PEP, IPPB and coughing. Other modifications included decreased and increased mobilisation. When comparing these results with results from Reeve et al (2007) it is encouraging to see that knowledge has improved since then, as only 17.4% of respondents in the Australian study by Reeve et al (2007) indicated positive pressure devices as being contra-indicated with persistent air leaks. Positive pressure devices are contra-indicated in persistent air leaks because the negative pleural space needs to be re-established, but if there is a connection between the lung and the pleural space, positive (expiratory) pressure will inflate the lung, pushing more air into the pleural space leading to positive pleural pressure (Medscape, December 2013).

Although OMT joint mobilisation, dry needling and electrotherapy ranked as the highest considered contra-indicated modalities, a similarly high percentage of physiotherapists used these techniques routinely during post-operative management. This conflicting finding indicates the lack of evidence-based knowledge under physiotherapists treating thoracotomy patients in regard to contra-indicated techniques, especially those not associated with respiratory care. This is of interest to the researcher, as most of the interventions used by physiotherapists post-operatively (during hospital stay) seem to focus on chest expansion and interventions to prevent PPCs. Limited interventions are focused on the pain management of these patients even though open thoracic surgery is considered one of the most painful surgical interventions (Bethencourt and Holmes, 1988, Khan et al, 2000). This inclination might be due to the high focus placed on pharmacological pain control during this stage, resulting in no consideration

given to alternative and supplementary/auxiliary pain management strategies available. This is regardless of a high percentage of patients' pain not being controlled by the norm of analgesics only (Doan et al, 2014). Joshi et al (2014) also stated that effective management of acute postoperative pain lead to a reduction in the prevalence of PTPS. A systematic review and meta-analysis done by Sbruzzi et al (2012) delivered results that TENS in thoracotomy patients, together with analgesia, lead to significantly better pain control than placebo TENS and analgesia, although it had no effects on pulmonary function. Fiorelli et al (2012) however found that when comparing a 'TENS and analgesia group' with an 'analgesia only' control group, the TENS group had faster recovery of both FEV1 and FVC. Improved management of pain results in better respiratory mechanics which in turn leads to a decrease in PPCs (Doan et al, 2014; Mans, Reeve and Elkins, 2014). It is evident from the low use of TENS (12.9%; n=11) in the current study, that only a small number of physiotherapists are aware of its benefits to their patients, or willing to spend the time and cost associated with the use of TENS. Hirayama et al (2003) also postulated that combining manual therapy with analgesics will lead to better postoperative pain contro,l but again, this knowledge does not reflect in the choices of techniques to manage the patient during this phase. It is therefore imperative that physiotherapists need to be educated as they can play a more active role in managing pain and preventing complications.

In the current study, respondents' personal experience (81.2%; n=69) and established practice protocols (75.2%; n=64) were the most influential factors when choosing post-operative management techniques, while the patients were still in hospital. Similar factors were identified by Agostini et al (2013) with established protocol ranking highest when considering management choices.

A summary of findings for this phase include treatment to improve ventilation and lung function (to prevent PPCs with early mobilisation and respiratory techniques like DBE and ACBT) is in line with standard care and current literature recommendations. Additionally, management of shoulder mobility is in line with literature recommendations. However, pain management strategies are lacking, and education in this regard is indicated for physiotherapists managing patients during their hospital stay.

Section 5.4 will discuss the findings of the study related to physiotherapy management of patients following discharge from hospital.

5.4 PHYSIOTHERAPY MANAGEMENT PROVIDED TO PATIENTS AFTER OPEN THORACOTOMY SURGERY AFTER DISCHARGE FROM HOSPITAL AND FACTORS INFLUENCING MANAGEMENT CHOICES

Of the 141 respondents in this study only 32.6% (n=46) indicated that they treat patients that had received open thoracotomy surgery after they were discharged from hospital. Twenty five respondents (17.7%) indicated that they only manage this population of patients after their discharge from hospital. Furthermore, only 29.7% (19/64) of physiotherapists who treat patients in hospital refer patients to an outpatient setting. The remainder (70.3%; n=45) of patients seen on an outpatient level are either referred by their doctor or self-referred. These results are similar to those reported by Agostini et al (2013) where post-op pulmonary rehabilitation and post-thoracotomy pain management were only rendered in 3%-26% of cases. Reeve et al (2007) reported that only 13% of physiotherapists are involved in post-thoracotomy pain management after patients' hospital discharge. This is of concern but also unusual that physiotherapist are so rarely involved at this stage of pain management, as physiotherapy is seen as one of the conservative and alternative pain management options in a myriad other scenarios. Although Doan et al (2014) reported that physiotherapy forms part of the multimodal management of PTPS it does not seem to be frequently the case in either of the three studies named *supra*.

Open thoracotomy patients are associated with a high percentage of long term post-thoracotomy pain and analgesic use according to Khan et al (2000). Several other authors have supported this finding with percentages ranging from 50%-70% of patients suffering from long term pain (Yarnitsky et al. 2008; Guastella et al, 2011). Although there seems to be a group that is of the opinion that these patients suffer only from neuropathic pain and that physiotherapy might be of limited or no value (Maguire et al, 2006; Hopkins et al, 2012; Klemensky et al, 2012), Guastella et al (2011) found that only 29% of the post-thoracotomy pain population could be diagnosed with neuropathic pain. This leaves the question as to why such a relatively small number of physiotherapists are involved in assessing and treating patients with post-thoracotomy pain. A huge gap exists in the physiotherapy management of post thoracotomy pain in these patients after discharge.

There are a few, albeit small, studies available to support the effectiveness of post-discharge pulmonary rehabilitation (Spruit et al, 2006; Cesario et al, 2007) but there seems to be insufficient literature relating to post-discharge pain management by physiotherapists. When

evaluating the modalities used by the small number of physiotherapists that are involved in the management of these patients after discharge, the group of modalities most often utilised were respiratory and exercise therapy interventions (see figure 4.14). Although to a lesser extent, pain management was addressed through OMT (60.9%; n=39), strapping (37.5%; n=24), soft tissue techniques (84.4%; n=54), dry needling (21.9%; n=14) and electrotherapy (53.1%; n=34). This is in line with results by Reeve et al (2007) who reported that service provision for pain management was infrequent but consisted of scar tissue mobilisation and TENS.

Management choices for thoracotomy patients after discharge were guided by undergraduate education (46.9%; n=30) for most participants. Literature recommendations (21.9%; n=14) and established practice protocol (21.9%; n=14) were the next highest scorers. Respondents were not asked to identify any literature, as was the case in the Reeve et al (2007) and Agostini et al (2013) studies. The studies by Reeve et al (2007) and Agostini et al (2013) do not state the factors that influenced respondents' choice of treatment modality in their studies in this category, to allow comparison.

The results from the current study seem to mirror those of Reeve et al (2007) and Agostini et al (2013) in that little or no consideration is given to management of these patients after discharge- leaving them vulnerable to developing functional disabilities and chronic pain. Education and more research is needed in this area.

Section 5.5 will discuss the findings of the study regarding the post-operative complications addressed by physiotherapists.

5.5 POST-OPERATIVE COMPLICATIONS ADDRESSED FROM A PHYSIOTHERAPEUTIC PERSPECTIVE

The 66 respondents who referred patients for physiotherapy immediately after hospital discharge, indicated that the two main reasons were respiratory difficulties (74.2%; n=49) and decreased functional ability (69.7%; n=46). This was also confirmed by the replies to the questionnaire, in that out-patient physiotherapists rendering treatment to this patient population indicated that they routinely utilise respiratory and exercise therapy modalities after discharge (see figure 4.14).

Respondents who treat thoracotomy patients after discharge from hospital (n=64) indicated that during the first six weeks directly after discharge from hospital the main reasons for

patients to receive physiotherapy, were for respiratory difficulties (64%; n=40), pain (57.8%; n=37) and decreased functional ability (48.4%; n=31). Even though pain was the second highest reason for physiotherapy treatment during this stage, it was not one of the most common reasons for referral by the physiotherapist who managed the patient while in hospital as stated in the previous paragraph. This might indicate that hospital physiotherapists do not give thought to, or have limited knowledge of the possibility that physiotherapy might be of value in pain reduction in line with the study done by Hirayama et al (2003) suggesting that manual therapy has the potential to assist in longer standing reduction in post-thoracotomy pain, especially if used concomitantly with analgesics. It would have been of great value to have had the patients' insight into what problem they perceived to be their primary concern at this stage.

According to Owen et al (2013) the incidence of PPCs after open thoracotomy surgery is 59% and even higher for immunocompromised patients. This is very relevant in the South-African population with the high incidence of HIV, TB and poor nutrition (World Health Organization Global Tuberculosis Report, 2013). The high percentage of patients who receive treatment during the first six weeks post-operatively for respiratory difficulties and decreased functional ability, is therefore considered to be in line with the expectation that residual effects of surgery or PPCs might still be present (Mans, Reeve and Elkins, 2014).

According to Yarnitsky et al (2008) the most common long term post-operative complaint is pain, with an incidence of 58% of patients reporting PTPS. Furthermore, Khan et al (2000) reported that up to 50% of patients still need analgesics at one year follow-up. The result of this study showed that the reason physiotherapists treat patients more than six weeks after discharge from hospital, is indeed pain (57.8%; n=37). Respiratory difficulties seem to have subsided in incidence (26.6%; n=17) at this stage, and might be linked to an improvement in the activity level of patients.

Reeve et al (2010) reported that all patients have returned to their pre-operative levels of shoulder mobility at three month follow-up, regardless of whether or not they received a supervised shoulder exercise program. The results in the current study however show an upsurge in the percentage of treatments rendered due to decreased shoulder mobility, with 37.5% (n=24) incidence before six weeks post discharge, and 51.5% (n=33) incidence after six weeks. This could possibly be due to protective posture maintained by the patients, leading to decreased shoulder mobility over time. It could also possibly be due to the poor referral rate by

physiotherapists at the time of discharge, coinciding with the long post-operative period when the patient becomes concerned that recovery is slow or not optimal - at this stage being referred by either their doctor or themselves for treatment. It is therefore vital that patients receive adequate education and information while still in hospital but also referral to be checked postoperative after a period of time by an out-patient physiotherapist.

Considering all of the above, it seems that physiotherapists are indeed active in treating all the possible post-operative complications in open thoracotomy patients. The researcher is still concerned about the high incidence of chronic pain in this patient population, and the relative small number of patients receiving early physiotherapy interventions for this complication. Education regarding the comprehensive role of physiotherapy in the patient that received open thoracic surgery, is of utmost importance.

Chapter 6 will contain the limitations, conclusions and point out the recommendations for future research and clinical practice.

CHAPTER 6

6. CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

6.1 CONCLUSION

The aim of this study was to establish which physiotherapy treatment modalities and techniques are used in the management of open-thoracotomy patients in Gauteng, South Africa.

The majority of physiotherapists who treated patients who had received an open thoracotomy were females between the ages of 23 and 69 with a Bachelor's degree. Only 13.4% of respondents had higher qualifications. More than 98% of respondents were active with their personal professional development during the year before participating in the current study. Dry needling and OMT were the special interest fields of choice for CPD. The special interest groups that represented the majority of participants were OMPTG and CPRG. Employment specifics revealed that 87.2% worked in private practice.

Pre-operative physiotherapy management for open thoracotomy patients was instituted by 93.1% of participants. However, 55.6% treated patients only after assessing their risk profile and determining necessity. Management during this phase most commonly consisted of information and respiratory techniques like coughing, huffing and ACBT. This is similar to findings in studies in Australia (Reeve et al, 2007) and the UK (Agostini et al, 2013) and in line with current standard or accepted practice (Denehy, 2008; Arbane et al, 2011; Agostini et al, 2009). Inspiratory muscle training was not utilised to its full potential, even though its effectiveness was reported in decreasing the incidence of PPCs (Mans et al, 2014). The respondents who indicated that they never instituted pre-operative management, did not supply reasons.

Prophylactic post-operative management was high and in accordance with studies from Reeve et al (2007) and Agostini et al (2013). Even though evidence of effectiveness of specific techniques is sparse, this approach is in alignment with the standard care as described in international studies (Reeve et al, 2007; Agostini et al, 2013) and also with surgeons' preference of routine provision, and their belief that it is of value to their clients. The main reason for supplying physiotherapy in this patient population is to prevent or decrease the incidence of PPCs or to manage recovery if complications are present. The modalities used

most commonly were respiratory techniques like DBE, coughing, ACBT and IS, as well as early mobilisation to address pulmonary problems. Exercise interventions were used to manage shoulder and thoracic cage mobility, which is in line with evidence based practice (Reeve et al, 2010). A limited number of modalities focused on treating pain, with this part of patient management seemingly left to be controlled by analgesics.

Post-hospital discharge physiotherapy management was sparse and uncommon. Management that was instituted during the first six weeks following discharge, focused on respiratory difficulties. The focus of physiotherapy more than six weeks after being discharged from hospital, changed to treating pain.

Even with the difference in patient profile in South-Africa (e.g. more trauma and TB patients) when compared to Australia and the UK, the management rendered to these patients seem to be very similar in all three countries.

Decision making in management choices during all phases of contact with patients after open thoracotomies, were mainly influenced by personal experience and established practice protocol. Although physiotherapists seem to be active in treating most postoperative complications, the focus remains on pulmonary complications. A more active role in the management of patients' pain should be advocated, as a decrease in pain leads to better respiratory mechanics resulting in a reduction of not only PPCs but also the incidence of PTPS/CPTP as indicated by Joshi et al (2014).

Clinical decisions that were made by participants in the current study, were based on the limited available evidence. In this regard, it is suggested that, until conclusive data becomes available it is possible that different inferences can be drawn based on available evidence. Available evidence, even though limited, currently used to guide physiotherapist should therefore be combined into clinical guidelines.

6.2 LIMITATIONS OF THE STUDY

Information gained from this study is limited to physiotherapists registered with the SASP in Gauteng. Only 23.3% (n=323) of the 1389 members registered with the SASP in Gauteng responded and only 10.2% (n=141) were liable to be included in the study. The results therefore only give an initial glimpse on current practice in South Africa. The majority of liable (n=141) respondents (93.6%; n=132) indicated that they work in private practice and therefore

information regarding management in the public sector might differ. Although there seem to be several resemblances between results from this study compared to the study by Reeve et al (2007) in Australia and New Zealand, as well as the study of Agostini et al (2013) done in the United Kingdom, caution should be applied when generalising results to the broader physiotherapy population in South-Africa. As physiotherapists in South-Africa do not have first line practitioner status in hospitals, they are obliged to adhere to the primary care specialist's instructions (South African Society of Physiotherapy 2014). Doctors' regimes and preferences could differ from province to province, as well as from private to public sector, and thus influence the management of open thoracotomy patients. The trend to base managements on personal experience and established practice protocol seems to be a theme in pre- and post-operative management.

In hindsight more information about the reason/s why not all patients are seen post-operatively, as well as the possible assessment process, would have given valuable insight into the post-operative management of patients while still in hospital. A clearer South African picture might have emerged if respondents had been asked to differentiate between techniques used after elective thoracotomy vs emergency thoracotomy. More in-depth questioning why certain techniques are preferred might have revealed that more physiotherapists than estimated in this study might, indeed be involved in early interventions to prevent PTPS.

The researcher is fully aware of the fact that not all respondents might have responded truthfully and indeed might have marked answers that they suspect might be 'the correct' answers, even though they do not routinely use these techniques.

6.3 RECOMMENDATIONS

6.3.1 Clinical Recommendations

Owners of private practices, as well as educators, share the responsibility of keeping up to date with current literature and evidence-based treatments for patients after receiving open thoracotomy incisions, with the responsibility to translate them to employees and students.

Physiotherapists should take cognisance of current literature in their field of practice and not just their field of interest, and be willing to challenge existing practice protocols to ensure that patients receive the best available evidence-based care.

Literature should be more freely available to benefit private health care. Furthermore, special interest groups should distribute full-text articles in their field to allow members the opportunity to stay up to date in a cost effective way. Universities could offer subscriptions to their library, especially to alumni, in order to promote continuous evidence-based education and practice. Physiotherapists should be more critical about the courses they attend in order to ensure that it is evidence-based.

Physiotherapists treating patients who receive open thoracotomy surgery should include education, assessments, support and appropriate referral of patients who may be susceptible to complications, especially those associated with the post-hospital discharge period.

6.3.2 Recommendations for Future Research

Future research in the following areas would be of great value to our profession:

This survey should be repeated on a national level with emphasis on public and private participation at a higher level.

Randomised controlled trials to assess patient satisfaction and emotional well-being when rendering pre-operative physiotherapy vs. no pre-operative contact.

Randomised controlled trials comparing different post-operative management pathways.

A more in depth study assessing the treatment modalities used to treat patients after discharge from hospital as well as reasons for continued care.

Randomised controlled trials to assess if standard treatment combined with pain intervention techniques, compared to “standard treatment”, would render a lower PTPS incidence.

A in depth study assessing patients’ perspective regarding problems they experience post-operative.

Evaluation of public sector physiotherapy management of patients undergoing thoracic surgery.

REFERENCES

Agostini P., Naidu B., Cieslik H., Rathinam S., Bishay E., Kalkat M.S., Rajesh P.B., Steyn R.S. and Singh S. 2011. Comparison of recognition tools for postoperative pulmonary complications following thoracotomy. *Physiotherapy.* 97: 278-283.

Agostini, P. and Singh S. 2009. Incentive spirometry following thoracic surgery: what should we be doing? *Physiotherapy*. 95: 76-82.

Agostini, P., Reeve, J.C., Dramond, S., Steyn R.S. and Naidu B. 2013. A survey of physiotherapeutic provision for patients undergoing thoracic surgery in the UK. *Physiotherapy*. 99: 56-62.

Arbane G., Douiri A., Hart N., Hopkinson N.S., Singh S., Speed C., Valladares B. and Garrod R. 2014. Effect of postoperative physical training on activity after curative surgery for non-small cell lung cancer: a multicentre randomised controlled trial. *Physiotherapy*. 100: 100-107.

Arbane G., Tropman D., Jackson D. and Garrod R. 2011. Evaluation of an early exercise intervention after thoracotomy for non-small cell lung cancer (NSCLC), effects on quality of life, muscle strength and exercise tolerance: Randomised controlled trial. *Lung Cancer*. 71: 229-34.

Athanassiadi K., Kakaris S., Theakos N. and Skottis I. 2007. Muscle-sparing versus posterolateral thoracotomy: a prospective study. *European Journal of Cardio-Thoracic Surgery*. 31: 496-500.

Bao F., Ye P., Yang Y., Wang L., Zhang C., Lv X. and Hu J. 2014. Segmentectomy or lobectomy for early stage lung cancer: a meta-analysis. *European Journal of Cardio-Thoracic Surgery.* 46: 1-7.

B.H.F. Southern Africa. 84% of South Africans have no medical aid cover - 29/06/11. 21 July 2011. Available: http://www.bhfglobal.com/84-south-africans-have-no-medical-aid-cover-290611 [Accessed 06.01.2015]

Bartlett, R.L. 1998. Clinical Procedures in Emergency Medicine. *Resuscitative Thoracotomy.* 17: 264-280. Philadelphia: W. B. Saunders Company.

Benedetti F., Amanzio M., Casadio C., Cavallo A., Cianci R. and Giobbe R. 1997. Control of postoperative pain by transcutaneous electrical nerve stimulation after thoracic operations. *Annals of Thoracic Surgery.* 63: 773-776.

Bethencourt D.M. and Holmes E. 1988. Muscle-sparing posterolateral thoracotomy. *Annals of Thoracic Surgery.* 45: 337-339.

Bogduk N. (2009). On the definitions and physiology of back pain, referred pain, and radicular pain. *Pain*. 14: 717-719.

Bryant M.J, Harris S.R., Parkhill J., Dawson R., Diacon A.H., Van Helder P., Pym A., Mahayiddin A.A., Chuchottaworn C., Sanne I.M., Louw C., Boeree M.J., Hoelscher M., McHugh T.D., Bateson A.L.C., Hunt R.D., Mwaigwisya S., Wright L., Gillespe S.H. and Bentley S.D. 2013. Whole-genome sequencing to establish relapse or re-infection with Mycobacterium tuberculosis: a retrospective observational study. *Lancet Respiratory Medicine*. 1: 786-792.

Burd T.A., Pawalek L. and Lenke G.L. 2002. Upper extremity functional assessment after anterior spinal fusion via Thoracotomy for adolescent idiopathic scoliosis. *Spine*. 27(1): 65-71.

Calligaro G.L., Moodly L., Symons G. and Dheda K. 2014. The medical and surgical treatment of drug-resistant tuberculosis. *Journal of Thoracic Disease*. 6(3): 186-195.

Cesario A., Ferri L., Galetta D., Pasqua F., Bonassi S. and Clini E. 2007. Post-operative respiratory rehabilitation after lung resection for non-small cell lung cancer. *Lung Cancer*. 166(1): 175-180.

Clarke D.L., Quazi M.A., Reddy K. and Thomas S.R. 2011. Emergency operation for penetrating thoracic trauma in a metropolitan surgical service in South-Africa. *Journal of Thoracic and Cardiovascular Surgery*. 142(3): 563-8.

Courtney M., Townsend R., Beauchamp D., Evers B.M. and Mattox K.L. 2012. *Sabiston Textbook of Surgery*. 13: 281-327. Saunders: Elsevier Inc.

Das-Neves-Pereira J.C., Bagan P., Coimbra-Israel A. and Grimaillof-Junior A. 2009. Fast track rehabilitation for lung cancer lobectomy: a five year experience. *European Journal Cardio-Thoracic Surgery*. 36: 383-92.

Denehy L. 2008. *Physiotherapy for Respiratory and Cardiac Problems*. 428. Edinburgh: Churchill Livingstone.

Deng G., Rusch V., Vickers A., Malhortra V., Ginex P., Downey R., Bains M., Park B., Rizk N., Flores R., Yeung S. and Cassileth B. 2008. Randomized controlled trial of a special acupuncture technique for pain after thoracotomy. *Journal of Thoracic and Cardiovascular Surgery*. 136(6): 1464-1469.

Doan L.V., Augustus J., Androphy R., Schechter D. and Gharibo C. 2014. Mitigating the impact of acute and chronic post-thoracotomy pain. *Journal of Cardiothoracic and Vascular Anesthesia*. 28(4): 1060-1068.

Dronkers J., Veldman A., Hoberg E., Van der Waal C. and Van Meeteren N. 2008. Prevention of pulmonary complications after upper abdominal surgery by preoperative intensive inspiratory muscle training: a randomized controlled pilot study. *Clinical Rehabilitation*. 22: 134-42.

El-Fiky M.M., El-Sayegh T., El-Beisshry A.S., Aziz M.A., Eneien H.A., Waheid S. and Sallam I.A. 2000. Limited right anterolateral thoracotomy for mitral valve surgery. *European Journal of Cardio-Thoracic Surgery*. 17: 710-713.

Erdogan M., Erdogan A., Erbil N., Karakaya H.K. and Demircan A. 2005. Prospective randomized, placebo-controlled study of the effect of TENS on post-thoracotomy pain and pulmonary function. *World Journal of Surgery*. 29: 1563-1570.

Erus S., Tanju S., Kapdagli M., Ozkan B., Dilige S. and Toker A. 2014. The comparison of complications, pain, quality of life and performance after lung resections with thoracoscopy and axilliray thoracotomy. *European Journal of Cardio-Thoracic Surgery*. 1-6. doi:10.1093/ejcts/ezu050 [Accessed 16.08.2014]

Finweek. Retiring at age 65: An archaic idea that doesn't fit into today's world. 30 April 2013. Available: http://finweek.com/2013/04/30/retiring-at-age-65-an-archaic-idea-that-doesnt-fit-into-todays-world/ [Accessed 23.12.2014]

Fiorelli A., Morgillo F., Milione R., Pace M.C., Passavanti M.B., Laperuta P., Aurilio C. and Santini M. 2012. Control of post-thoracotomy pain by transcutaneous electrical nerve stimulation: effect on serum cytokine levels, visual analogue scale, pulmonary function and medication. *European Journal of Cardio-Thoracic Surgery*. 41: 861-868.

Gosselink R., Schrever K., Cops P., Witvrouwen H., De Leyn P. and Troosters T. 2000. Incentive spirometry does not enhance recovery after thoracic surgery. *Critical Care Medicine*. 28: 679-683.

Grogan E.L. and Jones D.R. 2008. VATS Lobectomy is better than open thoracotomy: What is the evidence for short-term outcomes? *Thoracic Surgery Clinics*. 18: 249-258.

Grosen K., Drewes A.M., Hojsgaard A., Pheiffer-Jensen M., Hjortdal V.E. and Pilegaard H.K. 2014. Perioperative gabapectin for prevention of persistent pain after thoracotomy: a randomized controlled trial. *European Journal of Cardio-Thoracic Surgery*. 46: 76-85.

Guastella V., Mick G., Soriano C., Vallet L., Escande G., Dubray C. and Eschalier A. 2011. A prospective study of neuropathic pain induced by thoracotomy: Incidence, clinical description and diagnosis. *Pain*. 152(1): 74-81.

Gulbahar G., Kocer B., Muratli S.N., Yildirim E., Gulbahar O., Dural K. and Sakinci U. 2010. A comparison of epidural and paravertebral catheterization techniques in post-thoracotomy pain management. *European Journal of Cardio-Thoracic Surgery*. 37: 467-472.

Health Professions Council of South Africa. 2013. CPD. Available: http://www.hpcsa.co.za/CPD [Accessed 25.01.2015]

Hirayama F., Kageyama Y., Urabe N. and Senjyu H. 2003. The effect of postoperative ataralgesia by manual therapy after pulmonary resection. *Manual Therapy*. 8(1): 42-45.

Hopkins K.G. and Rosenzweig M. 2012. Post Thoracotomy pain syndrome: assessment and intervention. *Clinical Journal of Oncology Nursing*. 16 (4): 365-70.

Hughes R. and Gao F. 2005. Pain control for thoracotomy. *Continuing Education in Anaesthesia, Critical Care and Pain*. 5(2):56-60.

Hulzebos E.H., Helders P.J., Favie N.J., De Brie R.A., Brutel de la Riviere A., and Van Meeteren N.L. 2006. Pre-operative intensive inspiratory muscle training to prevent postoperative pulmonary complications in high-risk patients undergoing CABG surgery: a randomized clinical trial. *Journal of the American Medical Association*. 296: 1851-1857.

Hunt P.A., Greaves I. and Owens W.A. 2006. Emergency thoracotomy in thoracic trauma-a review. *Injury*. 37(1): 1-19.

International association for the study of pain. Subcommittee of Taxonomy. 1996. Classification of chronic pain. *Pain*. 3: S138-S139.

Joshi G.P., Schug S.A. and Kehlet H. 2014. Procedure-specific pain management and outcome strategies. *Best Practice and Research Clinical Anaesthesiology*. 28: 191-201.

Karmakar M.K. and Ho A.M. 2004. Post-thoracotomy pain syndrome. *Thoracic Surgery Clinics*. Aug 14 (3): 345-352. [Pubmed: 15382766].

Khan I.H., McManus K.G., McCraith A. and McGuigan J.A. 2000. Muscle sparing thoracotomy: a biomechanical analysis confirms preservation of muscle strength but no improvement in wound discomfort. *European Journal of Cardio-Thoracic Surgery*. 18: 656-661.

Khelemskey Y. and Noto C.J. 2012. Preventing post-thoracotomy pain syndrome. *Mount Sinai School of Medicine*. 79:133-39.

Khuri S.F., Daley J., Henderson W., Barbour G., Lowry P., Irvin G., Gibbs J., Grover F., Hammermeister K. and Stremple J. 1995. The National Veterans Administration Surgical

Risk Study: risk adjustment for the comparative assessment of the quality of surgical care. *Journal of the American College of Surgeons*. 180:519–531.

Kotani N., Hashimoto H., Sato Y., Sessler D.I., Yoshioka H. and Kitayama M. 2001. Preoperative intradermal acupuncture reduces postoperative pain, nausea and vomiting, analgesic requirements and sympathoadrenal responses. *Anesthesiology*. 95: 349-356.

Linde K., Vickers A., Hodras M., Ter Riet G., Thormahlen J. and Berman B. 2001. Systematic review of complementary therapies-an annotated bibliography. Part1: Acupuncture. *BMC Complementary and Alternative Medicine*. 1: 3.

Mackay M., Ellis E. and Johnston C. 2005. Randomised clinical trial of physiotherapy after open abdominal surgery in high risk patients. *Australian Journal of Physiotherapy*. 51: 151-159.

Maguire M.F., Ravenscroft A., Beggs D. and Duffy J.P. 2006. A questionnaire study investigating the prevalence of the neuropathic component of chronic pain after thoracic surgery. *European Journal of Cardiothoracic Surgery*. 29 (5): 800-805.

Mans C.M., Reeve J.C. and Elkins M.R. 2014. Postoperative outcomes following preoperative inspiratory musce training in patients undergoing cardiothoracic or upper abdominal surgery: a systematic review and meta-analysis. *Clinical Rehabilitation*. 2 Aug 2014: 1-13. doi: 10.1177/0269215514545350. [Accessed 30.08.2014]

Martinez-Barenys C., Busquets J., de Castro L., Garcia-Guasch R., Perez J., Fernandez E., Mesa M.A. and Astudillo J. 2011. Randomized double-blind comparison of phrenic nerve infiltration and suprascapular nerve block for ipsilateral shoulder pain after thoracic surgery. *European Journal of Cardio-Thoracic Surgery*. 40: 106-112.

McElnay P., Casali G., Batchelor T. and West D. 2013. Adopting a standardized anterior approach significantly increases video-assisted thoracoscopic surgery lobectomy rates. *European Journal of Cardio-Thoracic Surgery*. 46: 100-105.

McGraw-Hill Concise Dictionary of Modern Medicine. 2002. McGraw-Hill Companies Inc.

Medscape. 17 December 2013. Tube Thoracostomy Management. Available: http://emedicine.medscape.com/article/1503275-overview#showall [Accessed 25.01.2015]

Mihaljevic T., Cohn L.H., Unic D., Aranki S.F., Couper G.S. and Byrne J.G. 2004. One hundred minimally invasive valve operations. Early and late results. *Annals of Surgery*. 240(3): 529-534.

Moore K.L., Dalley A.F. and Agur A.M.R. 2010. *Clinically Orientated Anatomy*. Philadelphia: Lippencot Williams and Wilkins.

Moorjani N., Zhao F., Tian Y., Liang C., Kaluba J. and Maiwand M.O. 2001. Effects of cryoanalgesia on post-thoracotomy pain and on the structure of intercostal nerves: a human prospective randomized trial and a histological study. *European Journal of Cardio-Thoracic Surgery*. 20: 502-507.

Nordberg J., Nilsson T., Eriksson A. and Hardcastle T. 2009. The costs of a bullet – inpatient costs of firearm injuries in South Africa. *SAMJ*. 99(6). *Print version* ISSN 0256-9574.

Numan R.C., Klomp H.M., Li W., Buitelaar D.R., Burgers J.A., Van Sandick J.W. and Wouters M.W. (2012). A clinical audit in a multidisciplinary care path for thoracic surgery: an instrument for continuous quality improvement. *Lung Cancer*. 78: 270-275.

O'Donohue W. 1992. Postoperative pulmonary complications. When are preventive and therapeutic measures necessary? *Postgraduate Medicine*. 91 (3): 167-175.

Öhman A., Stenlund H. and Dalhgren A. 2001. Career choice, professional preferences and gender - the case of Swedish physiotherapy students. *Advances in Physiotherapy*. 3: 94-107.

Ohmori A., Iranami H., Fujii K., Yamazaki A. and Doko Y. 2013. Myofascial involvement of supra- and infraspinatus muscle contributes to ipsilateral shoulder pain after muscle-sparing thoracotomy and video-assisted thoracic surgery. *Journal of Cardiothoracic and Vascular Surgery*. 27(6): 1310-1314.

Orman J. and Westerdahl E. 2010. Chest physiotherapy with positive expiratory pressure breathing after abdominal and thoracic surgery: a systematic review. *Acta Anaesthesiologica Scandinavica*. 54: 261-267.

Owen R.M., Force S.D., Pickens A., Mansour K.A., Miller D.L. and Fernandez F.G. 2013. Pneumonectomy for benign disease: analysis of early and late outcomes. *European Journal of Cardio-Thoracic Surgery.* 43: 312-317.

Pasquina P., Tramer M. and Walder B. 2003. Phrophylactic respiratory physiotherapy after cardiac surgery: systematic review. *British Medical Journal*. 327: 1373-1379.

Peter J.G., Cashmere T.J., Metdau R., Theron G., van Zyl-Smit R. and Dheda K. 2012. Diagnostic accuracy of induced sputum LAM ELISA for tuberculosis diagnosis in sputum-scarce patients. *Int J Tuberc Lung Dis.* 16(8): 1108-1112.

Pipanmekaporn T., Punjasawadwong Y., Charuluxananan S., Lapisatepun W., Bunburaphong P., Patumanond J., Saeteng S. and Chandee T. 2014. Incidence of risk factors for cardiovascular complications after thoracic surgery for noncancerous lesions. *Journal of Cardiothoracic and Vascular Anesthesia*. 8(24): 960-965.

Reeve J.C., Denehy L. and Stiller K. 2007. The physiotherapy management of patients undergoing thoracic surgery: a survey of current practice in Australia and New Zealand. *Physiotherapy Research International.* 12 (2): 59-71.

Reeve J.C., Nicol K., Stiller K., McPherson K.M., Birch P., Gordon I.R. and Denehy L. 2010. Does physiotherapy reduce the incidence of postoperative pulmonary complications following pulmonary resection via open thoracotomy? A preliminary randomised single-blind clinical trial. *European Journal of Cardiothoracic Surgery*. 37: 1158-67.

Reeve J.C., Stiller K., Nicol K., McPherson K.M., Birch P., Gordon I.R. and Denehy L. 2010. A postoperative shoulder exercise program improves function and decreases pain following open thoracotomy: a randomised trial. *Journal of Physiotherapy*. 56: 245-52.

Reeve, J.C. 2008. Physiotherapy interventions to prevent post-operative pulmonary complications following lung resection. What is the evidence? What is the practice? *New Zealand Journal of Physiotherapy*. Nov 36(3): 118-30.

Reid J.C., Jamieson A., Bond J., Versi B.M., Nagar A., Ng B.H.K. and Moreland J.D. 2010. A pilot study of the incidence of post-thoracotomy pulmonary complications and the effectiveness of pre-thoracotomy physiotherapy patient education. *Physiotherapy Canada*. 62 (1): 66-74.

Rocco G. 2014. Towards a standardized approach for video-assisted thoracoscopic surgery lobectomy. *European Journal of Cardio-Thoracic Surgery*. 46: 106.

Rodriguez E., Malaisrie S.C., Mehall J.R., Moore M., Salemi A., Ailawadi G., Gunnarsson C., Ward A.F. and Grossi E.A. 2014. Right anterior thoracotomy aortic valve replacement is associated with less cost than sternotomy-based approaches: a multi-institution analysis of 'real world' data. *Journal of Medical Economics*. doi: 10.3111/13696998.2014.953681. [Accessed 23.09.2014]

Sarkar P., Chandak T., Shah R. and Talwar A. 2010. Diagnosis and management Bronchopleural fistula. *The Indian Journal of Chest Diseases and Allied Sciences*. 52: 97-104.

Sawada S., Komori E. and Yamashita M. 2009. Evaluation of video-assisted thoracoscopic surgery lobectomy requiring emergency conversion to thoracotomy. *European Journal of Cardio-Thoracic Surgery*. 36: 487-490.

Sbruzzi G., Silviera S.A., Silva D.V., Coronel Cand Plentz R.D.M. 2012. Transcutaneous electrical nerve stimulation after thoracic surgery: systematic review and meta-analysis of randomized trials. *Brazilian Journal of Cardiovascular Surgery*. 27 (1): 75-87.

Sharony R., Grossi E.A., Saunders P.C., Schwartz C.F., Ursomanno P., Ribakove G.H., Galloway A.C. and Colvin S.B. 2006. Minimally Invasive Re-operative Isolated Valve Surgery: Early and Mid-Term Results. *Journal of Cardiac Surgery*. May-Jun; 21(3): 240-44.

Shields T.W. 2005. *General Thoracic Surgery*. Seventh ed. Philadelphia: Williams and Wilkins.

Simons D.G., Travell J.G. and Simons L.S. 1999. Travell & Simons' Myofascial pain and dysfunction. *The Trigger Point Manual*. Volume 1. Sec Ed. Williams and Wilkins.

Solak O., Turna A., Pekcolaklar A., Metin M. and Sayar A. 2007. Transcutaneous electric nerve stimulation for the treatment of postthoracotomy pain: a randomized prospective study. *Journal of Thoracic and Cardiovascular Surgery*. 55: 182-185.

South African Society of Physiotherapy. 2012. The role of dry needling in Physiotherapy-SASP position paper. Approved at National Assembly – Apr 2010. Revised Sept 2012.

South African Society of Physiotherapy. 2014. First Line Practitioner Status of Physiotherapists – Guiding Principles. Rev 3 – reviewed 10 Feb 2014.

Spruit M.A., Janssen P.P., Willemsen S.C., Hochstenbag M.M. and Wouters E.F. 2006. Exercise capacity before and after an 8-week multidisciplinary inpatient rehabilitation program in lung cancer patients: a pilot study. *Cancer*. 52: 45-51.

The Merck Manual - The professional edition. September 2013. Thoracotomy. Available: http://www.merckmanuals.com/professional/pulmonary_disorders/diagnostic_pulmonary_procedures/thoracotomy.html [Accessed 23.09.2014]

Tiippana E., Nelskyla K., Nilsson E., Sihvo E., Kataja M. and Kalso E. 2014. Managing post-thoracotomy pain: Epidural or systemic analgesia and extended care - A randomized study with an 'as usual' control group. *Scandinavian Journal of Pain*. 267. Doi: 10.1016/j.sjpain.2014.07.001 [Accessed 22.0711]

Trading Economics. South Africa Retirement Age - Women 2008-2015. Available: http://www.tradingeconomics.com/south-africa/retirement-age-women [Accessed 23.12.2014]

Varela G. Editorial comment. *European Journal Cardio-Thoracic Surgery*. 2010; 20: 1166-67.

Varela G., Ballesteros E., Jiminez M.F., Novoa N. and Aranda J.L. 2006, Cost-effectiveness analysis of prophylactic respiratory physiotherapy in pulmonary lobectomy. *European Journal of Cardio-Thoracic Surgery*. 29: 216-220.

Von Oppell U.O., Bautz P. and De Groot M. 2000. Penetrating thoracic injuries: what we have learnt. *Journal of Thoracic and Cardiovascular Surgery.* 48(1): 55-61.

Weber A., Stammberger U., Inci I., Schmid R.A., Dutly A. and Weder W. 2001.Thoracoscopic lobectomy for benign disease – a single centre study on 64 cases. *European Journal of Cardio-Thoracic Surgery*. 20: 443-48.

Weiner P., Man A., Weiner M., Rabner M., Waizman J. and Magadle R. 1997. The effect of incentive spirometry and inspiratory muscle training on pulmonary function after lung resection. *Journal of Thoracic and Cardiovascular Surgery*. 113: 552-557.

World Health Organization. Global tuberculosis report 2013. Available: http://www.who.int/tb/publications/global_report/en/ [Accessed 07.01.2015]

Yarnitsky D., Crispel Y., Eisenberg E., Granovsky Y., Ben-Nun A., Sprecher E., Best L. and Granot M. 2008. Prediction of chronic post-operative pain: Pre-operative DNIC testing identifies patients at risk. *Pain*. 138: 22–28. doi: 10.1016/j.pain.2007.10.033 [Accessed:16.08.2014]

APPENDIX A

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

Dear physiotherapy colleague,
This survey aims to:
1. Establish the profile of physiotherapists rendering a service to post thoracic surgery patients
2. Determine the current physiotherapy practice of thoracic surgery patients during hospital stay
3. Determine the current physiotherapy practice of thoracic surgery patients after discharge as out patients
4. Identify trends in the variability of service provision
5. Further develop the evidence base in physiotherapy following major surgery

Completion of the survey will indicate your consent to participate.

If I can be of further assistance in the completion of this questionnaire please do not hesitate to call or email me on:
Mobile: 082 491 4549
Email: liezel.schweinus@gmail.com
I thank you in advance for your participation in this survey.
Yours sincerely,
Ms LB Schweinus MSc student, The University of the Witwatersrand

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

General information

For the purpose of this survey, except where stated, thoracic surgery should be taken to mean open thoracic surgery via a thoracotomy incision.

Please answer honestly.

***1. Please state your age**

***2. Please state your gender**

- Male
- Female

***3. Please state your highest qualification**

- Diploma in Physiotherapy
- Bachelor in Physiotherapy
- Masters in Physiotherapy
- Doctorate in Physiotherapy

4. Have you done any of the following courses (all modules and exams)? Please tick all that apply.

- CPT 1 (Cardiopulmonary Physiotherapy)
- Dry needling (including anatomy exam)
- OMT 1 (Orthopaedic Manual Therapy)
- Pain
- SPT (Sports Physiotherapy)
- Other (Please specify)

***5. Did you do any CPD (continuous professional development) courses during the last year?**

- Yes
- No

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***6. In what speciality did you do the CPD activity? Please tick all that apply.**

- ☐ CPT
- ☐ OMT
- ☐ Pain
- ☐ Sport
- ☐ Other (please specify)

***7. How long have you been qualified as a physiotherapist?**

***8. What is your current employment?**

- ○ Working in private practice
- ○ State employed / Public sector physiotherapist
- ○ Both Private and Public sector
- ○ Academic

***9. What does your current work involve regarding physiotherapy practice?**

- ○ Rooms/Out patients
- ○ Hospital/In patients
- ○ Rooms & Hospital
- ○ Only Academic work (employed by a University)
- ○ Academic & Clinical work

***10. Are you a member of a special interest group?**

- ○ Yes
- ○ No

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***11. Please indicate the special interest groups you belong to. (Please tick all that apply)**

- ☐ CPRG
- ☐ Dry needling
- ☐ OMPTG
- ☐ Pain
- ☐ SPT
- ☐ Other (please specify)

***12. Do you treat patients that received open thoracic surgery via a thoracotomy incision (either in hospital or as an outpatient following discharge during their recovery)?**

- ○ Yes during hospital stay
- ○ Yes as an outpatient
- ○ Yes both in hospital and as an outpatient
- ○ No

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

SECTION 2: Service Provision

***13. On average, how many patients that undergo open thoracotomy, do you treat per week?**

- 1 per week
- 2 – 5
- 6 – 10
- Over 10
- I don't treat open thoracotomy patients weekly

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***14. If you don't treat thoracotomy patients weekly, on average how many do you treat per month?**

***15. What types of surgery are undertaken in your unit by means of open thoracotomy? (Please tick all that apply)**

- ☐ Chest wall reconstruction surgery (non-traumatic)
- ☐ Lung volume reduction surgery (LVRS) (elective)
- ☐ Oesophageal surgery (elective)
- ☐ Pleural surgery (elective)
- ☐ Pulmonary resection (elective)
- ☐ Traumatology sequelae
- ☐ Other (please specify)

***16. In which ICU's/units do you treat patients that had an open thoracotomy? Please tick all that apply.**

- ☐ Cardiothoracic ICU
- ☐ Surgical ICU
- ☐ Trauma ICU
- ☐ Other (please specify)

***17. What is the average length of post-operative stay for patients undergoing elective thoracotomy in your hospital?**

- ○ 0 – 3 days
- ○ 4 – 7 days
- ○ 8 – 10 days
- ○ > 10 days
- ○ I don't treat elective thoracotomy patients

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***18. What is the average length of stay for patients undergoing thoracotomy due to traumatology sequelae?**

- ◯ 0 – 3 days
- ◯ 4 – 7 days
- ◯ 8 – 10 days
- ◯ > 10 days
- ◯ I don't treat traumatology thoracotomy patients

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

SECTION 3: Pre-operative physiotherapy management

For the purpose of this survey, pre-operative management should be taken to mean patients that have been admitted specifically for an elective thoracotomy procedure. This will exclude patients that were treated/managed by you for any number of treatments before the decision was made to perform a thoracotomy (including traumatology).

***19. Do you treat elective thoracotomy patients?**

◯ Yes ◯ No

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***20. What proportion of patients undergoing an open thoracotomy procedure is seen pre-operatively by you?**

- ◯ All
- ◯ Some
- ◯ None

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***21. If no patients are seen pre-operatively by you, please highlight the reasons why. Please tick all that apply.**

- [ ] Information given by information booklet
- [ ] Information given by other staff members
- [ ] Insufficient time/staff
- [ ] Other (please specify)

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

22. If only some patients are seen pre-operatively by you on what basis are they selected for pre-operative physiotherapy? Please tick all that apply.

- [ ] According to availability of staff/time
- [ ] High risk
- [ ] Other (please specify)

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

23. Please state criteria to determine high risk pre-operative patients

***24. For those patients seen pre-operatively, please indicate which of the following procedures you use/don't use on a routine basis?**

	Use	Don't use
Baseline assessment by review of clinical patient's notes	○	○
Baseline assessment with face to face contact with patient	○	○
Pulmonary function tests	○	○
Auscultation	○	○
Review of chest x-rays and/or CT scans	○	○
Assessment of chest expansion	○	○
Screening of functional ability	○	○
Endurance capacity testing (e.g. six minute walking test)	○	○
Assessment of shoulder range of motion (ROM)	○	○
Assessment of thoracic mobility	○	○
Oxygen saturation (SpO_2)	○	○
Patient education through face to face contact	○	○
Caregiver education	○	○
Education with information video	○	○
Education via written information	○	○
Education in group setting	○	○
Teaching of active cycle of breathing technique (ACBT)	○	○
Teaching supported cough/huff	○	○
Teaching sustained maximal inspirations	○	○
Teaching the use of	○	○

Incentive spirometry		
Teaching of intermittent positive pressure breathing (IPPB)	◯	◯
Inspiratory muscle training	◯	◯
Pre-operative pulmonary exercise rehabilitation for all open thoracotomy patients	◯	◯
Pre-operative pulmonary exercise rehabilitation only for patients receiving lung volume reduction surgery (LVRS)	◯	◯

25. Please rate how much, each of the following influence your PRE-OPERATIVE patient management.

	1 No influence at all	2	3	4	5 very influencial
Personal experience	◯	◯	◯	◯	◯
Undergraduate education	◯	◯	◯	◯	◯
Literature recommendations	◯	◯	◯	◯	◯
Established practice protocol	◯	◯	◯	◯	◯
Limited Resource (e.g. lack of equipment)	◯	◯	◯	◯	◯
Financial considerations (e.g. medical benefits)	◯	◯	◯	◯	◯
Limited staff numbers	◯	◯	◯	◯	◯
High or low caseload	◯	◯	◯	◯	◯

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

SECTION 4: Post-operative physiotherapy management

The following questions are specific to patients undergoing open thoracotomy only.

***26. Are all patients seen post-operatively by a physiotherapist?**

- ◯ Yes
- ◯ No

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***27. How often do you treat the patient?**

- ◯ Once a day
- ◯ Twice a day
- ◯ Other (please specify)

***28. Which of the following statements most accurately reflects the physiotherapy management in your unit following open thoracotomy?**

- ◯ Physiotherapists do not assess or treat any patients routinely post-operatively but rely upon referral to physiotherapy by other members of the medical team when necessary.
- ◯ All patients are assessed by physiotherapists but interventions are only instituted when deemed necessary.
- ◯ All patients are assessed by physiotherapists and receive prophylactic/preventative interventions.

***29. At what stage are patients first visited by the physiotherapist postoperatively?**

- ◯ Day of operation
- ◯ 1st post-operative day
- ◯ On doctor's request
- ◯ Other (please state)

***30. In which unit/division are patients normally nursed immediately following surgery?**

- ◯ Intensive care
- ◯ High dependency ward
- ◯ Ward

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***31. In uncomplicated open thoracotomy patients, which of the following treatment interventions do you normally incorporate, NOT normally incorporate or believe contra-indicated in your treatment programme (please tick one for each treatment intervention).**

	Normally use	Not normally use	Contra-indicated
Bi-level positive airway pressure (BiPAP) via non-invasive ventilation	◯	◯	◯
Constant Positive Airway Pressure (CPAP) via non-invasive ventilation	◯	◯	◯
Endotracheal suction	◯	◯	◯
Percussions	◯	◯	◯
Vibrations	◯	◯	◯
Body positioning	◯	◯	◯
Deep breathing exercises	◯	◯	◯
Cough	◯	◯	◯
PEP devices (Positive expiratory pressure e.g. blow bottle)	◯	◯	◯
FET (Forced expiratory techniques e.g. huffing)	◯	◯	◯
ACBT	◯	◯	◯
Sustained maximal inspirations	◯	◯	◯
Sniffs	◯	◯	◯
IPPB	◯	◯	◯
Incentive spirometry	◯	◯	◯
Upper limb mobility exercises	◯	◯	◯
Trunk mobility exercises	◯	◯	◯
Early mobilisation	◯	◯	◯
Strength training (e.g. resistance exercise)	◯	◯	◯
Endurance training	◯	◯	◯
Strapping	◯	◯	◯
OMT joint mobilisations	◯	◯	◯
Dry needling	◯	◯	◯
Tens	◯	◯	◯
Other electrotherapy (please state in the comment box below)	◯	◯	◯

Comments

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***32. Which of the following procedures do you use/don't use as part of your post operative regime?**

	Use	Don't use
Sitting out of bed	◯	◯
Walking	◯	◯
Shoulder ROM exercises	◯	◯
Thoracic mobility exercises	◯	◯
Stair climbing	◯	◯
Home education/advice	◯	◯
Discharge booklet	◯	◯

***33. If possible please indicate on which DAY post-operatively you commence with the following activities. If you are unable to state day of commencement please mark the field with "X"**

Sitting out of bed	
Walking	
Shoulder ROM exercises	
Thoracic mobility exercises	
Stair climbing	
Home education/advice	
Discharge booklet	

***34. Do you alter your physiotherapy interventions in patients with persistent air leaks following open thoracotomy?**

◯ No

◯ Yes

If Yes please state how

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***35. Please rate how much, each of the following influence your POST-OPERATIVE patient management.**

	1 No influence at all	2	3	4	5 Very influencial
Personal experience	◯	◯	◯	◯	◯
Undergraduate education	◯	◯	◯	◯	◯
Literature recommendations	◯	◯	◯	◯	◯
Established practice protocol	◯	◯	◯	◯	◯
Limited Resource (e.g. lack of equipment)	◯	◯	◯	◯	◯
Financial considerations (e.g. medical benefits)	◯	◯	◯	◯	◯
Limited staff numbers	◯	◯	◯	◯	◯
High or low caseload	◯	◯	◯	◯	◯

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

SECTION 5: Post hospital discharge physiotherapy management

***36. Does your unit/practice offer outpatient post-operative treatment for patients following thoracic surgery?**

- ◯ No
- ◯ Yes for all patients
- ◯ Some patients only (Please state who and why in the comment field)

Comment

***37. If you treat hospital patients, do you refer them post discharge for outpatient treatment?**

- ◯ Yes Always
- ◯ Sometimes
- ◯ No
- ◯ I don't treat hospital patients

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***38. If you refer your patient for outpatient treatment what are the reasons? Please tick all that apply.**

- [ ] Decreased functional ability
- [ ] Decreased thoracic and shoulder mobility
- [ ] Pain
- [ ] Reduced cardiovascular endurance
- [ ] Respiratory difficulties
- [ ] Other (please specify)

***39. If you see patients post hospital discharge when do you first see them?**

- ◯ 1 week post op
- ◯ 2-3 weeks post op
- ◯ 4-6 weeks post op
- ◯ More than 6 weeks post op
- ◯ I don't see patients post hospital discharge who underwent open thoracotomy procedure

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***40. If you treat a patient after hospital discharge in an outpatient setting, who usually refers the patient?**

- ◯ Hospital physiotherapist
- ◯ Doctor
- ◯ Self-referral

***41. What is the main reason for referral during the FIRST SIX WEEKS after discharge? Please tick all that apply.**

- ☐ Decreased functional ability
- ☐ Decreased thoracic and shoulder mobility
- ☐ Pain
- ☐ Reduced cardiovascular endurance
- ☐ Respiratory difficulties
- ☐ Other (please specify)

***42. What is the main reason for referral SIX WEEKS and LATER after hospital discharge? Please tick all that apply.**

- ☐ Decreased functional ability
- ☐ Decreased thoracic and shoulder mobility
- ☐ Pain
- ☐ Reduced cardiovascular endurance
- ☐ Respiratory difficulties
- ☐ Other (please specify)

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***43. Which of the following treatment interventions do you normally incorporate, NOT normally incorporate or believe contra-indicated in your treatment programme when treating a thoracotomy patient as an outpatient? (please tick one for each treatment intervention).**

	Normally use	Not normally use	Contra-indicated
OMT joint mobilisations for reduction in pain	○	○	○
Strapping	○	○	○
Soft tissue treatment techniques to decrease pain	○	○	○
Dry Needling	○	○	○
Electrotherapy to decrease pain	○	○	○
General exercises	○	○	○
Resistance exercises	○	○	○
Stretch exercises	○	○	○
Progressive walking programme	○	○	○
Stair climbing	○	○	○
Cycling	○	○	○
Upper limb mobility exercises	○	○	○
Trunk mobility exercises	○	○	○
OMT joint mobilisations for increase in mobility	○	○	○
Soft tissue treatment techniques to increase mobility	○	○	○
Nebulisation	○	○	○
Manual airway clearance techniques	○	○	○
Postural drainage/positions	○	○	○
Incentive spirometry	○	○	○
Blow bottle	○	○	○
IPPB	○	○	○
ACBT	○	○	○

THE PHYSIOTHERAPY MANAGEMENT OF POST-THORACOTOMY

***44. Please rate how much, each of the following influence your patient management POST HOSPITAL DISCHARGE.**

	1 No influence at all	2	3	4	5 Very influencial
Personal experience	◯	◯	◯	◯	◯
Undergraduate education	◯	◯	◯	◯	◯
Literature recommendations	◯	◯	◯	◯	◯
Established practice protocol	◯	◯	◯	◯	◯
Limited Resource (e.g. lack of equipment)	◯	◯	◯	◯	◯
Financial considerations (e.g. medical benefits)	◯	◯	◯	◯	◯
Limited staff numbers	◯	◯	◯	◯	◯
High or low caseload	◯	◯	◯	◯	◯

45. Do you have any comments, questions, or concerns?

APPENDIX B

The Physiotherapy Management of Patients Following Thoracic Surgery

A survey of current practice

This survey is being conducted to ascertain the current physiotherapy management of patients undergoing thoracic surgery in all thoracic surgical units throughout Australia and New Zealand.

A (senior) respiratory physiotherapist from each provider unit is asked to complete the attached questionnaire. Your help in completing this survey is greatly appreciated. The survey aims to:

i. Survey current physiotherapy practice in thoracic units throughout Australia and NZ

ii. Identify trends in the variability of service provision throughout Australia and NZ

iii. Further develop the evidence base in physiotherapy following major surgery

It is anticipated that the survey should take no longer than 30 minutes to complete. Your response is voluntary and completely confidential (within the limits of the law). There will be no attempt to identify any individual respondent during the analysis of the data. You may withdraw any information provided at any stage. Data collected will be securely stored for 5 years and accessible only to the researchers. Completion of the survey will indicate your consent to participate.

PLEASE RETURN THE SURVEY EVEN IF IT IS NOT COMPLETED.

If we can be of further assistance in the completion of this questionnaire please do not hesitate to call or email Julie Reeve on:

Work: 00 64 (0) 9 9179999 ext 7085

Mobile: 00 64 (0) 21 585900

Email: julie.reeve@aut.ac.nz

If you have any concerns about the conduct of this study, you can contact the executive officer, Human Research Ethics at the University of Melbourne, ph 00 61 3 83447507 or fax 00 61 3 83476739.

May we take this opportunity to thank you in advance for your assistance with this questionnaire.

Yours sincerely,

Ms Julie Reeve	PhD student, The University of Melbourne. Lecturer, School of Physiotherapy, Auckland University of Technology
Dr Linda Denehy	Lecturer, School of Physiotherapy, University of Melbourne 00 61 3 83444171
Dr Kathy Stiller	Senior Physiotherapist, Royal Adelaide Hospital

THE UNIVERSITY OF MELBOURNE

AUT

General information:

For the purpose of this survey, except where stated, thoracic surgery should be taken to mean open thoracic surgery via a thoracotomy. This does not include video assisted thoracoscopic surgery (VATS), thoracoscopy or mediastinoscopy but would include any lung resection, mediastinal and pleural surgery.

Please feel free to consult with your work colleagues where necessary.

Where boxes are included for responses please tick ONE box only unless otherwise stated.

SECTION 1: Service provision

1. On average, how many patients undergo open thoracotomy *per week* in your unit?

☐ Less than 1 per week ☐ 1 – 5 ☐ 6 – 10 ☐ Over 10

☐ Other (please state)

.....

.....

.....

2. What types of surgery are undertaken in your thoracic unit? (Please tick all that apply)

☐ Pulmonary resection ☐ Video assisted thoracoscopic surgery (VATS)

☐ Pleural surgery ☐ Chest wall reconstruction surgery

☐ Oesophageal surgery ☐ Lung volume reduction surgery (LVRS)

☐ Other (please state)

.....

.....

.....

3. Do you have a dedicated/specialist thoracic surgeon (i.e. undertakes *only* thoracic surgery) in your surgical unit?

☐ Yes ☐ No

4. What is the average length of post-operative stay for patients undergoing *uncomplicated* pulmonary resection (lobectomy or pneumonectomy)?

☐ 0 - 3 days ☐ 4 - 7 days ☐ 8 - 10 days ☐ > 10 days

Comments.....

.....

.....

SECTION 2: Preoperative physiotherapy management

5. What proportion of patients undergoing thoracic surgery are seen *preoperatively* by a physiotherapist?

☐ All (please go to Q8) ☐ Some (please go to Q7) ☐ None (please go to Q6)

6. If no patients are seen preoperatively by a physiotherapist, please highlight the reasons why (please go to Question 10).

☐ Insufficient time/staff ☐ Considered unnecessary ☐ No evidence to support preop intervention

☐ Information given by other means e.g. in writing, by nursing staff ☐ Other

.....

.....

7. If only some patients are seen preoperatively by a physiotherapist on what basis are they selected for preoperative physiotherapy?

☐ High risk (please state criteria used to determine high risk) ☐ According to staff/time available

☐ Other (please state)

.....

.....

8. When are these patients seen preoperatively (please tick all that apply)?

☐ Pre admission ☐ Post admission ☐ Both

9. For those patients seen preoperatively, which of the following procedures does the *physiotherapist* undertake on a *routine basis* (please tick all those that apply)?

Baseline assessment by:

☐ Nursing &/or medical notes only ☐ Face to face contact ☐ Both

Objective testing by:

☐ Pulmonary function tests (please state which)

.....

.....

.....

.....

☐ Exercise testing (please state which e.g. 6MWT)

.....

.....

.....

.....

☐ Assessment of shoulder ROM

☐ Assessment of thoracic mobility

☐ SpO2

☐ Other (please state)

.....

.....

.....

Education/advice by:

☐ Face to face contact ☐ Video ☐ Written information ☐ Group contact

Teaching of respiratory manoeuvres to be utilised postoperatively by:

- ☐ ACBT
- ☐ Deep breathing exercises
- ☐ Incentive spirometry
- ☐ Cough/huff
- ☐ Sustained maximal inspirations
- ☐ Other (please state) .....

Preoperative inspiratory muscle training:

☐ Yes (Please provide regimen) ☐ No

.....

.....

Preoperative pulmonary exercise rehabilitation

- ☐ For all patients undergoing pulmonary resection
- ☐ For LVRS only
- ☐ Other (please state)

.....

.....

Any other routine preoperative physiotherapy interventions? (please state)

.....

.....

10. Please rank how much each of the following influence your preoperative practice.

	1	2	3	4	5	
No influence at all	–	–	–	–	–	Very influential
	(Circle one number)					Comments
Personal experience	1	2	3	4	5	.....
Literature recommendations	1	2	3	4	5	.....
Anaesthetic/ surgical colleagues preferences	1	2	3	4	5	.....
Resource/financial considerations	1	2	3	4	5	.....
Established practice	1	2	3	4	5	.....
Staffing numbers/caseload	1	2	3	4	5	.....
Public/private hospital patient	1	2	3	4	5	.....
Other ** (please state)	1	2	3	4	5	.....

.....

.....

.....

.....

SECTION 3: Postoperative physiotherapy management

The following questions are specific to the patient undergoing *open thoracotomy only*.

11. Are *all* patients seen postoperatively by a physiotherapist?

☐ Yes ☐ No

12. Which of the following statements most accurately reflects the physiotherapy management following open thoracotomy in your unit:

☐ Physiotherapists are not involved in the assessment or treatment of patients following open thoracotomy (please go to Q 21)

☐ Physiotherapists do not assess or treat any patients routinely postoperatively but rely upon referral to physiotherapy by other members of the medical team when necessary (please go to Q14)

☐ All patients are assessed by physiotherapists but interventions are only instituted when deemed necessary (please go to Q13)

☐ All patients are assessed by physiotherapists and receive prophylactic/preventative interventions (please go to Q13)

☐ Other (please state).....

13. At what stage are patients *first* visited by the physiotherapist *postoperatively*?

☐ Day of operation ☐ 1st postoperative day ☐ Other (please state)

.....

.....

14. In what location are patients normally nursed immediately following surgery?

☐ Intensive care ☐ Surgical ward ☐ Dependent upon surgery (please explain)

.....

.....

.....

15. In *uncomplicated* open thoracotomy patients, which of the following respiratory treatment interventions do you normally incorporate, NOT normally incorporate or believe contraindicated (CI) in your treatment programme (please ***tick*** one for each treatment intervention). (If this varies for different surgical procedures please indicate how in the comment section).

	Normally used	NOT normally used	CI	Comments
Deep breathing exercises	☐	☐	☐	.....
Active cycle of breathing exercises	☐	☐	☐	.....
Sustained maximal inspirations	☐	☐	☐	.....

Sniffs	☐	☐	☐	.....
IPPB	☐	☐	☐	.....
Incentive spirometry	☐	☐	☐	.....
BiPAP	☐	☐	☐	.....
CPAP	☐	☐	☐	.....
PEP	☐	☐	☐	.....
Cough	☐	☐	☐	.....
FET	☐	☐	☐	.....
Endotracheal suction	☐	☐	☐	.....

Others/Further Comments (please state)

.....

.....

16. Which of the following procedures are performed, by whom and (commencing) on which postoperative day:

	Physio	Nurse	Not routinely undertaken	(Commencing) on which post op day
Sitting out of bed	☐	☐	☐	.....
Walking	☐	☐	☐	.....
Shoulder ROM exercises	☐	☐	☐	.....
Thoracic mobility exercises	☐	☐	☐	.....
Stair climbing	☐	☐	☐	.....
Home education/advice	☐	☐	☐	.....
Discharge booklet	☐	☐	☐	.....

17. Does your unit use minitracheostomy in the routine management of open thoracotomy patients?

☐ Frequently ☐ Rarely ☐ Never

18. Does your physiotherapy management of patients following pulmonary resection differ from that of those undergoing open pleural surgery (such as decortication/open pleurectomy)?

☐ No ☐ Yes (please state how)

.....

19. Do you alter your physiotherapy interventions in patients with persistent air leaks following open thoracotomy?

☐ No ☐ Yes (please state how)

.....

.....

.....

20. Does your unit undertake lung volume reduction surgery (LVRS) procedures?

☐ No ☐ Yes

If yes, please state if and how your physiotherapy management of these patients differs from other types of open thoracotomy.

.....

.....

.....

21. Does your unit undertake VATS procedures?

☐ No ☐ Yes

If yes, please state if and how your physiotherapy management of these patients differs from open thoracotomy.

.....

.....

.....

22. Please rank how much each of the following influence your postoperative practice.

	1	2	3	4	5	
No influence at all	_	_	_	_	_	Very influential
	(Circle one number)					Comments
Personal experience	1	2	3	4	5	.....
Literature recommendations	1	2	3	4	5	.....
Anaesthetic/ surgical colleagues preferences	1	2	3	4	5	.....
Resource/financial considerations	1	2	3	4	5	.....
Established practice	1	2	3	4	5	.....
Staffing numbers/caseload	1	2	3	4	5	.....
Peer pressure	1	2	3	4	5	.....
Contractual obligation	1	2	3	4	5	.....
Public/private hospital patient	1	2	3	4	5	.....
Other **	1	2	3	4	5	.....

If you answered other** above please specify what this is. .....

SECTION 4: Post hospital discharge physiotherapy management

23. Does your unit offer outpatient postoperative pulmonary exercise rehabilitation for patients following thoracic surgery?

☐ Yes for all patients ☐ Some patients only (please state who/why) ☐ No

.....

.....

.....

24. Do physiotherapists follow up patients during their outpatient clinic visits postoperatively?

☐ Yes for all patients ☐ Some patients only (please state who/why) ☐ No

.....

.....

.....

25. Are physiotherapists involved in the management of postoperative thoracotomy pain post hospital discharge?

☐ No ☐ Yes (please state how)

.....

.....

.....

26. Which literature (if any) has influenced your physiotherapy management of patients following thoracic surgery. (Please be as specific as possible including names of authors, title of publication, year of publication).

.....

.....

.....

.....

.....

Any other comments:

Thank you for your participation in this survey

APPENDIX C

RESEARCH QUESTIONNAIRE: REEVE, DENEHY AND STILLER

From: Liezel Grassman <grassman.liezel@gmail.com>
Date: January, 25
To: **Julie Reeve <julie.reeve@aut.ac.nz>**

Dear Ms Reeve

My name is Liezel Schwellnus, a physio in Pretoria, South Africa. I was one of the initial partners who started a practice approximately 14 years ago and our field of practice include cardiothoracic hospital-patients as well as all types of out-patients. In 2013 I started an MSC in course work at the Witwatersrand University in Johannesburg and need to complete a research report in 2014. As part of the literature I have reviewed, I came across the articles 'The physiotherapy management of patients undergoing thoracic surgery: survey of current practice in Australia and New Zealand' as well as 'A survey of physiotherapeutic provision for patients undergoing thoracic surgery in the UK' of which you were one of the authors. I want to do a similar study in one of the provinces in South Africa with additional emphasis on an attempt to establish if OMT-techniques are used to reduce patients' pain.

In this regard, I was wondering whether it would be possible for you to not only make available both the questionnaires used in the above-mentioned researches to enable me to apply same, but also to advise me of the requirements pertaining to usage and acknowledgement.

Your kind assistance would be appreciated.

Regards

Liezel Schwellnus

Telephone home: +27 12 3456560
Cell: +27 82 4914549

From: **Julie Reeve <julie.reeve@aut.ac.nz>**
Date: February, 18
To: **Liezel Grassman <grassman.liezel@gmail.com>**

Hi Liezel

Sorry, I recall you emailed me whilst I was on sabbatical and I never replied as I did not have my files available to me. I attach here the NZ survey that you enquire about. You will need to email paula agostini (the UK lead author) for the UK study.
I am quite happy for you to use the NZ survey should you wish to but would ask that you fully acknowledge this in the paper acknowledgements, including discussing in the methods that you used our paper for your survey (either in its original or adapted form).

Don't hesitate to come back to me if you need any more information about this. Good luck with your masters

With kind regards

Julie

Dr Julie Reeve,
PhD, MSc, Grad Dip Phys
Senior Lecturer in Physiotherapy
Tel: 921-9999 ext 7085
AA 260, Akoranga Campus, Northcote, Private Bag 92006, Auckland
Julie.reeve@aut.ac.nz

From: Liezel Grassman <grassman.liezel@gmail.com>
Date: Tuesday, 18 February 2014 5:30 am
To: Julie Reeve <jreeve@aut.ac.nz>
Subject: Research questionnaire: Reeve, Denehy and Stiller

Attachments area
Preview attachment Thoracic surgery questionnaire final version .pdf

Thoracic surgery questionnaire final version .pdf

APPENDIX D

SOUTH AFRICAN SOCIETY OF PHYSIOTHERAPY
106 – 154 NPO

PO BOX 752378
GARDENVIEW
JHB, 2047

UNIT 4 PARADE ON KLOOF
OFFICE PARK, 1 THE PARADE
BEDFORVIEW, 2007

TEL: +27 116153170
FAX: 086 559 8237

www.physiosa.org.za
info@saphysio.co.za

WITS University
Ethics committee

9 June 2014

RE: PERMISSION TO SEND INFORMATION TO THE GAUTENG SASP MEMBERS

To whom it may concern

The South African Society of Physiotherapy (SASP) is committed to support physiotherapy research projects and is therefore willing to send questionnaires for research purposes to our membership upon request.

A request was received from Liezel Schwellnus (DUP015) to send information to all Gauteng SASP members which the SASP will gladly be assisting.

Regards



Magda Fourie
Physiotherapy Consultant
On behalf of the Management
South African Society of Physiotherapy

APPENDIX E

R14/49 Ms LB Schwellnus

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M140414

NAME: (Principal Investigator)	Ms LB Schwellnus
DEPARTMENT:	Physiotherapy Gauteng Province
PROJECT TITLE:	The Physiotherapy Management of Post-Thoracotomy Patients: A Survey of Current Practice in Gauteng
DATE CONSIDERED:	25/04/2014
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Ms S Mtshali
APPROVED BY:	Professor P Cleaton-Jones, Co-Chairperson, HREC (Medical)
DATE OF APPROVAL:	26/06/2014

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**.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX F

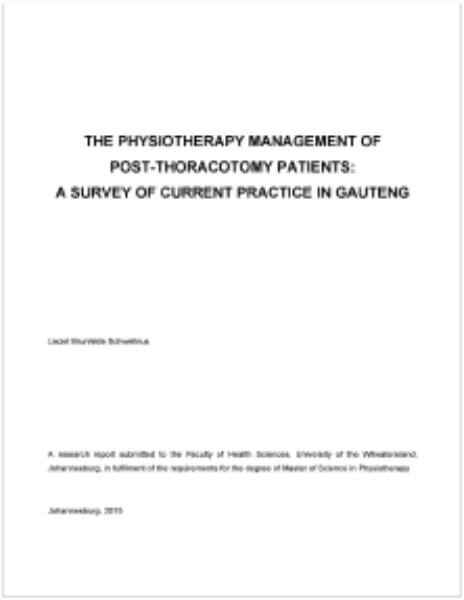
turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Liezel Schwellnus
Assignment title:	Research Reports
Submission title:	LBSchwellnus329590MastersRese...
File name:	l_Schwellnus_329590_LBSchwellnu...
File size:	2.27M
Page count:	93
Word count:	25,228
Character count:	156,172
Submission date:	19-Feb-2015 11:37AM
Submission ID:	507098066



THE PHYSIOTHERAPY MANAGEMENT OF
POST-THORACOTOMY PATIENTS:
A SURVEY OF CURRENT PRACTICE IN GAUTENG

Copyright 2015 Turnitin. All rights reserved.

LBSchwellnus329590MastersResearchReport.docx

by Liezel Schwellnus

FILE	L_SCHWELLNUS_329590_LBSCHWELLNUS329590MASTERSRESEARCHREPORT.DOCX (2.27M)		
TIME SUBMITTED	19-FEB-2015 11:37AM	WORD COUNT	25228
SUBMISSION ID	507098066	CHARACTER COUNT	156172

LBSchwellnus329590MastersResearchReport.docx

ORIGINALITY REPORT

6%	4%	3%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Witwatersrand Student Paper	1%
2	www.taroborah.com.au Internet Source	<1%
3	Julie Reeve. "The physiotherapy management of patients undergoing thoracic surgery: a survey of current practice in Australia and New Zealand", Physiotherapy Research International, 06/2007 Publication	<1%
4	Athanassiadi, K.. "Muscle-sparing versus posterolateral thoracotomy: a prospective study", European Journal of Cardio-Thoracic Surgery, 200703 Publication	<1%
5	Daniela S. Dettling. "Feasibility and Effectiveness of Pre-operative Inspiratory Muscle Training in Patients Undergoing Oesophagectomy: A Pilot Study : Pre-operative Care for Surgical Patients", Physiotherapy	<1%