THE EFFECT OF A SINGLE PRE-OPERATIVE PHYSIOTHERAPY SESSION ON PHYSICAL FUNCTION IN ELDERLY PATIENTS FOLLOWING ABDOMINAL SURGERY

Rozelle Labuschagne

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Supervised by Associate Professor Ronel Roos

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DECLARATION

I, Rozelle Labuschagne declare that this Dissertation is my own, unaided work. It is being submitted for the MSc Physiotherapy degree at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

27/09/2021

Rozelle Labuschagne Date

DEDICATION

This dissertation is dedicated to my daughter,

Caroli Labuschagne.

It might not have been easy but this is for you.

You kept me motivated!

ABSTRACT

Elderly patients report a decrease in function and activities of daily living following abdominal surgery. Literature suggests that pre-operative rehabilitation may assist in the prevention of complications and may improve physical function. An education and exercise pamphlet was developed from current literature following a narrative review. The pamphlet was then used in a pilot single-blind randomised controlled trial. Outcome measures included clinical outcomes (length of hospital stay, post-operative pulmonary complications and first mobilisation uptime parameters), the DeMorton Mobility Index (DEMMI), six minute walk test (6MWT), Lawton-Brody's instrumental activities of daily living (IADL) and the Functional Comorbidity Index (FCI). From the narrative review of the current literature, eight articles were applicable. Following a peer review the pamphlet was used in the clinical trial. Twelve participants with a mean age of 65.75 (± 4.47) years were included in this pilot study. The intervention and control groups were comparable at baseline ($p>0.05$). Intervention participants recovered passed baseline ($p=0.006$) in terms of mobility (DEMMI score 79.5 (± 2.46) at baseline; 95.67 (±4.33) at four week follow-up). Recruitment was low with only 10.95% referral rate and 47.82% non-consent. This study shows that a single physiotherapy session prior to surgery could improve recovery of mobility among the high-risk elderly patients but a larger sample is needed to confirm. The feasibility of a large prehabilitation study in the current South African climate is hampered by a number of factors.

Key words: *physical function, elderly, prehabilitation, abdominal surgery, instrumental activities of daily living, deMorton mobility index, six minute walk test, functional comorbidity index*

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LIST OF ABBREVIATIONS

6MWT	Six Minute Walk test
ADL	Activities of Daily Living
ASA	American Society of Anaesthesiologists
COPD	Chronic Obstructive Pulmonary Disease
DBE	Deep Breathing Exercises
DEMMI	DeMorton Mobility Index
ERAS	Enhanced Recovery After Surgery
FCI	Functional Comorbidity Index
IADL	Instrumental Activities of Daily Living
ICU	Intensive Care Unit
LAS	Lower Abdominal Surgery
LOS	Length of Stay
MGS	Melbourne Group Scale
MV	Mechanical Ventilation
n	Number of participants
NR	Not Reported
NYHA	New York Heart Association
PPC	Post-operative Pulmonary Complications
SF-36 (PFS)	Short-Form 36 Health Related Quality of Life: Physical Function Section
UAS	Upper Abdominal Surgery
UN	United Nations
WHO	World Health Organization

DEFINITION OF TERMS

Abdominal Surgery	Any incision below the diaphragm and above the inguinal ligament (Reeve & Boden, 2016)
Elderly	60 years or older as per the United Nations agreed minimum age in reference to the elderly (Kowal & Dowd, 2001)
Frailty	Health status where an individual, usually an older patient, demonstrates a decreased physiological reserve in multiple organ systems (Makary *et al.*, 2010)
Functional Status	A person's ability to perform physical and social activities necessary in daily routines and life roles (Van Cleave *et al.*, 2011)
Hypercapnia	High levels of carbon dioxide (Dyer, 2012)
Hypoxia	Low levels of oxygen (Dyer, 2012)
Laparoscopy	Several small (less than 1cm) incisions (Reeve & Boden, 2016)
Laparotomy/ Open surgery	Incision longer than 5 cm (Reeve & Boden, 2016)
Mobility	Movement through the change of body position or location, transferring from place or by moving objects. (WHO, 2017)
Patient-centred outcomes	Care that respects the individuality, values, ethnicity, social endowments, and information needs of each patient (Tevis & Kennedy, 2013)

Physiotherapy	An evidence based profession with the focus on optimal human function through prevention, restoration, maintenance and promotion of health and wellness (Scalzitti & Costello, 2019)
PPC	Respiratory abnormalities producing dysfunction that is clinically significant, affects the patient's recovery and requires additional medical intervention after anaesthesia or surgery (O'Donohue, 1992; Shander *et al.*, 2011)
Prehabilitation	A process that attempts to pre-emptively improve function, psychological capacity and promote recovery (Bruns *et al.*, 2016; Merchea & Larson, 2018)
Upper Abdominal Surgery	When the surgical incision extends above the umbilicus (Reeve & Boden, 2016)
Uptime	The amount of time spend an upright position (Browning *et al.*, 2007)
Lower Abdominal Surgery	When the incision extends below the umbilicus (Reeve & Boden, 2016)

Chapter 1

1 INTRODUCTION

Surgery has become a frequent medical intervention as disease patterns, treatments and technology change, resulting in a rise worldwide (Weiser *et al.*, 2008; 2016). In 2012 an estimated 4991 operations per 100 000 people was performed in South Africa, that accounts for nearly three million operations per year (Weiser *et al.*, 2016).

Abdominal surgery is one of the most often performed surgeries (Reeve & Boden, 2016). It is generally performed for the removal or biopsy of tumours (malignant or benign), visceral or vascular tissue aneurysm repairs, or inflammatory and obstructed bowel segment removal. When the surgical incision extends above the umbilicus it is classified as upper abdominal surgery (UAS) (Grams *et al.*, 2012; Reeve & Boden, 2016). Lower abdominal surgery (LAS) is when the incision extends below the umbilicus (Reeve & Boden, 2016).

Following abdominal surgery up to 35% of patients may experience complications (Pouwels *et al.*, 2014; Reeve & Boden, 2016). Complications may include urinary tract infections, wound infections and pneumonia (Arozullah *et al.*, 2001). However, post-operative pulmonary complications (PPC) are the most common (Boden *et al.*, 2015; Dronkers *et al.*, 2008; Parry *et al.*, 2014).

PPC are defined as respiratory abnormalities producing dysfunction that is clinically significant, affects the patient's recovery and requires additional medical intervention after anaesthesia or surgery (O'Donohue, 1992; Shander *et al.*, 2011). This definition of PPC covers respiratory infection or failure, pneumonia, atelectasis, pleural effusion, pneumothorax, bronchospasm, hypoxemia, pulmonary oedema and acute exacerbation of chronic obstructive pulmonary disease (COPD) (Hanekom *et al.*, 2012; Miskovic & Lumb, 2017; Reeve & Boden, 2016; Shander *et al.*, 2011). Arozullah *et al.* (2001) reports that the odds of developing a PPC increases significantly in elderly patients. This finding is supported by multiple other studies stating that the risk for developing a PPC increases significantly in patients over the age of 60 years (Miskovic & Lumb, 2017).

This may be due to compromised respiratory function in the elderly, caused by a restrictive lung pattern (Sharma & Goodwin, 2006). The respiratory system changes with age (Lalley, 2013). Structural and physiological changes to the thoracic cage, lungs and diaphragm affects chest wall and lung compliance as well as respiratory muscle strength. This leads to an increase in work of breathing and a weaker cough effort, causing a decrease in airway clearance (Dyer, 2012; Lalley, 2013; Sharma & Goodwin, 2006). Exercise capacity may however still differ between a fit and frail elderly patient (Dyer, 2012; Sharma & Goodwin, 2006).

The development of PPC significantly increases mortality, morbidity and length of stay (LOS) in hospital (Dronkers *et al.*, 2008; Katsura *et al.*, 2015; Miskovic & Lumb, 2017; Shander *et al.*, 2011). Increase in LOS may lead to a decrease in physical function of individuals due to reduced mobility while in hospital (Graf, 2008; Hoogeboom *et al.*, 2014).

In order to optimise post-operative physical function, LOS needs to be reduced through the prevention of PPC. Katsura *et al.*, (2015) noted that it is more effective to prevent PPC rather than trying to treat already established PPC. To prevent or reduce the incidence of PPC it is imperative that high risk patients, such as the elderly patient, are identified and targeted both pre- and post-operatively (Hoogeboom *et al.*, 2014; McAlister *et al.*, 2005; Shander *et al.*, 2011).

Studies show physiotherapy (such as early mobilisation, deep breathing exercises (DBE) and supported coughing) to be effective in preventing PPC following abdominal surgery (Boden *et al.*, 2015; Cassidy *et al.*, 2013; Katsura *et al.*, 2015; Lawrence *et al.*, 2006; Patman *et al.*, 2017; Qaseem *et al.*, 2006; Scholes *et al.*, 2009). Recent literature reviews find any physiotherapy to be better than none in the effort to prevent PPC post-operatively (Cassidy *et al.*, 2013; Dronkers *et al.*, 2008; Katsura *et al.*, 2015; Kulkarni *et al.*, 2010; Lawrence *et al.*, 2006; Possa *et al.*, 2014; Qaseem *et al.*, 2006). Most studies agree that early mobilisation (out of bed within twelve hours after surgery) is the best prevention for PPC (Boden *et al.*, 2015; Browning *et al.*, 2007; Haines *et al.*, 2013; Hanekom *et al.*, 2012; Patman *et al.*, 2017; Samnani *et al.*, 2014).

Despite post-surgical physiotherapy, hospitalisation and surgery still reduce the functional status of elderly patients through decreased activity, surgical stress and complications (Bruns *et al.*, 2016; Graf, 2008; Hoogeboom *et al.*, 2014; Pouwels *et al.*, 2014). From an elderly patient's perspective, physical function is a major indicator of surgical success (Groll *et al.*, 2005). Graf (2008) states that functional decline begins within 48 hours of hospitalisation and that by discharge a third of elderly patients have reduced abilities in one or more activities of daily living (ADL). Furthermore, two thirds of frail patients may lose instrumental ADL (IADL) function after surgery (Rønning *et al.*, 2014). This is aggravated by already reduced pre-operative physical function in patients due to lack of activity prior to surgery (Bruns *et al.*, 2016; Hoogeboom *et al.*, 2014; Pouwels *et al.*, 2014).

A recent systematic review on elderly patients undergoing colorectal surgery, found that pre-surgical rehabilitation (endurance, strength and respiratory training in various combinations) may improve physical function (Bruns *et al.*, 2016). An improvement in the physical function of the elderly patient improves self-reported wellbeing and decreases levels of pain (Zasadzka *et al.*, 2016). Hoogeboom *et al.* (2014) advises that exercise therapy be initiated pre-operatively for elderly patients undergoing elective surgery as it could counter the detrimental effects of surgery and hospitalisation on physical function and assist in the reduction of PPC.

Pre-operative studies focussing on both physical exercise and inspiratory muscle training have shown to be effective in reducing PPC and preserving physical function in patients undergoing major abdominal (Barberan-garcia *et al.*, 2018; Boden *et al.*, 2015; Dronkers *et al.*, 2008; Katsura *et al.*, 2015; Kulkarni *et al.*, 2010; Mayo *et al.*, 2011; Pouwels *et al.*, 2014; Soares *et al.*, 2013) and cardiac surgery (Hulzebos, van Meeteren, *et al.*, 2006; Katsura *et al.*, 2015). These studies show that it is possible to improve physical function in patients in a short pre-operative timeframe (two to four weeks of intervention) (Hoogeboom *et al.*, 2014; Hulzebos, van Meeteren, *et al.*, 2006; Pouwels *et al.*, 2014).

Boden *et al.* (2015) hypothesised that when physiotherapy is provided might be more important than the amount of physiotherapy received. Pre-operative exercise has benefits beyond improving physical function as it helps to reduce emotional stress and anxiety (Mayo *et al.*, 2011; Samnani *et al.*, 2014). This also improves patient motivation

and thereby increases the amount of early mobilisation (Boden, El-Ansary, *et al.*, 2017; Cassidy *et al.*, 2013; Samnani *et al.*, 2014). Pre-operative counselling is reported to improve adherence to physiotherapy and reduce PPC (Samnani *et al.*, 2014). Boden *et al.* (2017) states that patients receiving pre-operative physiotherapy education and training are exponentially more likely to remember the exercises than patients who only receive an information booklet.

Pre-surgical exercise and education studies demonstrate that patients are better prepared physically as well as emotionally, thus improving outcomes. Concepts like "strong for surgery" could significantly improve post-surgical recovery by decreasing complications such as PPC, and improving general quality of life (Hoogeboom *et al.*, 2014). The current study will thus investigate the effect of such a programme on elderly patients undergoing abdominal surgery when done once off in the South African context.

1.1 RESEARCH QUESTION

What is the effect of a single pre-operative physiotherapy session on post-operative physical function in elderly patients following abdominal surgery?

1.2 PROBLEM STATEMENT

Many patients experience a reduction in function, quality of life and basic ADL after surgery and hospitalisation. This is exponentially true for high risk patients, especially the elderly and frail individuals. The body functions as a unit in an effort to perform ADLs. A therapeutic intervention targeting multiple components of function (respiratory, physical and emotional) may yield a greater improvement in functional outcomes. Education on the importance and training of functional aspects such as bridging, getting in and out of bed, early mobility, deep breathing, coughing with wound support, thoracic exercises and upper limb mobility might help to optimise function pre-surgery in the elderly (Bruns *et al.*, 2016; Cassidy *et al.*, 2013). Improved pre-surgical function could improve the uptake of early mobilisation in hospital, thereby reducing the incidence of PPC and the LOS in the intensive care unit (ICU) and hospital among elderly patients. It is currently not known whether a once off education and exercise session would have any effect in the population of interest. This pilot study was a starting point for this line of research.

1.3 SIGNIFICANCE OF THE STUDY

The correlations between poor pre-operative physical function and poor postoperative outcomes has previously been established. The effect of exercises aimed at improving function before surgery on postoperative outcomes is still to be determined. Moreover, the effect of a pre-operative physiotherapy intervention, with multiple components has not been studied. There is also a general lack of pre-surgical intervention research as it pertains to different surgery types, populations and techniques. The current body of literature regarding preoperative exercise focuses mostly on relatively healthy patients undergoing various types of surgery. The main outcomes measured in these studies are the development of PPC, LOS in hospital, pulmonary function, respiratory muscle strength and quality of life. Very few studies measure physical function as an outcome.

This pilot study generated some data regarding the physical function of elderly patients undergoing abdominal surgery and could lead to further larger studies. This pilot study also highlighted challenges that need to be considered with follow-up studies. Should this intervention prove effective, it may not only optimise physical function but reduce post-surgical LOS, complications and costs and improve patient and surgeon satisfaction.

1.4 AIM OF STUDY

The aim of this pilot study was to determine the effect of a single pre-operative physiotherapy session on physical function in elderly patients following abdominal surgery.

1.5 OBJECTIVES OF STUDY

The objectives of this study were to determine the following in elderly patients that underwent abdominal surgery:

- To design an evidence-based education and exercise pamphlet that targets physical function post-operatively.
- To describe the demographic profile; the pre-operative physical function status as determined by the Functional Comorbidity Index (FCI), the DeMorton Mobility Index (DEMMI) and the Six Minute Walk test (6MWT); pre-operative ADL status as assessed with the Lawton-Brody Instrumental Activities of Daily Living Scale (IADL).

- To establish the effect of a single pre-operative physiotherapy session on clinical recovery as measured by the length of hospital and ICU stay, length of mechanical ventilation (MV), development of PPC and time of first mobilisation out of bed.
- To determine the effect of a single pre-operative physiotherapy session on physical function and ADL as measured on discharge and four weeks post-operatively.
- To describe the relationship between the development of PPC and physical function.
- To assess the adherence to a home based pre-operative physiotherapy exercise programme.
- To identify any challenges related to conducting the pre-operative education and exercise programme.

1.6 VARIABLES AND HYPOTHESIS

The independent variable for this study was the single pre-operative physiotherapy exercise and education session and the dependent variables were: physical function parameters i.e. functional capacity, mobility status, ADL status and clinical recovery. The null hypothesis was that there would be no difference between the intervention and control groups. The alternate hypothesis was that the intervention group would demonstrate better physical function than the control group post-operatively.

1.7 ETHICAL ASPECTS

Ethical clearance was sought from the University of Witwatersrand Human Research Ethics Committee *(Appendix A)* and all amendments were approved *(Appendix B).* A clinical trial number was applied for from the Pan African Clinical Trial Registry; PACTR201809874713904 *(Appendix C)*. Permission and informed consent was obtained from all involved parties prior to commencing the study. These parties included relevant hospitals, the researcher's employers, appropriate specialists and the participants (*See Chapter 4 – Methodology)*.

Several important ethical aspects regarding participant consent should be noted. Participants were given an information document where they were informed that they may withdraw from the study at any time without suffering repercussions (*Appendix D).* Furthermore, participants were informed that even if they did not participate in this study, they would still receive physiotherapy care in hospital. Personal information was only used for the purpose of the study and individual results were made available to participants. All participants were treated ethically and results were kept anonymous

and confidential. Control group participants received an information pamphlet as well as standard post-operative physiotherapy.

1.8 CONCLUSION

Chapter 2 will be a presentation and discussion regarding the literature surrounding abdominal surgery, why it may compromise physical function in elderly patients and the role that physiotherapy could play in limiting those complications. Chapter 3 will discuss the development of the pre-operative pamphlet that was used in the education and exercise programme described in Chapter 4. The effect and results of the pamphlet and programme will be discussed in Chapter 5. Chapter 6 will conclude this dissertation.

The general outline of the dissertation can be seen in the Figure 1.1 below:

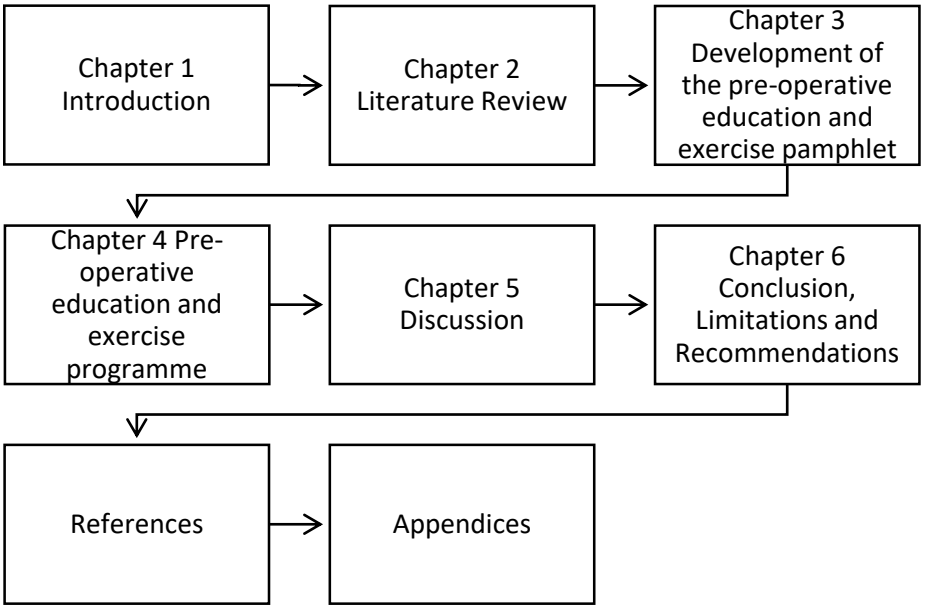


Figure 1.1 Outline of the dissertation

Chapter 2

LITERATURE REVIEW

Chapter 2 will be a presentation and discussion regarding the literature surrounding abdominal surgery including definitions, types of incisions, complications and risk factors. Why abdominal surgery compromises elderly patients, especially their physical function will also be discussed. The role that physiotherapy could play in improving outcomes in elderly patients will be reviewed.

2.1 ABDOMINAL SURGERY

2.1.1 Incidence, Definition and Type of Incisions

Surgery has become a frequent medical intervention as disease patterns, treatments and technology change, resulting in a rise worldwide (Weiser *et al.*, 2008; 2016). Over an eight year period, 2004 until 2012 the number of surgical procedures increased by approximately 38%. In 2012 an estimated 4991 operations per 100 000 people were performed in South Africa, that accounted for nearly three million operations per year (Weiser *et al.*, 2016).

Abdominal surgery is one of the most often performed surgeries (Reeve & Boden, 2016). It is usually performed for the removal or biopsy of tumours (malignant or benign), visceral or vascular tissue aneurysm repairs, or inflammatory and obstructed bowel segment removal. Abdominal surgery can be categorised in various ways; by the location, the length and direction of the incision and type of procedure (Grantcharov & Rosenberg, 2011; Reeve & Boden, 2016).

When the surgical incision extends above the umbilicus it is classified as UAS (Grams *et al.*, 2012; Reeve & Boden, 2016). LAS is when the incision extends below the umbilicus (Reeve & Boden, 2016). An open abdominal procedure or laparotomy will have an incision longer than five centimetres where a laparoscopic procedure will have smaller incisions (*see Figure 2.1*). With minimally invasive surgery such as laparoscopic procedures long thin instruments and a small camera is used to assist with surgical manipulation and tissue removal (Flahive, 2018; Reeve & Boden, 2016).

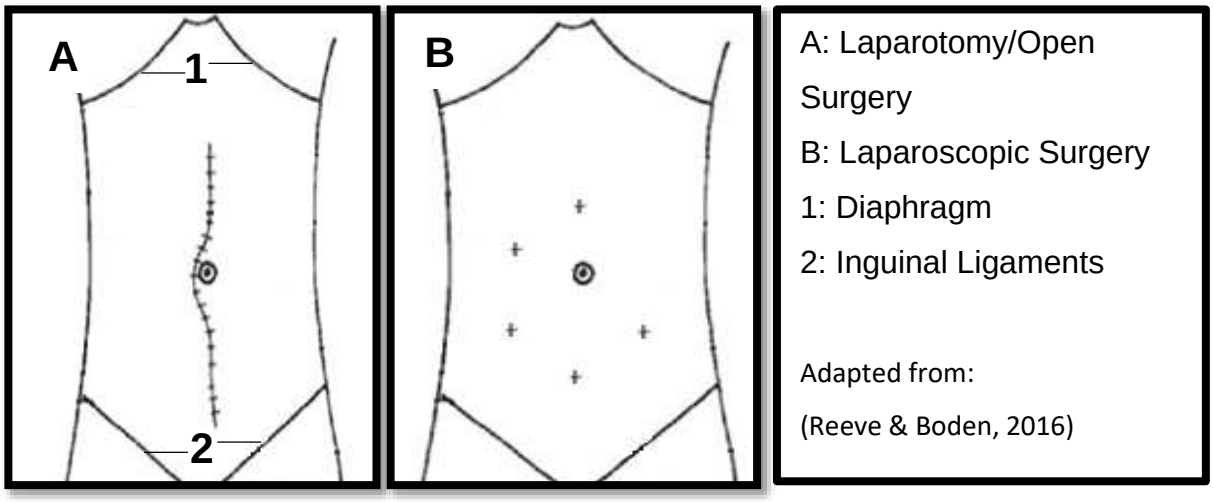


Figure 2.1 Incisions for Laparotomy/Open Surgery compared to Laparoscopic Surgery

Abdominal surgery can therefore be defined as any incision made below the diaphragm and above the inguinal ligament. Multiple types of surgical procedures fall within this definition including colorectal, upper gastrointestinal, urological and several other surgical procedures (Reeve & Boden, 2016). The type of surgery consequently dependents on the diagnosis of the patient and multiple incisional approaches are often utilized as can be seen in Figure 2.2.

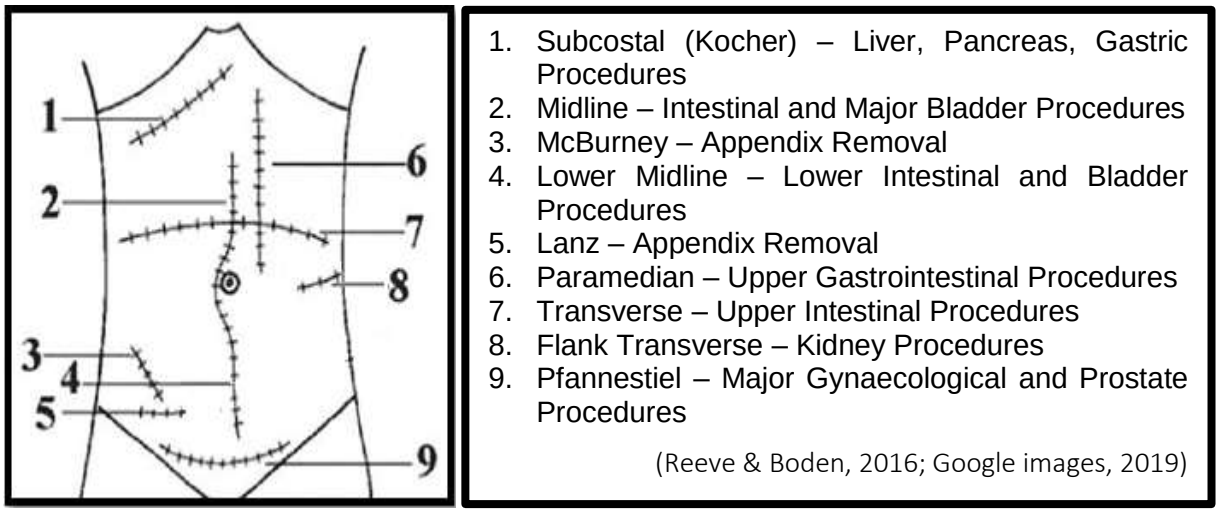


Figure 2.2 Incisions used for open abdominal surgery

Grantcharov & Rosenberg (2011) found that transverse incisions caused less postoperative complications and pain as opposed to vertical incisions. Similarly Reeve & Boden (2016) reported that minimally invasive surgery has been proven to decrease complications and is hence being used more often. When comparing open and

laparoscopic procedures, several pathophysiological differences can be noted. Open surgery generally leads to an increase in pain, fluid shift (thus requiring more intravenous fluids post-operatively), systemic inflammatory response and abdominal ileus (Scott & Miller, 2015). A decrease in renal perfusion, mobility and lung function will also be noted when compared to laparoscopic surgeries (Scott & Miller, 2015). Open surgery therefore leads to more complications.

2.1.2 Complications

Following abdominal surgery up to 35% of patients may experience complications (Pouwels *et al.*, 2014; Reeve & Boden, 2016). Multiple complications may be either surgical or medical of nature. Surgical complications include wound infections, abscess formation, bleeding, hernias, ileus or septicaemia (Arozullah *et al.*, 2001; Artinyan *et al.*, 2008; Bosma, 2016; Flahive, 2018; McGillicuddy *et al.*, 2009; Tahiri *et al.*, 2016). Medical complications may include pulmonary, cardiovascular and urinary complications such as pneumonia, atelectasis, deep vein thrombosis, arrhythmia, urinary tract infections, renal failure and even delirium (Arozullah *et al.*, 2001; Atalay *et al.*, 2011; Flahive, 2018; McGillicuddy *et al.*, 2009; Schiphorst *et al.*, 2015; Tahiri *et al.*, 2016). However, PPC are the most common (Boden *et al.*, 2015; Dronkers *et al.*, 2008; Parry *et al.*, 2014).

The encompassing nature and lack of specificity in the definition of PPC led to a wide range of reported incidence among studies (5-76%). Several factors influence the incidence of PPC including different diagnostic tools, periods studied, patient risk profiles, types of surgery performed and study populations (Boden *et al.*, 2015; Browning *et al.*, 2007; Dronkers *et al.*, 2008; Haines *et al.*, 2013; Katsura *et al.*, 2015; Kulkarni *et al.*, 2010; Mackay *et al.*, 2005; Parry *et al.*, 2014; Reeve & Boden, 2016; Scholes *et al.*, 2009; Tyson *et al.*, 2015). Tyson *et al.*, (2015) conveyed that limited data suggested that post-operative infections are more common in Sub-Saharan Africa than in high income countries and hypothesised that this could correlate to the incidence of PPC. The occurrence of PPC is higher following UAS (60-75%) than with other major surgical procedures (Kulkarni *et al.*, 2010; Miskovic & Lumb, 2017; Reeve & Boden, 2016).

The higher incidence of PPC in UAS can be explained by the pathophysiological changes following this type of surgery. A patient's respiratory drive and function is

affected immediately following loss of consciousness with anaesthesia. When combined with a surgical incision above the umbilicus it causes diaphragm dysfunction. The collective dysfunction then leads to atelectasis, decreased mucociliary clearance, reduced lung volumes, weak respiratory muscles and weak cough effort causing bacterial production and increased risk for respiratory infection and PPC (Boden *et al.*, 2015; Dronkers *et al.*, 2008; Hulzebos, van Meeteren, *et al.*, 2006; Katsura *et al.*, 2015; Miskovic & Lumb, 2017; Smetana, 2009; Tyson *et al.*, 2015).

Despite the variation of incidence, several studies claimed the incidence of PPC more common than cardiac complications (Katsura *et al.*, 2015; McAlister *et al.*, 2005; Miskovic & Lumb, 2017; Shander *et al.*, 2011). Smetana *et al.*, (2006) theorised that PPC are better predictors of long-term mortality after surgery than cardiac complications. A quarter of deaths within six days of surgery are related to PPC (Arozullah *et al.*, 2001). Other factors affecting mortality include sepsis, organ failure and bleeding (Fukuda *et al.*, 2012).

In order to improve outcomes, such as mortality, PPC need to be prevented. Weiser *et al.* (2008) estimated that nearly seven million patients per year have major complications following surgery and that almost half of these complications could have been prevented. “The prevention of PPC can be more effective than the treatment of already established PPC” (Katsura *et al.*, 2015; p7). In order to prevent or reduce the incidence of PPC it is imperative that high risk patients be identified and targeted both pre- and post-operatively (Hoogeboom *et al.*, 2014; McAlister *et al.*, 2005; Shander *et al.*, 2011).

2.1.3 Risk factors

Studies using the same diagnostic scale, the Melbourne Group Scale (MGS), showed the incidence of PPC to be 13-18% in UAS but 39-42% in high risk UAS patients (Agostini *et al.*, 2011; Boden *et al.*, 2015; Browning *et al.*, 2007; Haines *et al.*, 2013; Parry *et al.*, 2014; Reeve & Boden, 2016; Samnani *et al.*, 2014; Scholes *et al.*, 2009). Several risk factors for the development of PPC have been recognised and can be categorised into two groups; procedural and patient dependant risk factors.

Procedural risk factors include type, location and duration of surgery, general anaesthesia, anaesthetic drugs used and nasogastric tubes (Arozullah *et al.*, 2001;

Hoogeboom *et al.*, 2014; Hulzebos, van Meeteren, *et al.*, 2006; Katsura *et al.*, 2015; McAlister *et al.*, 2005; Miskovic & Lumb, 2017; Possa *et al.*, 2014; Reeve & Boden, 2016; Shander *et al.*, 2011; Smetana *et al.*, 2006; Smetana, 2009). In terms of the surgery, open procedures are higher risk than laparoscopic procedures, surgeries closer to the diaphragm are more risky than distal surgeries and procedures lasting more than three hours further increase risk (Arozullah *et al.*, 2001; Miskovic & Lumb, 2017; Smetana, 2009).

Pulmonary function is impaired by general anaesthesia and MV which leads to decreased oxygenation post-operatively. Studies show that functional residual capacity can decrease up to 50% following surgery and that atelectasis occurs in 85% - 90% of patients receiving general anaesthesia (Karcz & Papadakos, 2013). Regional sedation and limited MV is therefore advised to reduce the risk of PPC (Miskovic & Lumb, 2017). The use of opioids and neuromuscular drugs also impair function and increase risk as they delay the return of normal physiological breathing following ventilation (Karcz & Papadakos, 2013).

Patient dependant factors include age, functional and mental status, obesity, respiratory status, American Society of Anaesthesiologists (ASA) score and general health (Arozullah *et al.*, 2001; Hoogeboom *et al.*, 2014; Hulzebos, van Meeteren, *et al.*, 2006; Katsura *et al.*, 2015; McAlister *et al.*, 2005; Miskovic & Lumb, 2017; Possa *et al.*, 2014; Reeve & Boden, 2016; Shander *et al.*, 2011; Smetana *et al.*, 2006; Smetana, 2009). Some of these risk factors have been confirmed whereas others such as obesity have been shown to not affect the development of PPC (Ntutumu *et al.*, 2016; Qaseem *et al.*, 2006; Smetana *et al.*, 2006). An ASA level of two or more on the grading system also relates to an increased risk. Levels are graded on a scale of one to five as can be seen in Table 2.1 (Miskovic & Lumb, 2017; Moriello *et al.*, 2008; Qaseem *et al.*, 2006).

Table 2.1 American Society of Anaesthesiologists Score

Level	Description
I.	Relatively healthy patient
II.	Patient with disease not limiting activity
III.	Patient with disease affecting activity but not incapacitating the patient
IV.	Patient with an incapacitating and life threatening disease
V.	Patient that is not expected to survive another day without surgery

Respiratory status looks at smoking and the presence of pre-existing pulmonary conditions (especially COPD), both of which increases risk (Miskovic & Lumb, 2017; Qaseem *et al.*, 2006; Smetana *et al.*, 2006). Other comorbidities, such as congestive heart failure, renal failure, diabetes and hypertension also increase the risk of developing PPC (Miskovic & Lumb, 2017; Smetana *et al.*, 2006).

Arozullah *et al.* (2001) developed a Postoperative Pneumonia Risk Index to identify patients at high risk for PPC, more specifically pneumonia. In this weighted risk index age above 80 was weighted as the highest risk, followed by aortic aneurism repair and thoracic surgery, age above 70, upper abdominal surgery and age above 60. This demonstrates that the odds of developing a PPC increases significantly in elderly patients (Arozullah *et al.*, 2001). Multiple other studies support this finding, stating the risk for developing a PPC increases significantly in patients over the age of 60 years (Karlsson *et al.*, 2018; Miskovic & Lumb, 2017; Qaseem *et al.*, 2006). Functional dependence, impaired sensorium and a greater number of comorbidities are common in older patients, possibly leading to the higher risk in older patients, although advanced age is an independent predictor of risk (Smetana *et al.*, 2006).

2.2 ELDERLY

2.2.1 Definition

According to the World Health Organisation (WHO) (2016) most developed countries accept a working definition of elderly as any person over the age of 65 years. This definition does not suit African populations due to the difference in cultural, traditional and community beliefs. Traditional African definitions of elderly, which focusses more on social roles than chronological age, equate to individuals aging 50 years and older

(Kowal & Dowd, 2001). These social roles include new contributions to the community (custodians of tradition, peacekeepers, leadership) but also functions lost due to physical decline (Kowal & Peachy, 2001). Retirement funds, however define elderly as a person aged 60 to 65 years and up (Kowal & Dowd, 2001). This contrast has led to the United Nations (UN) developing a standard criteria of 60 years and older, in order to be accepted as an elderly individual (Kowal & Dowd, 2001).

Elderly patients are therefore considered high risk patients in abdominal surgery. The increase in risk as a person ages could be due to compromised respiratory function in the elderly, caused by a restrictive lung pattern (Sharma & Goodwin, 2006) or a reduction in physical function (Karlsson *et al.*, 2018).

2.2.2 Respiratory System of the Elderly patient

The respiratory system changes with age (Lalley, 2013). Structural and physiological changes to the thoracic cage, lungs and diaphragm affects chest wall and lung compliance as well as respiratory muscle strength. Stiffness of the thoracic cage and chest wall leads to weakened inspiratory and expiratory respiratory muscles, which then aggravates the loss of lung elasticity. This decline in respiratory function leads to the collapse of smaller airways and air entrapment as expiration volumes are decreased (Dyer, 2012; Feeney *et al.*, 2011; Lalley, 2013). Furthermore, diffusing capacity worsens with age leading to a larger ventilation-perfusion mismatch especially with exertion or exercise. This leads to an increase in work of breathing and a weaker cough effort, causing a decrease in airway clearance (Dyer, 2012; Lalley, 2013; Sharma & Goodwin, 2006).

Lung function and cough reflexes are generally impaired following abdominal surgery, irrespective of the patient's age (Patman *et al.*, 2017). The motor components of the cough reflex are as follows (Lalley, 2013):

1. Expansion of the lungs by means of contraction of the diaphragm and external intercostal muscles.
2. Contraction of the vocal folds close the glottis.
3. Increased lung pressure is achieved through relaxation of the diaphragm and contraction of the expiratory chest and abdominal muscles.
4. Relaxation of the vocal folds open the glottis and expel air from the lungs.

5. Collapse of the bronchi and parts of the trachea form narrow openings to force irritants from the lung.

The physical changes in the lung of an elderly person (*see Table 2.2*), therefore makes the cough reflex already less forceful and thus less effective (Dyer, 2012; Lalley, 2013; Sharma & Goodwin, 2006), predisposing the elderly patient to diaphragmatic fatigue and respiratory failure when an extra load (such as abdominal surgery) is added (Sharma & Goodwin, 2006). Elderly patients also show a poor response to hypoxia (low levels of oxygen) and hypercapnia (high levels of carbon dioxide), increasing their vulnerability to respiratory failure with surgery (Dyer, 2012). The resulting shortness of breath, possibly worsened by comorbidities, may then lead to a decrease in quality of life (Dyer, 2012).

Table 2.2 Changes in the lung of an aging individual

Reduced	Increased
Lung elasticity	Dynamic lung compliance
Muscle strength of respiratory muscles	Residual volume
Chest wall distensibility	Lung volume on exercise
Vital capacity	
Perception of bronchoconstriction	**Unchanged**
Forced expiratory volume	Total lung capacity
Lung capacity	Airway resistance
Bronchial hyper-responsiveness	Pulmonary arterial resistance
Diffusing capacity	Arterial carbon dioxide levels
Respiratory response to hypoxia and hypercapnia	

Source: (Dyer, 2012)

Exercise capacity may however still differ between a fit and frail elderly patient as musculoskeletal changes, such as kyphosis, osteoporosis and decreased intervertebral disc space also affect respiratory function (Dyer, 2012; Karlsson *et al.*, 2018; Lalley, 2013; Sharma & Goodwin, 2006). More rigorous physical activity and better fitness can slow the aging process in the respiratory system of an individual (Sharma & Goodwin, 2006).

2.2.3 Physical Function

The aging process with subsequent lung alterations increases the risk of PPC in the elderly patient but Karlsson *et al.*, (2018) found that functional status was a better predictor of risk and outcome than chronological age. Functional status can be defined as a person's ability to perform physical and social activities necessary in daily routines and life roles (Van Cleave *et al.*, 2011). Physical function declines with age affecting both ADL and IADL (Zasadzka *et al.*, 2016). This decline can further be influenced by multiple factors such as frailty, comorbidities, strength and walking ability (Isik *et al.*, 2015; Karlsson *et al.*, 2018). These factors impact the patient's ability to withstand surgery (Makary *et al.*, 2010).

2.2.3.1 Influencing Factors

Frailty summarises aspects of health status where an individual, usually an older patient, demonstrates a decreased physiological reserve in multiple organ systems. This can be observed through a decrease in gait speed, grip strength, physical activity, energy and weight. The resulting reduction in physical function then causes an increase in susceptibility to poor health outcomes and disability, even with minor stressors. The presence of frailty may explain why certain patients recuperate worse than expected while more fit patients of the same age recover better (Brinson *et al.*, 2016; Makary *et al.*, 2010; Partridge *et al.*, 2012; Robinson *et al.*, 2013; Søreide & Desserud, 2015; Tevis & Kennedy, 2013). Functional status will therefore differ greatly between a fit (easily able to complete daily activities) and frail elderly patient.

The presence of comorbidities also influence physical function. Van Cleave *et al.*, (2010) reported that the presence of three or more comorbidities negatively affected the recovery of functional status following surgery. The number and severity of comorbidities also heighten the chance of postoperative complications (Isik *et al.*, 2015; Petrucci *et al.*, 2018; Tahiri *et al.*, 2016) further slowing down the recovery of function.

While certain comorbidities have an impact on strength, muscle weakness in and of itself decreases physical function (Karlsson *et al.*, 2018; Kirchhoff *et al.*, 2010; Newman *et al.*, 2006; Volaklis *et al.*, 2015). Muscle aging happens as muscle fibres deteriorate leading to a reduction in muscle mass, which in turn affects muscle strength (Newman

et al., 2006). A decline in both muscle mass and strength has been reported as predictive of mortality. Newman *et al.*, (2011), however found that muscle strength, not mass predicts mortality. Handgrip strength influences upper limb function and ADL. A recent literature review also found handgrip strength to be a good predictor for long term fractures and multiple comorbidities (Volaklis *et al.*, 2015). Grip strength and quadriceps muscle strength show similar predictive qualities. The ability to extend the knee plays an important role in balance and risk of falling, thus affecting the patient's walking ability (Volaklis *et al.*, 2015).

Walking ability is synonymous with the ability to live safely and independently within a community (Minnella *et al.*, 2016). A decrease in walking ability or exercise capacity will therefore greatly affect physical function (Flahive, 2018; Paisani *et al.*, 2012). A decrease in exercise capacity leads to a reduced metabolic ability to cope with the demands of surgery (Paisani *et al.*, 2012). The 6MWT is generally used to measure exercise capacity (*please see Section 4.1.4.5*). Several studies showed that a reduction in walking ability was predictive of postoperative complications in older patients (Awdeh *et al.*, 2015; Keeratichananont *et al.*, 2016) and mortality in patients with comorbidities (Shi *et al.*, 2017). Paisani *et al.*, (2012) found that the 6MWT however, does not predict PPC in UAS however the study excluded patients with low functional statuses.

General low physical function in elderly patients prior to surgery increase the risk for complications following surgery (Brinson *et al.*, 2016; Bruns *et al.*, 2016; Carli *et al.*, 2010; Flahive, 2018; Hoogeboom *et al.*, 2014; Isik *et al.*, 2015; Karlsson *et al.*, 2018; Minnella *et al.*, 2016; Petrucci *et al.*, 2018; Pouwels *et al.*, 2014). Kow, (2019) reported that poor physical function at surgical time causes increased mortality, complications and slow recovery. Depending on the reasons for surgery up to 50% of patients already experience a decrease in function prior to surgery (Hoogeboom *et al.*, 2014). Isik *et al.*, (2015) reported that preoperative functional status directly affected postoperative outcomes and that from an elderly patient's perspective, physical function is a major indicator of surgical success (Groll *et al.*, 2005; Karlsson *et al.*, 2018; Tahiri *et al.*, 2016; Tevis & Kennedy, 2013).

2.2.3.2 Effects of Surgery on Physical Function

Hospitalisation and surgery further reduce the functional status of elderly patients through decreased activity, surgical stress, anaesthesia and complications (Bruns *et al.*, 2016; Graf, 2008; Gustafsson *et al.*, 2011; Hoogeboom *et al.*, 2014; Kisialeuski *et al.*, 2015; Petrucci *et al.*, 2018; Pouwels *et al.*, 2014). Petrucci *et al.*, (2018) stated that major surgery in elderly participants contributed to rapid loss of muscle strength causing postural instabilities and negatively affect walking ability. This loss is aggravated by a decrease in activity following surgery. Studies show that elderly patients spend up to 80% of their recovery time in bed, severely compromising their independence (Hoogeboom *et al.*, 2014; McComb *et al.*, 2018).

Mobility in hospital can be any of the following: moving in the bed, sitting over the side of the bed, sitting in a chair, standing, marching, walking in the hallway or other cardiovascular exercise (Browning *et al.*, 2007). Upright mobilisation, or uptime, is considered best for the prevention of pulmonary, functional or psychological complications (Browning *et al.*, 2007). Studies show that mobility following surgery is severely decreased with only three minutes of uptime on the first day post operatively. It takes five to six days for elderly patients to mobilise independently with only about half an hour on the fourth day post-operatively (Browning *et al.*, 2007; McComb *et al.*, 2018).

Uptime can be reduced due to fear, pain and surgical attachments. Browning *et al.*, (2007) reported that 90% of patients needed assistance with mobilisation day one post-operatively and that by day five 22% still required assistance. It can be surmised that uptime for these patients will be reduced if adequate assistance is not available. Inadequate pain control and drains also proved to limit uptime (Kisialeuski *et al.*, 2015). The presence of surgical attachments caused an hour difference in uptime on day one (Browning *et al.*, 2007; Kisialeuski *et al.*, 2015). An increase in uptime has a positive effect on psychological factors such as anxiety, depression and stress (Browning *et al.*, 2007).

Surgical stress syndrome adds to functional decline post-surgery as it causes metabolic and physiological effects in multiple organ systems including cardiopulmonary, muscular and neural functions (Finnerty *et al.*, 2013; Hoogeboom *et*

al., 2014; Kalogera & Dowdy, 2016; Scott & Miller, 2015). A stress response is an evolutionary survival mechanism as a result of any injury or trauma (Cassidy *et al.*, 2013; Scott & Miller, 2015). During surgery negative feedback to the brain decreases, leading to a drop in cortisol, leading to a stress response (Finnerty *et al.*, 2013). Surgery can be seen as the primary injury causing this stress response, thus the term surgical stress syndrome (Minnella & Carli, 2018; Scott & Miller, 2015). The response is directly related to the type and duration of the surgery. Abdominal surgery elicits a worse response compared to other surgeries due to the systemic effects of the abdominal organs. Open surgery also results in a larger stress response due the pathophysiological differences between open and closed surgery *(please see section 2.1.1*).

The effects of surgical stress could trigger frailty in the elderly patient (Moriello *et al.*, 2008) as it leads to increased muscle wasting, a decrease in immune function, wound healing and metabolism (Finnerty *et al.*, 2013; Hoogeboom *et al.*, 2014). In severe cases surgical stress syndrome could cause multiple complications including organ failure and death (Finnerty *et al.*, 2013).

Some elderly patients might be strong enough for surgery but would not be able to tolerate a complication "(Søreide & Desserud, 2015). Elderly patients have a decreased ability to cope with complications compared to younger and healthier patients (Fried *et al.*, 2002). Morbidity in the general surgical population is around 28% and mortality 2.3% (Kisialeuski *et al.*, 2015). In elderly patients these percentages increase to 51% and 7%, respectively (Kisialeuski *et al.*, 2015). Multiple studies show that pre-operative physical function is predictive of post-operative complications (Feeney *et al.*, 2011; Karlsson *et al.*, 2018; Lawrence *et al.*, 2004; Onerup *et al.*, 2015; Tahiri *et al.*, 2016; Tran *et al.*, 2014). However, post-operative complications also reduce activity levels with a consequential loss of function (Feeney *et al.*, 2011; Hoogeboom *et al.*, 2014; McComb *et al.*, 2018). Tahiri *et al.*, (2016) reported that the more severe the complications the longer the time needed to return to pre-operative function.

Graf (2008) states that functional decline begins within 48 hours of hospitalisation. To summarise, the considerable decline in function is largely due to the physiologic changes from aging, comorbidities, complications and inactivity associated with

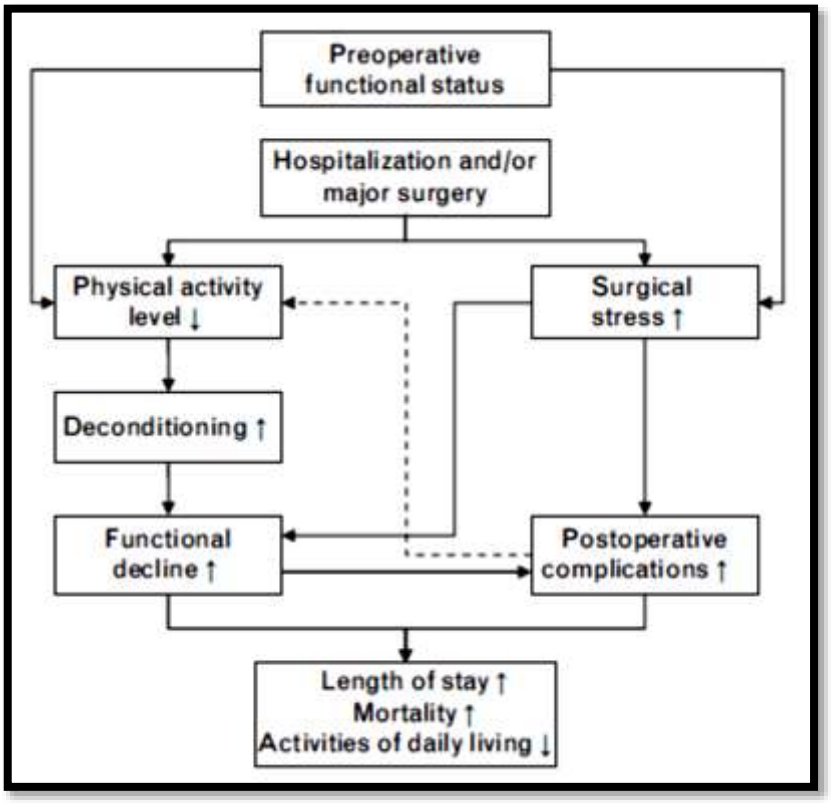
hospitalisation and surgery (Graf, 2008). Inactivity is the fourth highest risk of death according to the WHO (Onerup *et al.*, 2015). Muscle weakness, resulting from inactivity can be linked to fatigue in elderly patients further decreasing functional independence in terms of ADL and IADL (Luciani *et al.*, 2008; Mayo *et al.*, 2011).

On discharge a third of elderly patients have reduced abilities in one or more ADL (Graf, 2008) and two thirds of frail patients may lose IADL function after surgery (Rønning *et al.*, 2014). Several studies report that the physical function of over two thirds of patients had not returned to baseline after two months (Carli *et al.*, 2010; Flahive, 2018). At three months post-operatively 19% of patients have not recovered the ability to perform an ADL and 40% an IADL (Graf, 2008). Tahiri *et al.*, (2016) reported that at six months a third of patients were still not at baseline function. While most patients will recover function post-surgery, high risk patients might never fully recover to pre-operative functional status (Hoogeboom *et al.*, 2014; Minnella *et al.*, 2016).

Most elderly patients will refuse surgery if they might not be able to return to their prior level of function (Brinson *et al.*, 2016; Chee & Tan, 2010; Fried *et al.*, 2002; Tahiri *et al.*, 2016). Lawrence *et al.*, (2004) reported that 12% - 50% of patients over the age of 80 years are left with a permanent disability following surgical complications.

2.3 SURGICAL OUTCOMES

Poor surgical outcomes therefore correlates with the development of complications, the aging process of the lung and loss of function in elderly and frail patients (*see Figure 2.3*) A review by Partridge *et al.*, (2012) found that frailty could be modified through exercises targeting walking ability and strength; thereby improving physical function and reducing the risk for poor outcomes.



Source: (Hoogeboom et al., 2014)

Figure 2.3 Effect of Hospitalization and Surgery on Outcomes

2.3.1 Overview

Surgical outcomes can be categorised into two groups – patient-centred and hospital centred. Health in the elderly patient can be seen as a combination of physical, mental and social state of wellbeing, affected by disease or illness but not limited to the absence thereof (Chee & Tan, 2010).

Patient-centred outcomes can be defined as “care that respects the individuality, values, ethnicity, social endowments, and information needs of each patient” (Tevis & Kennedy, 2013; p106). The success of surgery in elderly patients should be measured with patient-centred outcomes, such as functional status (Brinson *et al.*, 2016; Chee & Tan, 2010). Functional status can be measured through self-reported information (ADL, IADL, and level of activity) or performance based tests (mobility, gait and walking capacity) (Brinson *et al.*, 2016). Surprisingly very few studies measure functionality as an outcome, rather concentrating on hospital centred outcomes such as mortality, morbidity, LOS and hospital costs (Boden *et al.*, 2015; Chee & Tan, 2010; Dronkers *et al.*, 2008; Hoogeboom *et al.*, 2014; Miskovic & Lumb, 2017; Scholes *et al.*, 2009; Shander *et al.*, 2011).

Multiple studies reported that the development of complications, especially PPC prolong hospital stay, increase hospital costs and negatively affect mortality and morbidity (Boden *et al.*, 2015; Dronkers *et al.*, 2008; Haines *et al.*, 2013; Hanekom *et al.*, 2012; Hoogeboom *et al.*, 2014; Katsura *et al.*, 2015; McAlister *et al.*, 2005; Miskovic & Lumb, 2017; Parry *et al.*, 2014; Reeve & Boden, 2016; Scholes *et al.*, 2009; Shander *et al.*, 2011). Length of hospital stay can be prolonged by as much as 22 days following the development of PPC adding considerably to associated costs (Haines *et al.*, 2013; McAlister *et al.*, 2005; Miskovic & Lumb, 2017; Reeve & Boden, 2016; Scholes *et al.*, 2009; Shander *et al.*, 2011) The development of complications could increase LOS with 89% and hospital costs with up to 55% (Shander *et al.*, 2011). The prevention of complications; including PPC, muscle weakness and loss of functionality, is thus important in order to improve both patient- and hospital centred outcomes.

2.3.2 Enhanced recovery after surgery

Enhanced recovery after surgery (ERAS), is an evidence based, multidisciplinary approach that aims to improve all surgical outcomes by maintaining normal physiology as far as possible (Altman *et al.*, 2019; Kalogera & Dowdy, 2016; Merchea & Larson, 2018). This global strategy has been proven to decrease the surgical stress response, complications, LOS, morbidity and hospital costs while improving patient mobility and speed of recovery (Altman *et al.*, 2019; Gustafsson *et al.*, 2016; Kalogera & Dowdy, 2016; Kisialeuski *et al.*, 2015; Merchea & Larson, 2018; Pedziwiatr *et al.*, 2015).

The three phases of ERAS include preoperative, intraoperative and postoperative strategies. Preoperative strategies focus on the optimization of physical status through education and counselling. There is no distinct time limit to this phase, as it stretches from directly prior to surgery to months prior depending on the goals of the study (Altman *et al.*, 2019; Kalogera & Dowdy, 2016; Kisialeuski *et al.*, 2015). During the intraoperative phase, type of surgery, temperature of the patient, fluid balance and anaesthetics play an important role. Laparoscopic procedures are advised over open operations (Altman *et al.*, 2019; Kalogera & Dowdy, 2016; Kisialeuski *et al.*, 2015). Following surgery, diet, fluids, pain control and the presence of drains and catheters influence recovery (Altman *et al.*, 2019; Kalogera & Dowdy, 2016; Kisialeuski *et al.*, 2015). Most studies agree that one of the most important strategies postoperatively is early mobilisation as it assists with many postoperative goals (Altman *et al.*, 2019;

Kisialeuski *et al.*, 2015). Altman *et al.*, (2019) states that two hours of mobilisation should occur within 24 hours of surgery, followed by at least six hours of uptime from day one onwards. Physiotherapy therefore plays an important role in ERAS, both pre- and postoperatively.

2.4 PHYSIOTHERAPY

Physiotherapy is an evidence based profession with the focus on optimal human function through prevention, restoration, maintenance and promotion of health and wellness (Scalzitti & Costello, 2019). Therapy addresses structural impairments in multiple systems including musculoskeletal, neuromuscular, cardiovascular and pulmonary systems (Scalzitti & Costello, 2019). With physiotherapy activity limitations and participation restrictions are managed to improve quality of life (Scalzitti & Costello, 2019).

2.4.1 Current physiotherapy protocol in abdominal surgery

The following protocol is used by most physiotherapist working with abdominal surgery patients. On admission to the hospital, prior to surgery an education session is given. Literature regarding what this session entails is lacking but information regarding the surgery and DBE are common themes. Research shows that a single education and training session that focuses on information preparing the patient for post-surgical mobilisation, DBE and coughing with wound support is effective in preventing PPC (Boden, Skinner, *et al.*, 2017; Reeve & Boden, 2016). Pre-operative education can reduce risk of complications with up to 52% and is proven to be memorable with good cooperation from patients (Boden, El-Ansary, *et al.*, 2017). Pre-operative counselling is reported to improve adherence to physiotherapy and reduce PPC (Samnani *et al.*, 2014). Boden *et al.* (2017) states that patients receiving pre-operative physiotherapy education and training are exponentially more likely to remember the exercises than patients who only receive an information booklet. It is important to note that giving advice is not the same as prescribing exercise, and that exercise prescription should therefore be specific (Minnella & Carli, 2018).

Many practitioners also train the patient in using an incentive spirometer pre-operatively, however the evidence is still inconclusive (Kulkarni *et al.*, 2010; Mackay *et al.*, 2005; Tyson *et al.*, 2015). The effects of spirometry could be a consequence of education regarding DBE rather than the device itself (Boden, Skinner, *et al.*, 2017).

Kulkarni *et al.*, (2010), reported that inspiratory muscle training assists with the preservation of inspiratory muscle strength following surgery and that it could assist with the preventions of PPC.

The following day (usually 24-30 hours after surgery), the patient is mobilised, DBE are given and the patient is reminded to cough with wound support (Boden, El-Ansary, *et al.*, 2017; Boden, Skinner, *et al.*, 2017; Grams *et al.*, 2012; Patman *et al.*, 2017; Possa *et al.*, 2014). Studies show physiotherapy (such as early mobilisation, DBE and supported coughing) to be effective in preventing PPC following abdominal surgery (Boden *et al.*, 2015; Cassidy *et al.*, 2013; Dronkers *et al.*, 2010; Katsura *et al.*, 2015; Lawrence *et al.*, 2006; Patman *et al.*, 2017; Qaseem *et al.*, 2006; Scholes *et al.*, 2009). Most studies agree that early mobilisation is the best prevention for complications, particularly PPC and muscle weakness (Boden *et al.*, 2015; Browning *et al.*, 2007; Haines *et al.*, 2013; Hanekom *et al.*, 2012; Patman *et al.*, 2017; Samnani *et al.*, 2014). Almost all physiotherapists (87% to 91%) include mobilisation in their first postoperative treatment (Browning *et al.*, 2007; Patman *et al.*, 2017; Reeve & Boden, 2016). Should the patient develop a PPC further chest physiotherapy is provided, including percussions, vibrations and nebulisation. This is in line with Pasquina *et al.*, (2006), who concluded that the routine use of respiratory therapy is not justified (Patman *et al.*, 2017). However, following a specific physiotherapy guideline improves surgical outcomes post-operatively (Possa *et al.*, 2014).

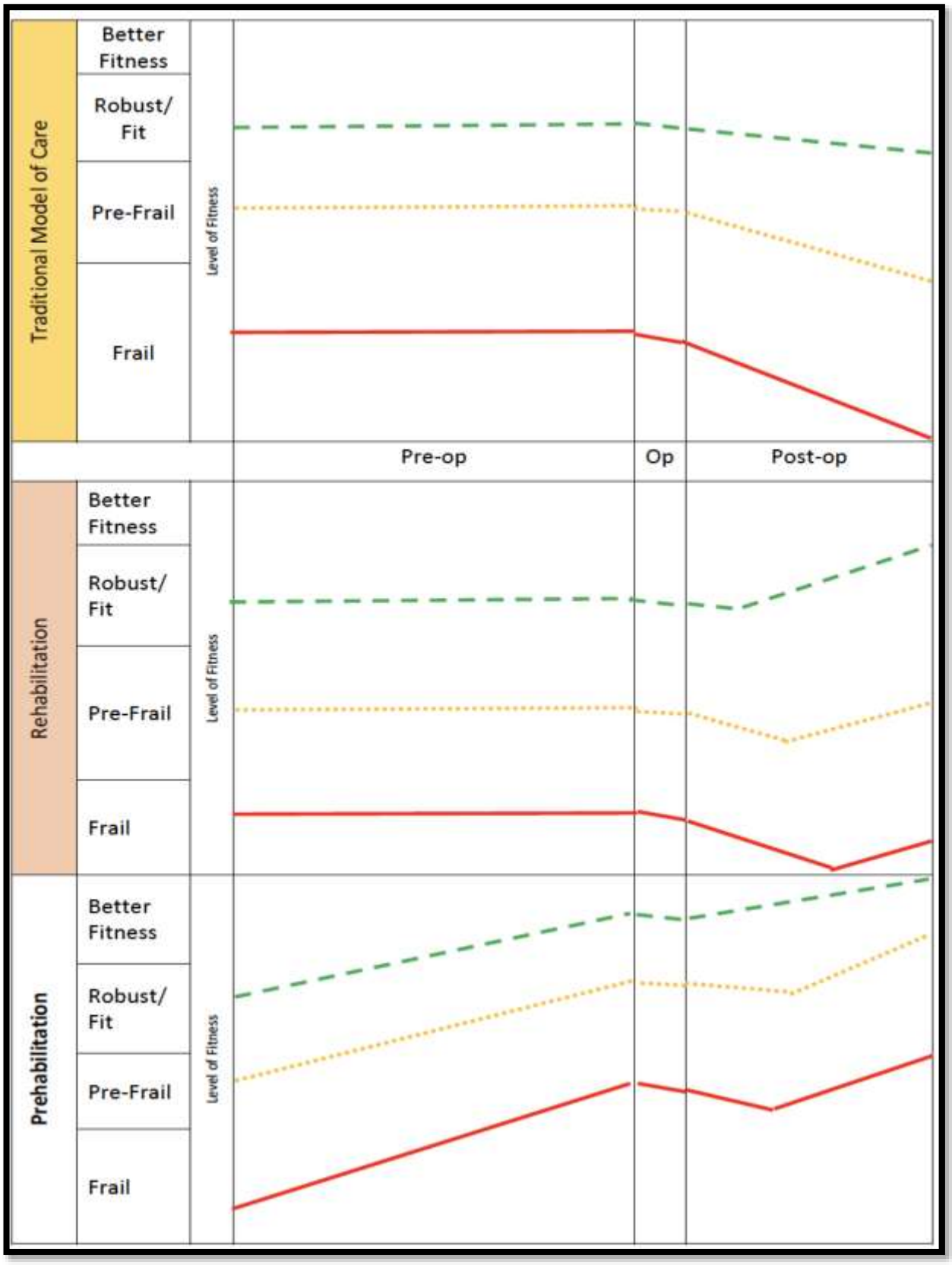
While this protocol is evidence-based, it does not comply with the ERAS guidelines for abdominal surgery. These guidelines state that on the first day following surgery the patient must sit out of bed for six to eight hours and mobilise at least 60m. Several factors affect the compliance with these guidelines, such as surgical side effects (pain, nausea and hypotension), staffing requirements and the traditional protocol (Altman *et al.*, 2019; Reeve & Boden, 2016). Pedziwiatr *et al.*, (2015) states that the implementation of ERAS guidelines is a gradual process but that compliance could further improve outcomes. Recent literature reviews, however find any physiotherapy to be better than none in the effort to prevent post-operative complications (Cassidy *et al.*, 2013; Dronkers *et al.*, 2008; Katsura *et al.*, 2015; Kulkarni *et al.*, 2010; Lawrence *et al.*, 2006; Possa *et al.*, 2014; Qaseem *et al.*, 2006).

Shaughness *et al.*, (2017) stated that prehabilitaion lacks evidence but could transform surgical care. Newer research focusses more on pre-operative clinics, where prehabilitation is given one to six weeks prior to surgery (a physiological stressor) in an effort to improve functional capacity (Carli *et al.*, 2010; Reeve & Boden, 2016).

2.4.2 Prehabilitation

The main factors influencing functional capacity is physical, nutritional and psychological status, all modifiable prior to surgery (Minnella & Carli, 2018). Prehabilitation is thus a process that attempts to pre-emptively improve function, psychological capacity and promote recovery (Bruns *et al.*, 2016; Kow, 2019; Merchea & Larson, 2018). This is accomplished through nutrition advice, exercises and education regarding the procedure and expected recovery (Merchea & Larson, 2018; Minnella *et al.*, 2017; Minnella & Carli, 2018). Prehabilitation intentions are similar to ERAS gaols and helps to improve outcomes set out by the ERAS guidelines (Merchea & Larson, 2018). Elderly, frail patients with comorbidities are the main targets of prehabilitation as surgery poses a high risk for functional decline to these patients (Minnella & Carli, 2018; Reeve & Boden, 2016).

The rehabilitation that follows surgery, does not impact muscle and functional reserves prior to surgery, thus the need for prehabilitation. Furthermore, frail patients start at a lower baseline function with less reserves and decline in fitness faster than pre-frail or fit patients, as can be seen in Figure 2.4 (Kow, 2019).



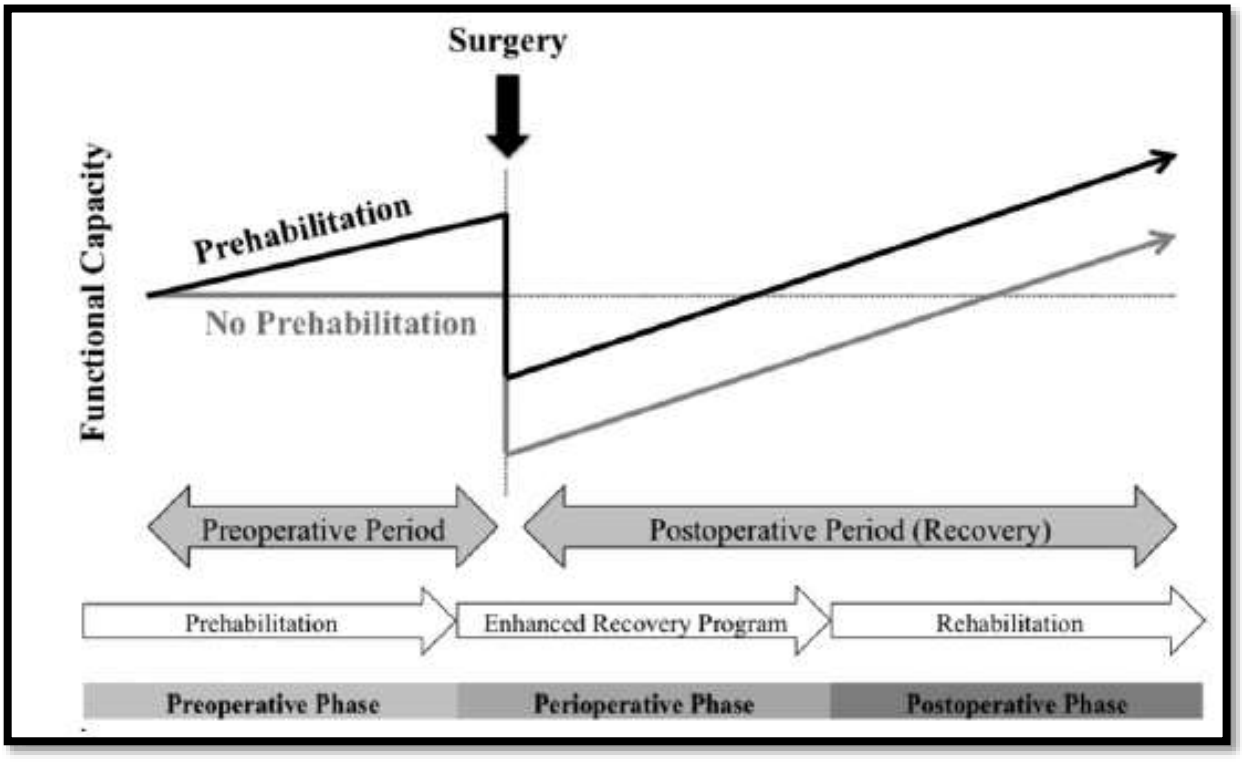
Source: (Kow, 2019)

Figure 2.4 Approaches to Elderly Surgical Care

2.4.2.1 Ideal Treatment

Minnella *et al.*, (2017), identified a continuum of care for cancer patients which could also be used as the ideal care for all high risk surgical patients (*see Figure 2.5*). In order for this to be effective three steps should be followed. All surgical patients should be screened to identify high risk patients. The high risk patients' functional variables (physical, nutritional and psychological status) should then be assessed and intervention (prehabilitation) given as needed (Minnella & Carli, 2018).

A recent systematic review on elderly patients undergoing colorectal surgery, found that pre-surgical rehabilitation (endurance, strength and respiratory training in various combinations) may improve physical function (Bruns *et al.*, 2016). An improvement in the physical function of the elderly patient improves self-reported wellbeing and decreases levels of pain (Shaughness *et al.*, 2017; Zasadzka *et al.*, 2016). Endurance, resistance and flexibility training cause complementary effects on muscle fibres and should all be included in prehabilitation programmes to achieve comprehensive functional improvement (Minnella & Carli, 2018). Hoogeboom *et al.* (2014) also advises that exercise therapy be initiated pre-operatively for elderly patients undergoing elective surgery as it could counter the detrimental effects of surgery and hospitalisation on physical function and assist in the reduction of PPC.



Source: (Minnella *et al.*, 2017)

Figure 2.5 Ideal Treatment for High Risk Surgical Patients

Pre-operative studies focussing on both physical exercise and inspiratory muscle training have shown to be effective in reducing PPC and preserving physical function in patients undergoing major abdominal (Barberan-garcia *et al.*, 2018; Boden *et al.*, 2015; Dronkers *et al.*, 2008; Katsura *et al.*, 2015; Kulkarni *et al.*, 2010; Mayo *et al.*, 2011; Pouwels *et al.*, 2014; Soares *et al.*, 2013) and cardiac surgery (Hulzebos, van Meeteren, *et al.*, 2006; Katsura *et al.*, 2015). These studies show that it is possible to improve physical function in patients in a short pre-operative timeframe (two to four weeks of intervention) (Hoogeboom *et al.*, 2014; Hulzebos, van Meeteren, *et al.*, 2006; Pouwels *et al.*, 2014).

2.4.2.2 Challenges of Prehabilitation

Despite the benefits of prehabilitation some challenges are evident. The main obstacles to the clinical implementation of a prehabilitation programme are recruitment and compliance (Northgraves *et al.*, 2020; Shaughness *et al.*, 2017). It is difficult to seamlessly integrate prehabilitation into the current patient care protocols as a collaboration between surgeons, clinicians and third parties are essential (Shaughness *et al.*, 2017; Zhu *et al.*, 2018). The patient can only be referred for prehabilitation once the surgeon makes the decision to operate.

Recruitment is mostly limited by three factors; short wait times for surgery, logistics and non-consent (Northgraves *et al.*, 2020; Shaughness *et al.*, 2017). Few patients or surgeons want to postpone surgery dates leading to shorter time frames for prehabilitation (Northgraves *et al.*, 2020; Shaughness *et al.*, 2017). In a study conducted at 20 hospitals Shaughness *et al.*, (2017) also noted a minimal capacity for workload increases among office staff, thereby negatively impacting recruitment. Non-consent also leads to low recruitment numbers as patients report time constraints, travel difficulties or personal commitments as reasons as to why they are unable to participate in prehabilitation (Northgraves *et al.*, 2020). A study in the United Kingdom found that only 42% of patients met the inclusion criteria due to the short time prior to surgery and of these only 18% consented to participation in the study (Northgraves *et al.*, 2020). However, consent and compliance was improved when prehabilitation was suggested by the surgeons (Shaughness *et al.*, 2017).

Compliance and adherence to prehabilitation is essential in order for it to be effective (Ferreira *et al.*, 2018). Compliance rates range from 16% - 97% depending on the structure of prehabilitation (Bruns *et al.*, 2016; Kow, 2019; Pouwels *et al.*, 2014). When patients are expected to continue independently at home, adherence is low (16%). This increases with supervised weekly sessions and is best (97%) with daily in hospital training. Zhu *et al.* (2018), suspects that the difference in adherence could be due to the difficulty in balancing chronic conditions with surgical preparations such as prehabilitation.

2.5 CONCLUSION

Pre-surgical exercise and education studies demonstrate that patients are better prepared physically as well as emotionally, thus improving outcomes. Concepts like “strong for surgery” could significantly improve post-surgical recovery by decreasing complications such as PPC, and improving general quality of life. The current study will thus determine the effect of such a programme on elderly patients undergoing abdominal surgery when done once off in the South African context. The education material used in this programme will be discussed in Chapter 3.

Chapter 3

3 DEVELOPMENT OF THE PRE-OPERATIVE EDUCATION AND EXERCISE PAMPHLET

This chapter will outline the development of the pre-operative education and exercise pamphlet used during the clinical study described in Chapter 4. A narrative review of the current literature was done to determine applicable content for the pamphlet. The pamphlet development involved three steps; compiling the pamphlet from current literature following review of the literature, content validation of the pamphlet by peer review and lastly assessing/adjusting the reading ease of the pamphlet before implementation clinically.

3.1 LITERATURE REVIEW

3.1.1 Type of Review

A narrative review of current literature was completed. This type of review was appropriate as it examines a collection of quantitative studies that examined different relationships or concepts using various methods (Siddaway *et al.*, 2019). Narrative reviews are a valuable way to link studies on different topics together to develop new ideas or theories (Baumeister & Leary, 1997; Siddaway *et al.*, 2019). Even though there are no acknowledged guidelines for narrative reviews, the researcher borrowed methodology from systematic reviews in order to reduce bias with article selection, as suggested by Ferrari (2015).

3.1.2 Literature Search Question

What is the best advice and exercise to aid with recovery of physical function following abdominal surgery in elderly patients?

3.1.3 Aims and Objectives

- To determine the appropriate preoperative physiotherapy advice for patients undergoing abdominal surgery.
- To select effective exercises to improve physical function in elderly patients undergoing abdominal surgery.

3.1.4 Methodology

This section will discuss the process of the literature review.

3.1.4.1 Search Strategy

An electronic search was performed within three data-bases, PubMed, Clinical Key and Google Scholar. Search terms included: ‘preoperative OR pre-surgical’, ‘advice OR education’, ‘exercise OR training’, ‘abdominal surgery’, ‘physical function’ and ‘elderly OR aged’. Variations of these terms were used to optimise results.

3.1.4.2 Inclusion Criteria

Articles were included if the effect of prehabilitation or rehabilitation was evaluated on participants over 60 years of age. Prehabilitation was defined as any advice or exercise given prior to surgery, irrespective of the duration of the intervention. Outcome measures had to evaluate physical function or post-operative complications.

3.1.4.3 Exclusion Criteria

The exclusion criteria were articles not in English or for which full text was not available. Articles were excluded if the surgery involved was not abdominal surgery. Studies were also excluded if the preoperative exercises were not specifically named or could not be replicated or modified to be independently done at home.

3.1.5 Results

Table 3.1 depicts the articles used to construct the pamphlet, the study design and outcome measures, type of exercise and a brief summary of the key results. How these results were used to create the pamphlet will be discussed in section 3.2 Creation of the Pamphlet.

Table 3.1 Literature Overview

ARTICLE	STUDY DESIGN	PARAMETER (OUTCOME MEASURES)	PARTICIPANT AGE/SURGERY LOCATION	INTERVENTION	RESULTS
(Alexander *et al.*, 2001)	RCT	*Bed-Rise & Chair-Rise Task Assessment (Time) *Strength (Reinforced Chair) *Range Of Motion (Goniometer & BROM) *Balance (BROM)	65+ Years Surgery NR	*Resisted task-specific training (bridging etc.) *Flexibility training (trunk rotation etc.)	*Better improvement for more frail participants *Improved trunk strength, range and balance *Both control and intervention groups showed improvement
(Steadman *et al.*, 2003)	RCT	*Mobility (Ten-Meter Timed Walk Test) *Balance (Berg Balance Scale) *Adl (Frenchay Activities Index) *Social Limitation (Falls Handicap Inventory) *QoL (European QoL Questionnaire	60+ Years Surgery NR	*Functional balance training (timed walking practice) *Conventional methods to improve mobility in elderly (sit to stand etc.)	*Balance training may improve confidence and quality of life *Training led to a significant decrease in number of falls and improved balance of intervention group *Training improved walking speed and quality of life in control group
(Said *et al.*, 2012)	Feasibility Study	*Mobility (Timed Up And Go, Elderly Mobility Scale, DEMMI)	60+ Years Surgery NR	*Usual care *Increased physical activity (walking etc.)	*Greater improvement of DEMMI score in intervention group

(Gill *et al.*, 2003)	Demon-stration Study	*Mobility (Rapid Gait Test, Single Chair Stand) *Range Of Motion (NR) *Balance (NR) *Muscle Conditioning And Strengthening (Dynamometer, Physical Performance Test) *Mobility (Performance-Orientated Mobility Assessment	75+ Years Surgery NR	*Resistance band exercises *Mobility exercises *Balance exercises	*Home-based programmes are effective and safe for the elderly *Poor progression from low level balance training and light strength training
(Cassidy *et al.*, 2013)	Before-After Trial	* Post-Operative Complications (Incidence and Risk Adjusted Ratios for Postoperative Pneumonia and Unplanned Intubation Postoperatively)	Age NR *Abdominal Surgery *Vascular Surgery	*Incentive spirometry *Coughing *Deep breathing *Education *Mobilisation *Positioning	*Decrease in pneumonia cases *Decrease in unplanned intubations *Patient education, early mobilisation and pulmonary interventions reduce complications postoperatively
(Carli *et al.*, 2010)	RCT	*Mobility (Six Minute Walk Test) *Exercise Capacity (VO_2 Max And Heart Rate) *Emotional Distress (Questionnaire)	± 60 Years Surgery NR	*Biking *Strengthening *Walking *Breathing	*No differences between groups in mean functional walking capacity *Greater improvement in walking capacity among walking group *Low adherence to advice

(Dronkers *et al.*, 2010)	RCT Pilot	*Functional Mobility (Timed Up And Go) *Strength And Power (Chair Rise Time) *Maximum Aerobic Capacity (Physical Work Capacity 170) *Maximal Inspiratory Pressure (Microrpm) & Endurance (Microrma) *QoL (European QoL Questionnaire) *ADL (LASA Physical Activity Questionnaire)	60+ Years Surgery NR	*Resistance training *Inspiratory muscle training *Aerobic exercise *Functional activities *Educational advice	*Greater respiratory muscle endurance among intervention group *No significant difference in hospital length of stay or postoperative complications
(Boden, Skinner, *et al.*, 2017)	RCT	*Postoperative Pulmonary Complications (MGS) *Hospital Length Of Stay (Days) *Hospital Costs *Qol (SF-36 Version 2) *Mobility (Ambulation Distance And Time)	Age NR *Abdominal Surgery	*Information booklet *30 minute breathing and exercise physiotherapy session	*Incidence of PPC halved among intervention group

ADL (Activities of Daily Living), BROM (Back Range of Motion Instrument), DEMMI (DeMorton Mobility Index), MGS (Melbourne Group Scale), NR (Not reported), PPC (Post-operative pulmonary complications), QoL (Quality of Life), RCT (Randomised Control Trial), VO_2 (Oxygen Uptake)

3.2 CREATION OF THE PAMPHLET

The researcher compiled the education and exercise pamphlet from the applicable literature, as selected by the review. Specific step-by-step instructions for each exercise was included to assist with the education of future participants with regards to exercise prescription. An elderly family member consented to participate in developing the pamphlet. Photographs of the volunteer were taken to demonstrate each exercise and movement to ensure understanding of the exercise/movement to be done. This was termed the preliminary education and exercise pamphlet.

3.2.1 Education Section

The education section of the pamphlet consisted of two pages, to be given to each participant (control and intervention groups). First and foremost the precautions were outlined e.g. that none of the exercises should cause or worsen pain levels of future participants.

Instructions and pictures were provided on how to roll in and out of bed post-surgery. Rolling onto the side and pushing up with one's arms while protecting the abdominal incision. This method of getting out of bed is important as it assists with decreasing pain with movement, thereby promoting mobility post-operatively (Alexander *et al.*, 2001; Cassidy *et al.*, 2013).

Advice was given to take deep breaths after surgery in order to assist with lung ventilation, decrease pain and help with maintaining lung compliance. This advice is suggested to help prevent PPC and maintain general lung function (Boden, Skinner, *et al.*, 2017; Bruns *et al.*, 2016; Carli *et al.*, 2010; Cassidy *et al.*, 2013; Dronkers *et al.*, 2010). Coughing while supporting the abdominal incision with a pillow was also explained, together with a picture on proper positioning. A strong cough assists with clearing sputum thereby helping to prevent PPC (Boden, Skinner, *et al.*, 2017; Cassidy *et al.*, 2013; Dronkers *et al.*, 2010).

Other advice given included not lifting anything heavier than two kilograms, not reaching overhead, only driving once one can safely do so and wearing orthopaedic stockings as prescribed. It was also noted that wounds should be kept dry and to observe for signs of infection.

3.2.2 Exercise Section

The exercise pamphlet was designed to be given to each participant in the intervention group. Steadman *et al.*, (2003) reported that patients with balance and mobility deficits (such as the elderly and frail individuals) greatly improve with exercise programmes. Participants were advised to perform each exercise twice a day and attempt each exercise 10 times. These exercises included bridging, back mobility exercises, resistance training and walking. Instructions and pictures were given for each exercise.

Functional or task specific exercises, such as bridging are shown to be more effective strength training in elderly and frail patients than single muscle group exercises (Alexander *et al.*, 2001). During hospitalisation transfer ability (such as getting out of bed and standing up from a chair) of the elderly is impaired and therefore important to improve pre- and post-operatively (Alexander *et al.*, 2001). A key exercise for gluteal strength and stability is bridging which aids with bed mobility as well as walking.

Early mobility is a key component of ERAS and improved walking ability pre-operatively may lead to easier rehabilitation post-surgery (Northgraves *et al.*, 2020). Daily increases in the distance and speed of walking improves exercise capacity, endurance, circulation and balance. This in turn improved balance leading to greater walking stability which assists with daily activities (Carli *et al.*, 2010, , 2017; Dronkers *et al.*, 2010; Steadman *et al.*, 2003). Among the elderly, uptime during the late afternoons and weekends are usually lower than during the week (Said *et al.*, 2012). By including walking practice on weekends greater gains in mobility can be seen as it also improves patient's confidence and reduces the risk of falling (Said *et al.*, 2012; Steadman *et al.*, 2003).

Controlled forward trunk flexion assists with standing up from a seated position, a function critical to the prevention of falls in the elderly patient (Alexander *et al.*, 2001).

Forward flexion and trunk rotation was therefor included in the programme to improve back mobility. These thoracic movements with the patients' arms crossed over their chest assists with improving lung expansion and flexibility as well as preventing diaphragm dysfunction and stiffness; while still protecting the abdominal wound (Alexander *et al.*, 2001; Carli *et al.*, 2017).

Improved upper limb mobility and strength also assists with sit to stand or rolling out of bed post-surgery (Alexander *et al.*, 2001). Resistance training with therabands improves joint mobility and strength, hand grip strength and coordination (Carli *et al.*, 2017; Gill *et al.*, 2003). All of these are essential to the performance of daily activities (Northgraves *et al.*, 2020).

An exercise log was added to the back of the exercise pamphlet to allow participants to self-report adherence to the prehabilitation programme.

3.3 PEER REVIEW

A peer review followed the creation of the preliminary pamphlet. Peer reviews are vital to the research process (Alberts *et al.*, 2008). Experts in the relevant field scrutinize and evaluate the content of a study prior to publication to help establish content validity (Alberts *et al.*, 2008; Brod *et al.*, 2009).

Five senior physiotherapists, based on their experience with abdominal surgery patients, elderly patients and academic expertise, were invited to participate in the peer review process. All five physiotherapists were phoned on 29 August 2018 and the aims of the research study and peer review process explained. Following the telephonic conversations, a cover letter explaining the procedure for the peer review, a table *(Appendix E)* showing the literature used to determine the content and the preliminary education and exercise pamphlet was e-mailed to the physiotherapists. One of the physiotherapists asked to review the pamphlet could not assist due to time limitations at work and her own research being conducted.

The preliminary pamphlet was therefore reviewed by the four remaining physiotherapy peers. The physiotherapists were asked to review and assess the content and quality of the pamphlet. They were given two weeks to send their suggestions via email.

The following suggestions were implemented:

- The format of the pamphlet was changed to clearly differentiate between advice and exercise sections.
- Walking was added to the education section along with the existing exercises. The exercise instructions remained the same but walking advice was added. It was advised that participants start to mobilise post-operatively as soon as their physiotherapist in hospital deems it safe. General mobility advice was given such as walking upright and increasing distance and uptime daily to minimise the risk of clotting.
- DBE were added to the exercise section together with the education advice given. More specific instructions on positioning and breathing technique (in through the nose and out through the mouth) was added. Participants were given three separate breathing exercises; to breathe in and out, hold for 3-5 seconds and sniff backwards.
- More detailed photographs were added to demonstrate each step clearly in the process of getting out of bed.
- Instructions were simplified and clarified especially with regards to resistance band exercises.
- Resistance band exercises were changed to one specific fixed point. This was important for elderly patients struggling with hand function.
- The feedback table layout was changed to help participants keep better track of exercises completed.
- Grammar corrections and some sentence construction changes were implemented to improve readability.
- A disclaimer was added; stating that exercises are meant to strengthen the participant but does not necessarily mean no complications may arise.

The suggestions were implemented and the improved pamphlet was e-mailed out to the same four physiotherapists for the final round of reviews on 30 September 2018. Second round feedback was received from three physiotherapists as one physiotherapist did not respond to multiple reminders. Suggestions were made to add more detailed instructions to the DBE, progress the amount of exercises done and to

change a few phrases to further improve ease of reading. Following these minor changes the pamphlet was finalised on 25 October 2018.

3.4 READING EASE

Reading ease is important to ensure comprehension of the pamphlet. Readability can be improved with short sentences, pictures, bold print for important information, personal and layman's language (Jamison, 2010). The Flesch Reading Ease formula was used to determine the ease with which one could read the finalised pamphlet. The readability of the pamphlet was calculated to 92.77 out of 100, indicating very easy reading (Jamison, 2010). The Flesch Reading Ease Formula uses the number of syllables per word and the number of words per sentence to determine readability: 206.835 – 0.846 (number of syllables per 100 words) – 1.015 (average number of words per sentence).

3.5 CONCLUSION

Please see the complete education pamphlet (first two pages) and exercise pamphlet (all six pages) on the following pages. This pamphlet was used during the Pre-Operative Education and Exercise Programme as will be discussed in Chapter 4.

PRE-SURGICAL EXERCISES FOR ABDOMINAL SURGERY

GENERAL INFORMATION AND ADVICE:

1. The following advice and exercises are recommended to prepare you for surgery. **They should not cause you any pain**. If you experience any pain or discomfort with these exercises please discontinue the exercise and contact me.

2. **Walking:** Please walk as soon as instructed by your surgeon and physiotherapist following your surgery. Your hospital physiotherapist will help you out of bed the first time and assist you with the walking as needed. Please try to walk upright. It is important to stand and walk every day and to increase the distance. This improves fitness and blood circulation to prevent blood clotting and infection. Walking also helps to reduce pain.

3. **Rolling and getting in and out of bed**: Please roll in and out of bed as shown in the picture and described below. This method protects the wound and minimizes pain as you will not be using your stomach muscles.

    a. Out of bed
        1. Lie on your back
        2. Bend the knee on the opposite side from which you want to stand up.
        3. Roll over onto your side by pushing with your bent leg.
        4. Bring your other arm forward to help push the body upwards.
        5. Push the body upwards by pushing into the bed with your elbow. Start lowering your legs over the side of the bed at the same time.
        6. Push up until you are sitting.
        7. Slowly stand up.
    b. Into bed (opposite of out)
        1. Sit on the bed.
        2. Slowly lie down sideways on your elbow.
        3. Pick your legs up onto the bed.
        4. Push with your legs to roll onto your back.

4. **Deep Breathing:** It is important to breathe deeply following your surgery. Make sure to sit up straight while practicing your deep breathing.

5. **Coughing:** Hold your stomach as shown in the picture and described below when you want to cough. This supports your wound and helps you to cough with more force in order to clear any phlegm. It is important to clear phlegm to prevent post-operative lung complications such as pneumonia (chest infection).
    a. Do not swallow the phlegm. Spit phlegm into a tissue and throw it in the red bin in hospital. At home flush it down the toilet.
        1. If you have access to a pillow, place it around our stomach.
        2. Cross your arms over the pillow.
        3. Lean forward a little bit.
        4. Gently squeeze your arms together hugging yourself.
        5. Take a deep breath in.
        6. Cough hard. It is always better to give one proper cough than to cough softly several times.

6. **Lifting:** Avoid lifting or carrying anything heavier than 2kg. Avoid reaching for things overhead. Lifting and carrying objects heavier than 2kg puts extra stress on your healing tissue and muscles and should therefore be avoided until you discuss this with your surgeon.

7. **Driving:** Only start driving when you can **safely** drive without any pain and your surgeon gave permission. You should be able to climb one flight of stairs without pain or shortness of breath before attempting to drive.

8. **Wounds:** Keep the wound dry while the wound is dressed. Plasters can usually be removed after 10 days or as the surgeon ordered. If your wounds are red, warm or have a yellow discharge, contact the surgeon's rooms.

9. **Orthopaedic stockings:** Please wear them for 6 weeks as prescribed by your surgeon. They are important to control swelling and to prevent blood clotting (signs of blood clotting include **severe** shortness of breath or chest pain). If you experience any of these signs please contact your surgeon.

10. **Questions:** For any queries regarding this pamphlet and exercises please phone my colleagues. They are the physiotherapists helping me with the exercise part of this study.
    Monique Bergh: 082 948 6875
    Toné Marais: 062 631 2091

EXERCISES: Perform these exercises **at least twice a day** until your surgery. Please continue with these exercises while in hospital and for 2 weeks after discharge from hospital. Complete **each exercise** at least **10 times**.

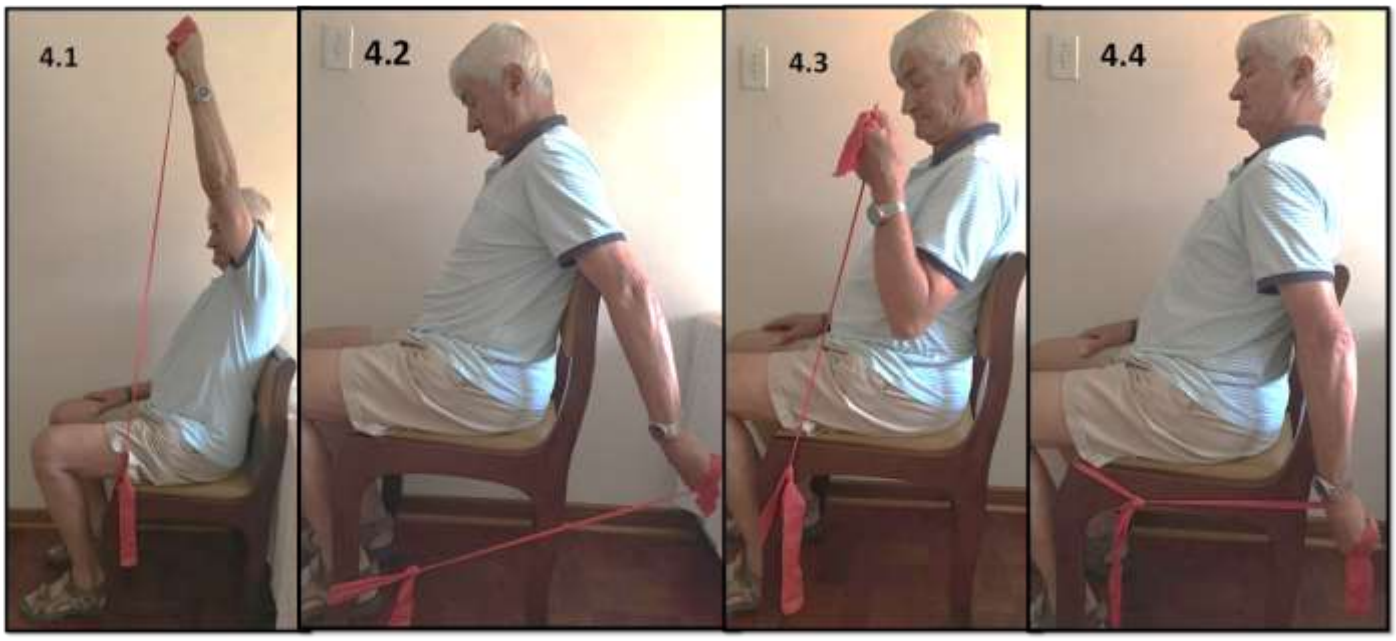
1. Bridging
    a. Lie down on your back.
    b. Slide one heel closer to your buttocks.
    c. Slide the other heel level to the first heel.
    d. Slowly **lift your buttocks** towards the ceiling.
    e. Keep the buttocks in the air for 5 seconds.
    f. Please be careful with this movement if you have a total hip replacement.

2. Deep Breathing
    a. Sit with your back straight and supported.
    b. Keep your shoulders relaxed.
    c. For the following exercises **breath in through your nose** and **out through your mouth.**
    d. When you breath in, push the air as far down into the lungs as you can.
        1. Take a deep breath in and out**.**
        2. Take a deep breath in, hold for 3-5 seconds and breath out.
        3. Take a deep breath in, then sniff backwards through your nose and breathe out.

3. Back Mobility
    a. Sit with your back supported (in front of a mirror if possible).
    b. Cross your arms around your chest holding onto your shoulders.
        1. **Bend forward** with your shoulders. Your elbows should come closer to your thighs.
        2. **Turn from side to side** as far as possible. Please be aware of your wound and stop turning if the movement causes pain on the wound after surgery.

PLEASE NOTE: These exercises are meant to strengthen you before surgery to help with recovery but that does not mean that no complications may arise. **They should not cause you pain.**

4. Resistance Training with Theraband:
    a. Please exercise both your left and right arm.
    b. Tie the exercise band to the front foot of the chair on the same side as you want to exercise.
    c. Sit in the chair with your back supported.
    d. Hold on tightly to the other end of the exercise band or wrap it around your hand.
    e. Slowly do each of the following movements.
        1. Reach for the ceiling.
        2. Move your arm backwards as far as possible.
        3. Bend your elbow, moving your hand to your shoulder.
        4. Straighten your elbow making sure to keep the shoulder still.



5. Walking:
    a. Walk at a comfortable pace for 10 minutes.
    b. If you cannot walk far, march on the spot.
    c. Please try to increase your distance daily.

PLEASE NOTE: These exercises are meant to strengthen you before surgery to help with recovery but that does not mean that no complications may arise. **They should not cause you pain.**

Exercise Log

Patient Number: _____

Start date: _____

Date of surgery: _____

Date	Morning Reps									Feedback	Afternoon Reps									Feedback
	1	2	3.1	3.2	4.1	4.2	4.3	4.4	5		1	2	3.1	3.2	4.1	4.2	4.3	4.4	5	

Chapter 4

4 THE EFFECT OF A PRE-OPERATIVE EDUCATION AND EXERCISE PROGRAMME

A once off pre-operative physiotherapy session focussing on education and exercise may improve the elderly patients' ability to recover physical function post-operatively. This was investigated with this study trial. Chapter 4 will outline the methodology and results of the clinical study according to the CONSORT statement (Schulz *et al.*, 2010).

4.1 METHODOLOGY

This section will describe the study particulars, outcome measures and procedures in detail.

4.1.1 Type of study

This study was a single-blind randomised controlled clinical trial.

4.1.2 Site of Study

This study was started in Rustenburg, South Africa but then moved to Pretoria, South Africa as the researcher relocated. All permissions (from the hospital and surgeons) were obtained following relocation (Appendices J, K, L).

4.1.3 Study Population and Selection

4.1.3.1 Source of participants

The population consisted of all elderly patients who underwent elective abdominal surgery in Midstream Mediclinic, Pretoria. Caring physicians e.g. general surgeons referred potential study participants for inclusion in this study.

4.1.3.2 Sample Selection

4.1.3.2.1 Inclusion criteria

Patients were included if they were:

- 60 years and older.
- Able to walk with or without a mobility aid prior to surgery.
- Scheduled for elective abdominal surgery.

- Proficient in English.
- At least one week delay before surgery.

4.1.3.2.2 Exclusion criteria

Patients were excluded from participation in the following instances:

- Individuals with a known documented diagnosis of dementia or Alzheimer's disease.
- Individuals diagnosed with an acute respiratory tract infection within two weeks of potential study participation.
- The presence of cardiovascular instability in an individual (such as unstable angina and New York Heart Association class 4 heart failure).
- The use of immunosuppressive medication for 30 days before surgery.
- Surgery with associated chest wall manipulation.

4.1.3.3 Sample Size

The sample size was calculated using a power calculation (University of California San Francisco, 2018). The threshold probability for rejecting the null hypothesis (alpha) was set at 5% and the probability of failing to reject the null hypothesis (beta) at 20%. A previous study investigating the effect of pre-surgical intervention on functional capacity (by means of the 6MWT) after surgery, reported effect size of 7.1m ± 11.5m (Carli *et al.*, 2010). When calculated this resulted in an estimated sample size of 82 individuals. To account for drop outs and missing data, this study aimed for a sample size of 100 participants. The goal was to have an equal division of participants, therefore 50 control group and 50 intervention group participants.

Pilot studies are small studies that help design further larger studies that confirm the results (Arain *et al.*, 2010). They encompass many aims such as evaluating feasibility, reviewing instrumentation, identifying problems with data collection, answering methodological questions, planning larger studies or gathering preliminary data for grant applications (Hertzog, 2008). There is a distinct difference between pilot work (background research for further studies), pilot studies (has specific hypotheses, aims and methods) and pilot trials (stand-alone study with randomisation) (Arnold *et al.*, 2009). Even with only a few participants, pilots may lead to a wealth of information regarding difficulties with recruitment, acceptance of interventions, logistics and costs

involved (Hertzog, 2008). Many studies recommend ten participants or 10% of the full study sample (Hertzog, 2008).

Due to confounding variables; recruitment issues and 2019 novel coronavirus (COVID-19) data collection progressed slowly. From the 1st of November 2018 to the 31st of December 2020 limited data was collected. This study will thus be presented as a pilot trial to reflect on the feasibility of a randomised clinical trial, as was planned.

4.1.4 Instrumentation and Outcome Measures

This study evaluated several clinical and functional outcomes as can be seen in Table 4.1.

Table 4.1 Instrumentation Parameters

Instrument/Outcome Measure	Parameter	Appendix number
Demographic Questionnaire	Demographic profile of study participants.	F
Evaluation form	Clinical outcomes e.g. length of hospital stay (LOS), length of ICU stay, length of MV, development of PPC and the first time mobilising out of bed.	G
Functional Comorbidity Index (FCI)	Predicts physical function based on comorbidity data.	H
DeMorton Mobility Index (DEMMI)	Functional mobility tasks within the domains of: bed mobility, chair mobility, static balance, walking and dynamic balance.	I
Lawton-Brody Instrumental Activities of Daily living Scale (IADL)	ADL within the domains of: ability to use a telephone, shopping, food preparation, housekeeping, laundry, mode of transportation, responsibility for own medication, ability to handle finances.	J
Six minute walk test (6MWT)	Exercise tolerance/physical function capacity.	K

4.1.4.1 Clinical Outcome Measures

Clinical outcome measures included LOS in hospital, LOS in ICU, length of MV (where applicable), the development of PPC and the first time the patient mobilised out of bed. The LOS in hospital and ICU was measured in days from the day of admission to discharge. The length of MV and time to first mobilisation was measured in hours from the completion of surgery. The development of PPC was identified by the MGS, when reviewing participants' clinical records.

A study comparing recognition tools for PPC by Agostini *et al.* (2011), found that the MGS is an easy to use tool that correlates well with a clinical diagnosis of PPC, demonstrating good validity. Several clinical symptoms are listed in the MGS and PPC was diagnosed when four or more of these symptoms were present. The MGS was designed to identify PPC that relate directly to physiotherapy and are responsive to physiotherapy intervention (Agostini *et al.*, 2011; Parry *et al.*, 2014; Scholes *et al.*, 2009). The MGS has demonstrated reliable comparable results in recent physiotherapy studies for both abdominal and thoracic surgery (Agostini *et al.*, 2011; Boden *et al.*, 2015; Browning *et al.*, 2007; Haines *et al.*, 2013; Parry *et al.*, 2014; Reeve & Boden, 2016; Samnani *et al.*, 2014; Scholes *et al.*, 2009). Studies using the MGS showed the incidence of PPC 39-42% in elderly UAS patients (Agostini *et al.*, 2011; Boden *et al.*, 2015; Browning *et al.*, 2007; Haines *et al.*, 2013; Parry *et al.*, 2014; Reeve & Boden, 2016; Samnani *et al.*, 2014; Scholes *et al.*, 2009). Table 4.2 is a representation of the MGS.

Table 4.2 MGS PPC Diagnostic Criteria

Diagnosis is confirmed when four or more of the following are present:
• New abnormal breath sounds on auscultation that differs from preoperative assessment • Production of yellow or green sputum that differs from preoperative assessment • Pulse oximetry oxygen saturation (SpO_2) <90% on room air on more than one consecutive post-operative day • Raised maximum oral temperature >38˚C on more than one consecutive post-operative day • Chest radiograph reports collapse or consolidation • An unexplained white cell count (WCC) > $11x10^9$/L • Sputum culture reports presence of infection • Physician's diagnosis of pneumonia, respiratory tract infection, undefined respiratory problem • Prescription of an antibiotic by treating doctor for a respiratory infection

4.1.4.2 Functional Comorbidity Index (FCI)

This index was designed by Groll *et al.* (2005) to predict physical function rather than mortality based on a patient's comorbidity data. Adjusting for comorbidities is essential in order to understand the role of an intervention on physical function. Physical function is generally decreased in elderly patients and is aggravated by the presence of one or more comorbidities. The FCI consists of 18 comorbidities, where severity is not specified. Each comorbidity identified scores one and if absent zero. A higher FCI score (maximum of 18) correlates to greater comorbidities and a greater impairment of physical function one year following the evaluation. These results compare well to the predictive value from the physical function subscale in the Short-Form 36 Health Related Quality of Life questionnaire (SF-36 (PFS)).

The FCI was validated against the SF-36 (PFS) in patients with acute respiratory distress syndrome (Groll *et al.*, 2006) and predictive validity, sensitivity and specificity were established in patients with acute lung injury (Fan *et al.*, 2012). Several methods of data gathering have been investigated including patient reported, hospital discharge summaries and admission records. These methods has been validated and found reliable, however the gold-standard for data collection remains a full medical chart

review (Fan *et al.*, 2012; Groll *et al.*, 2005). Fan *et al.* (2012) established high inter-rater reliability in patients with acute lung injury by reviewing discharge summaries.

For this study, the index was filled out by the participant with assistance from the researcher at baseline and comorbidities were confirmed at discharge from hospital by means of a full medical chart review. When the full chart was not available the discharge summary was used.

4.1.4.3 DeMorton Mobility Index (DEMMI)

The DEMMI, developed by de Morton, Davidson and Keating (2008) evaluates mobility. Mobility can be defined as movement through the change of body position or location, transferring from place or by moving objects (WHO, 2017). Mobility is therefore an integral part of physical function. The DEMMI is the outcome of choice in measuring mobility as it has a lower likelihood of a floor or ceiling effect in elderly patients when compared to the Elderly Mobility Scale and the Timed-Up and Go Test (Said *et al.*, 2012). It is also practical, safe, quick (average time is 10 minutes) and easier to administer. The index scores 15 hierarchical tasks ranging from bedbound to independent mobility, requiring minimal equipment. A raw score out of 19 is converted to the DEMMI score out of 100. The greater the DEMMI score the better the patient's mobility (De Morton *et al.*, 2008). Studies have shown that a change of eight or more DEMMI points relates to a perceived change in mobility by the patient and a score of ten or more points indicate a significantly relevant change (De Morton & Lane, 2010).

Validity, reliability and normative values have been established for elderly patients in acute hospital (De Morton *et al.*, 2008), sub-acute hospital (De Morton & Lane, 2010) and community dwelling settings (Davenport & De Morton, 2011) as well as for the individuals transitioning from a hospital to community setting (De Morton *et al.*, 2011). Convergent and discriminant validity as well as known groups (face, construct, content and criterion) validity is demonstrated in elderly patients in these different settings (Davenport & De Morton, 2011; De Morton *et al.*, 2008, , 2011; De Morton & Lane, 2010). Two of these studies also report high inter-rater reliability (Davenport & De Morton, 2011; De Morton & Lane, 2010). Scores for older adults living independently is ≥67 (median 83.5; 95% CI 82.5 – 85.4) and elderly living semi-independently is ≥48 (median 73.1; 95% CI 73.1 – 79.9). Normative DEMMI scores decrease with every ten

year age interval from 60 to 90+ years of age (DEMMI score 85 and 62 respectively) (Macri *et al.*, 2012).

The researcher assessed the participants' mobility with the DEMMI at baseline, on discharge from the hospital and again two weeks after surgery.

4.1.4.4 Lawton Brody Instrumental Activities of Daily Living (IADL)

This tool assesses the functional status of a patient (Vittengl *et al.*, 2006). The Lawton-Brody IADL is more relevant for the study population than the Katz Index which focuses on basic tasks such as bathing, dressing and feeding. The skills assessed with the Lawton-Brody IADL relies on a combination of cognitive and physical function. If a participant does not need to do a specific task it is omitted (some men don't have to cook, clean or do laundry) as this does not equate to lack of function (Graf, 2008; Lawrence *et al.*, 2004; Vittengl *et al.*, 2006). Information regarding these tasks is gathered through a participant-researcher interview, where questions are asked and based on clinical relevance. The higher the Lawton-Brody IADL score the higher the patient's independence with these tasks (Graf, 2008). The researcher assesses if the participant feels more able (score 1) or less able (score 0) to perform each task and how the participant accommodates for any inabilities. This dichotomous scoring system has been modified into more complex versions (trichotomous (1, 2, 3) and even polytomous (1-5) scoring) (Vittengl *et al.*, 2006). Some studies have also converted the total score into a Rasch score.

Seven scoring methods have been tested and all demonstrates similar validity in measuring functional status in rural elders (Vittengl *et al.*, 2006). Since the development of this scale in 1969 it has been translated and shown to be valid and reliable in many elderly populations, including Spanish individuals (Vergara *et al.*, 2012; Vittengl *et al.*, 2006). This tool has been proven valid and reliable with high reproducibility coefficients (Graf, 2008).

For the purpose of this study, dichotomous scoring was used but the sum was converted into a Rasch score for better analysis. The researcher interviewed the study participant to determine the Lawton-Brody IADL score at baseline and again at the two week follow up time point after surgery.

4.1.4.5 Six Minute Walk Test (6MWT)

This widely used and frequently recommended test is used to evaluate functional exercise capacity; by measuring the distance an individual can walk on a flat surface in six minutes (Crapo *et al.*, 2002; Hijazi *et al.*, 2017). All components of functional walking capacity is measured in the 6MWT, including balance, speed, coordination and endurance (Carli *et al.*, 2010; Steffen *et al.*, 2002). The 6MWT is designed to measure a submaximal level of function set by the participant, resulting in a better reflection of ADL as affected by exercise capacity. The participant may also stop to rest at any time and resume walking at their discretion. Research shows that the 6MWT is easy to administer, better tolerated by patients than other exercise capacity outcome measures and has the ability to detect change in clinical status (Bellet *et al.*, 2012; Hijazi *et al.*, 2017). A change of 20 meters or more is considered statistically significant in elderly individuals undergoing abdominal surgery e.g. colorectal surgery (Carli *et al.*, 2010).

Strong test-retest reliability, construct validity and responsiveness to change has been shown in outpatient cardiac rehabilitation (Bellet *et al.*, 2012). The 6MWT is also a valid measure (in terms of known group validity and sensitivity) in the post-surgical elderly population (Moriello *et al.*, 2008).

A predictive equation was used to calculate study participants' expected 6MWT distance (Duncan *et al.*, 2015). Duncan *et al.* (2015) formulated and validated the following predictive equations in a population of patients consisting of elderly individuals:

$$\text{Distance (male)} = (290.6) \times (\text{height in cm}^{0.525}) \times (\text{body mass in kg}^{-0.317}) \times \text{exponential}(-0.009 \times \text{age})$$

$$\text{Distance (female)} = (260.3) \times (\text{height in cm}^{0.525}) \times (\text{body mass in kg}^{-0.317}) \times \text{exponential}(-0.009 \times \text{age})$$

The 6MWT was administered to study participants by the researcher at baseline, discharge from hospital and at the two week follow up after surgery. The test followed the guidelines set out by the American Thoracic Society (Crapo *et al.*, 2002). A flat,

quiet, 30m corridor was used to administer the 6MWT, thereby complying with the gold-standard (Crapo *et al.*, 2002).

4.1.5 Procedure

The procedure related to the clinical study is outlined below for review.

4.1.5.1 Preparatory work

After the compilation of the exercise and education pamphlet (*see Chapter 3*) several preparatory tasks were completed in order for the study to be successful. These tasks included obtaining necessary permissions and liaising with specialists regarding study participant recruitment, generation of randomisation lists (Appendix L) and study concealment envelopes, training of the research assistants and the collection of study materials e.g. printing pamphlets and acquiring strength resistance bands.

4.1.5.1.1 Permissions

The researcher met with the hospital managers of Medicare and Life Peglerae in Rustenburg, to provide an information letter and request permission to evaluate participants on discharge and retrospectively review hospital files *(Appendix M).* The approved protocol, researcher's curriculum vitae and ethics approval letter was sent to the relevant Head Office, where approval was granted for the study to be completed in these hospitals *(Appendix N).*

Following the hospital approval the researcher met with Marius deBruyn and Gian Jacobs (the researcher's employers at the time), to provide them with an information letter. Permission for the use of a treatment room as well as permission to perform the study within business hours was obtained during this meeting *(Appendix O).*

The researcher then visited specialists performing abdominal surgery in Rustenburg to obtain their cooperation. They were provided with two relevant articles and an information page with a copy of the inclusion and exclusion criteria (*Appendix P).* Each willing specialist signed an agreement (*Appendix Q).*

When the study was relocated to Pretoria (as a result of the researcher relocating), an amendment letter (*Appendix R)* was sent to the Ethics Committee and approval for the site change was granted (*Appendix B).* The researcher followed the same process as

was conducted in Rustenburg with Midstream Mediclinic *(Appendix S),* Monique Bergh; new employer *(Appendix T),* and the relevant surgeons *(Appendix U).*

4.1.5.1.2 Randomisation and Concealment

Matched randomisation was done through a computerised random allocation generator at the University of Witwatersrand, by the study supervisor assisted by a statistician using Microsoft Excel (*Appendix L*). Participants were matched by FCI score and age category prior to random allocation. Matched randomisation allowed an even distribution of characteristics between the control and intervention groups. Group allocations were placed in sealed brown envelopes for concealment and given to the researcher. The researcher gave the sealed envelopes to the physiotherapy practice receptionist, along with a chart to keep track of participants' allocations (*Appendix V)*. To ensure blinding, the researcher did not have access to the envelopes or the chart during the course of the study.

4.1.5.1.3 Training Assistants

Two colleagues at Bergh and Cilliers Physiotherapists Private Practice were appointed as research assistants in order to insure availability for the duration of the clinical study. The function of the research assistants were to conduct the once-off face-to-face pre-operative education and exercise session with the intervention group participants. Each research assistant received a copy of the finalised education and exercise pamphlet to review. One week later a meeting was set where the researcher trained the assistants to ensure congruency. The following week each research assistant treated the researcher as they would a study participant. Minor adjustments and suggestions were made to further enhance similarity between research assistants when conducting face-to-face sessions with study participants.

4.1.5.1.4 Other

During this time, two different strength resistance bands were ordered, participant files and education material was printed and sorted. The receptionist was shown which forms were to be given to the participant to complete, how to manage the allocation envelopes and write receipts for travel reimbursements. Another function of the receptionist was to contact the available research assistant when the participant was allocated to the intervention group or alternatively give the education pamphlet to the

control participants. Phone numbers of the research assistants were given to participants in order to answer any queries participants might have.

4.1.5.2 Pilot study

The aim of the pilot study was to determine the time needed to perform assessments, to highlight any challenges related to data collection and to streamline the process. The pilot study was conducted on 10% of the sample population. Due to challenges encountered with data collection (*see section 4.3)* only a pilot study was completed.

4.1.5.3 Procedure

Procedure for the pilot study was as follows.

1. Referred patients were given a 30 minute evaluation appointment with the researcher, at the physiotherapy practice. If the participant had available time, the appointment was immediately following the consultation with the surgeon. If not patients were phoned to make an appointment. Patients were asked to arrive 15 minutes earlier for the completion of documents. The day before their appointment the researcher sent a reminder via SMS.
2. The study process, inclusion and exclusion criteria, as set out in the information letter *(Appendix D),* were explained to the study participants and informed consent was obtained from each study participant (*Appendix D)* on arrival at the practice.
3. All study participants completed the coding form *(Appendix W),* demographic questionnaire *(Appendix F)* and the FCI *(Appendix H).* The researcher was available to answer any questions.
4. The researcher performed and recorded baseline measurements in a quiet room in the private practice. Prior to each measurement being conducted its aim was explained.
    4.1 The DEMMI was carried out and recorded *(Appendix I)* starting in supine on the same plinth with each participant. Standardized procedure and instructions were followed *(Appendix X).*
    4.2 The Lawton-Brody IADL interview was conducted and recorded *(Appendix J)* with the participant comfortably seated.
    4.3 The participant was accompanied to a chair in a quiet corridor of the building, just outside the private practice, for the 6MWT. The same chair was used for

each evaluation. The 6MWT was carried out and recorded *(Appendix K).* Standard instructions and protocol were followed *(Appendix Y).*

4.4 The researcher offered the participant a drink of water and accompanied them back to the consultation room.

5. The researcher explained the rest of the study procedure to the patient, then left the office. This was necessary to ensure blinding of the researcher.
6. While the researcher was busy with the evaluation, the receptionist determined the study allocation group and documented it on her chart *(Appendix V).* Allocation to groups was concealed. Participants were thus allocated to either the intervention or control group. When the participant was allocated to the intervention group, the receptionist informed the available research assistant.
7. The receptionist then entered the consultation room and informed the participant to which group they were allocated to.
    a. If the participant was allocated to the control group, the receptionist handed them the education section (page 1 and 2) of the pamphlet (*Section 3.6*) and escorted them out of the private practice. Pre-operative education is strongly advised within ERAS guidelines and is considered standard treatment among many practices, especially when managing elderly patients (Boden, Skinner, *et al.*, 2017; Patman *et al.*, 2017; Reeve & Boden, 2016). Thus, education pamphlets were used as control for this study.
    b. The intervention group participant was asked to wait for the research assistant. Neither the patient nor therapist was blinded to group allocation.
8. The research assistant demonstrated and explained all the exercises as shown in the complete pamphlet including the exercise section (*Section 3.6*). Participants were encouraged to perform all exercises with the supervision of the research assistant as means of clarifying queries that participants might have regarding the exercises and ensure correctness during execution. Participants were asked to do the exercises twice a day until the day of surgery at home, during hospitalisation and for two weeks post-surgery. Participants were asked to keep a record of compliance with exercises done.
9. The receptionist gave each participant R50 to compensate for travel expenses occurred before they left the private practice.
10. The research assistant was available telephonically for any questions from all participants.

11. After surgery both groups received inpatient physiotherapy as was needed. Standard protocol of hospital treatment included assisted early mobilisation and DBE with cough support.
12. The treating physiotherapist informed the researcher of when a participant was scheduled for hospital discharge.
13. The researcher met the participant in the hospital.
    a. The DEMMI and 6MWT was evaluated in exactly the same manner as described in bullets 4.1 and 4.3. Chair height was measured to match the chair used on baseline evaluation.
    b. The researcher also made a follow-up appointment to suit the participant for final study assessment.
    c. The hospital file was examined in order for the researcher to document clinical outcomes *(Appendix G)* and FCI score *(Appendix H).*
14. The day before the appointment the researcher sent a reminder to the participant via SMS.
15. The researcher re-evaluated all participants in exactly the same manner as described in step four at the final study assessment. The researcher did not have the previous assessment records with her. This allowed for consistency in the assessment and reduced the potential for bias.

4.1.5.4 Challenges

Challenges were identified during the recruitment process of the study. Once the researcher noted a low rate of referral the following steps were implemented to attempt to increase the recruitment rate.

- Visits to the surgeons' rooms were implemented to clarify any queries related to the study.
- Surgeons were reminded about the study on ward rounds.
- Surgeons and receptionists were asked to refer patients if applicable for participation on the same day as the consultation where surgery was decided upon to lessen travel for participants.
- Posters and pamphlets related to the study were made and distributed in the surgeons rooms for potential participants' review (*See Appendix Z*)

In May 2020 a short questionnaire was developed by the researcher to obtain feedback from the surgeons and their receptionists to assist with the recruitment process. This was e-mailed to the surgeon and their receptionists or the researcher met with the relevant surgeon depending on their preference. The questionnaire consisted of three questions:

1. What, if anything prevented you from sending or referring patients as participants for this research study?
2. What do you suggest could I have done differently to assist with this process?
3. How would you suggest I recruit participants?

The COVID-19 pandemic in 2020 impacted the recruitment process for this clinical study and will be elaborated on in the results section of the chapter.

After completion of data collection of the study, data was coded and analysed by the researcher with assistance from the supervisor and a statistician.

4.1.6 Statistical Analysis

IBM SSPS version 27 software was used for data-analysis. A statistician was consulted when needed. Intention to treat (ITT) analysis was done to account for missing data. Intention to treat analysis accounts for each participant within their randomised group (Gupta, 2011). Depending on the data, either the group average or the previous assessment's data was imputed. The Shapiro-Wilk Test was used to determine normality of data as it is more objective than graphical tests (Lund & Lund, 2013). To determine differences between groups the independent T-test, Pearson's Chi-squared test or Mann-Whitney U test was used dependent on whether data were normally distributed or not. Data will be presented to two decimal points unless p-value is smaller than 0.01, in which case three decimal points will be reported.

Effect sizes (ES) reflect the magnitude of a correlation or difference and consequently help to determine the clinical significance (Pautz *et al.*, 2018). Effect size can successfully be compared among studies as it is not dependent on sample size (Pautz *et al.*, 2018) and will therefore be reported as Hedges' correction (g). Hedges' g more accurately reflects ES in sample sizes smaller than 20 when compared to Cohen's d (Pautz *et al.*, 2018).

Table 4.3 Statistical Parameters

Objective	Type of Data	Analysis between Groups	Analysis within Groups
1. Describe demographics, pre-operative physical function and ADL status	Nominal and Ordinal	Frequencies and Central Tendencies reported as the Mean (Standard Deviation (SD)) or Median (Interquartile range (IQR))	
2. Effect of intervention on Clinical outcomes	Ratio and Interval	Frequencies and Central Tendencies reported as the Mean (SD) or Median (IQR)	
Effect of intervention on physical function and ADL as measured at discharge and two weeks post-operatively			
FCI	Nominal	Frequencies and Central Tendencies reported as the Mean (SD) or Median (IQR)	
DEMMI	Interval	T-test	Repeated measure ANOVA
6MWT	Ratio	T-test	Repeated measure ANOVA
Lawton-Brody IADL	Nominal	T-test	Paired samples sign test
3. Relationship between PPC and physical function	Nominal	Pearson's Chi square	
4. Adherence to protocol exercises	Ordinal	Frequencies and Central Tendencies reported as the Mean (SD) or Median (IQR)	

4.2 RESULTS

The flow of study participants are outlined in Figure 4.1 below.

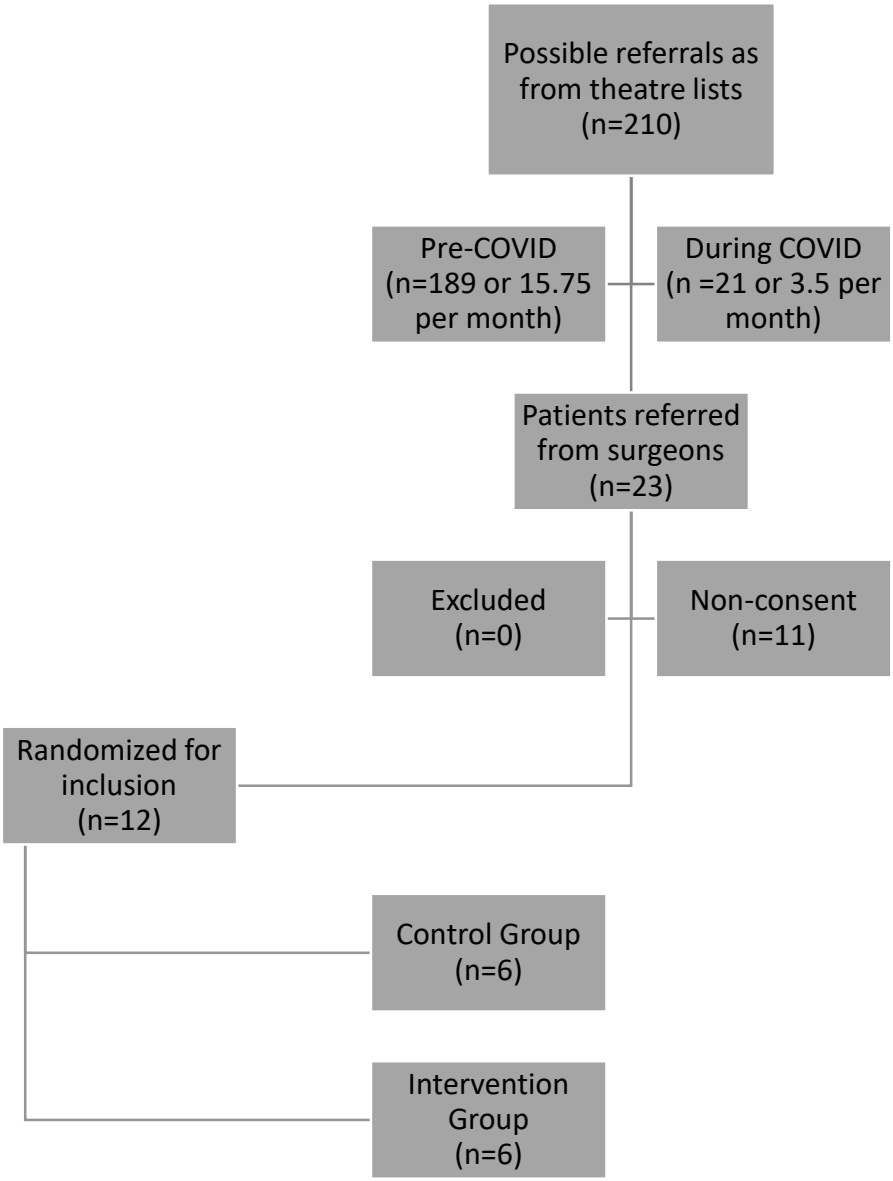


Figure 4.1 Number of Participants and Allocated Groups

4.2.1 Demographic Information

This study consisted of 12 participants (female n=11, 91.67%; male n=1, 8.33%), with a mean age of 65.75 (± 4.47) years and body mass index (BMI) of 27.89 (±4.09) kg.m^2. Most participants (n=10, 83.33%) did not smoke, while two participants (16.67%) reported having a smoking history. The majority of participants lived independently (n=9, 75%) and three participants (25%) had caregivers at home. Only two participants (16.67%) did not engage in any sport or physical activity prior to inclusion in the study. Physical activity preferences amongst the other participants included walking (n=6,

50%), stretching (n=1, 8.33%), house chores and gardening (n=2, 16.67%) or a combination of multiple activities such as swimming, biking and rowing (n=1, 8.33%).

Most participants were scheduled for an open-laparotomy (n=10, 83.33%) as opposed to a laparoscopic procedure (n=2, 16.67%). Gynaecological operations (n=10, 83.33%) were the most common, with only two general surgery procedures (16.67%). Most participants had LAS (n=10, 83.33%) and only two UAS procedures took place (16.67%).

The control and intervention groups were demographically similar (see Table 4.4) with p-values greater than 0.05 for gender, age, smoking history, activity levels, living conditions and surgery specifics.

Table 4.4 Comparison of Demographics at Baseline

Demographic Mean (± SD) or % (n)	**Cohort (n=12)**	**Control (n=6)**	**Intervention (n=6)**	**p-value**	**Effect Size** g (95% CI)
Gender (% Female, n)	91.67 (11)	83.33 (5)	100 (6)	0.36	-0.53 (-1.59;0.55)
Age (years)	65.75 (± 4.47)	65.83 (± 3.87)	65.67 (± 5.39)	0.95	0.03 (-1.01;1.08)
BMI (kg/m^2)	27.89 (±4.09)	25.49 (± 3.32)	30.29 (± 3.46)	0.03	-1.31 (-2.47;-0.09)
Smoking History (% Non-smokers, n)	83.33 (10)	83.33 (5)	83.33 (5)	0.54	0.34 (-0.73;1.38)
Activity Levels (% Active, n)	83.33 (10)	83.33 (5)	83.33 (5)	0.38	0.49 (-0.59;1.55)
Living Conditions (% Independent, n)	75 (9)	66.67 (4)	83.33 (5)	0.55	0.33 (-0.73;1.38)
Surgery Type (% Gynaecological, n)	83.33 (10)	66.67 (4)	100 (6)	0.20	0.78 (-0.34;1.86)
Surgery Method (% Laparotomy, n)	83.33 (10)	83.33 (5)	83.33 (5)	1.00	0.00 (-1.13;1.13)

BMI (Body Mass Index), kg/m^2 (kilograms per meter squared)

The only statistically significant difference was mean BMI measured for control (25.49 ± 3.32) and intervention (30.29 ± 3.46) groups (p-value 0.03 ≤ 0.05).

4.2.2 Pre-operative Physical Function and Daily Living Status

The pre-operative physical function of each participant was determined using the FCI, DEMMI and the 6MWT. The Lawton-Brody. IADL was used to assess independency in several domains of daily living. The results for each outcome measure at baseline will be presented.

4.2.2.1 Functional Comorbidity Index (FCI)

The mean FCI score of the study cohort (n=12) was 3 (±1.12). The FCI consists of 18 comorbidities, where severity is not specified. The following conditions were most prevalent among participants: arthritis and back disease respectively (n=7, 58.33%), visual impairments (n=4, 33.33%), osteoporosis (n=3, 25%) and upper gastrointestinal conditions (n=3, 25%). Conditions with only one response (n=1, 8.33%) included chronic obstructive lung disease, congenital heart failure, stroke, diabetes and obesity. Both depression and angina were comorbidities listed by two (16.67%) participants. No participants suffered from comorbidities such as asthma, previous heart attack, neurological diseases, peripheral vascular disease or anxiety and panic disorders.

When comparing the baseline percentage 6MWT distance achieved to the baseline FCI score a strong negative correlation was observed (r= -0.792, p=0.002).

4.2.2.2 DeMorton Mobility Index (DEMMI)

The median DEMMI score was 79.50 (IQR 74 - 96.25) of the study cohort (n=12). Participants mostly struggled with the balance component measured within the 15 hierarchical tasks. Three participants (25%) scored the maximum score of 100 and one participant (8.33%) showed a marked decrease in mobility with a score of 48. Most participants (n=11, 91.67%) were able to mobilise independently with one (8.33%) requiring a walking stick.

4.2.2.3 Six Minute Walk Test (6MWT)

The median distance participants managed to walk in six minutes was 435.50 meters (IQR 364.75 – 458.50 meters). The expected distance a participant should be able to mobilise was calculated using gender, age, height and weight. The percentage 6MWT distance achieved was 81.90% (IQR 64.63 – 87.62%). During testing the mean change in dyspnoea from pre-test to post-test was 2.58 (±2.23) and fatigue 1.83 (±1.19) on the

Borg Scale. Only two (16.67%) participants needed to stop and rest during testing, with one (8.33%) stopping short of the six minute mark.

4.2.2.4 Lawton-Brody Instrumental Activities of Daily Living Scale (IADL)

The mean score for IADL of the study cohort was 95% (±17.32). Only one (8.33%) participant did not score 100% but had a caregiver at home, who took care of most house hold tasks and IADL.

4.2.2.5 Baseline group characteristics

A summary of the pre-operative physical function between groups can be seen in Table 4.5.

Table 4.5 Comparison of Physical Function at Baseline

Physical Parameter Mean (± SD) or Median (IQR)	**Cohort (n=12)**	**Control (n=6)**	**Intervention (n=6)**	**P-value**	**Effect Size** g (95% CI)
FCI (conditions)	3 (± 1.13)	3.17 (± 1.47)	2.83 (± 0.75)	0.63	0.26 (-0.79;1.31)
DEMMI (score out of 100)	79.50 (74 – 96.25)	87 (67.50 – 100)	79.50 (74 – 85)	0.74	0.19 (-0.87;1.23)
6MWT Distance (meters)	435.50 (364.75 – 458.50)	448 (293.50 – 468.25)	435.50 (393 – 441.25)	0.67	-0.24 (-1.28;0.82)
6MWT Predicted (meters)	535.62 (514.39 – 550.47)	544.09 (526.08 – 608.05)	523.70 (502.30 – 541.65)	0.08	1.09 (-0.08;2.22)
6MWT % of Predicted Distance (%)	81.90 (64.63 – 87.62)	79.82 (52.40 – 88.66)	81.90 (73.69 – 86.11)	0.47	-0.40 (-1.45;0.67)
Lawton-Brody IADL (score out of 100)	100 (100 – 100)	100 (85 – 100)	100 (100 – 100)	0.36	-0.53 (-1.59;0.55)

6MWT (Six minute walk test), DEMMI (DeMorton Mobility Index), FCI (Functional Comorbidity Index), IADL (Instrumental Activities of Daily Living)

Both groups were similar at baseline with regards to physical function as no statistical significant differences were noted.

4.2.3 Pre-operative Education and Exercise Programme

Matched randomisation on participants allowed for an even distribution of control (n_c=6, 50%) and intervention (n_i=6, 50%) participants. As shown in the previous sections (4.2.1 and 4.2.2), both groups were comparable at baseline. This pilot study aimed to explore and measure the preliminary effect of the intervention on clinical outcomes and physical function parameters.

4.2.3.1 Effect of the pre-operative education and exercise programme on clinical outcomes

Clinical outcomes analysed were hospital LOS, possible ICU stay and MV time, development of PPC and time of first mobilisation out of bed following surgery. Participants who underwent a laparotomy (n=10, 83.33%) stayed three (n=3, 30%) or four nights (n=7, 70%) in hospital. Participants who underwent laparoscopic procedures (n=2, 16.67%) stayed only one or two nights (n=1, 50% respectively). No participants were admitted to the ICU or required MV post-operatively.

Six participants (50%) did not develop any signs of PPC, one participant (8.33%) showed signs of PPC on the day of theatre and five participants (41.67%) the first day post operatively. Two of the six participants who did develop PPC were in the intervention group (33.33%) and four in the control group (66.67%). The signs developed included shortness of breath (n=3, 50%) and a productive cough with purulent sputum (n=3, 50%), however no participants were diagnosed with PPC according to the MGS. Half of the participants who developed symptoms (n=3, 50%) reported an improvement following one physiotherapy session and only one participant needed multiple physiotherapy sessions for the symptoms to improve.

The mean time from surgery to first mobilisation out of bed was 20 hours (± 2 hours and 44 minutes). The median distance mobilised at that time was 90m (IQR 60 – 245) for the control group and 177m (IQR 100 – 242.5) for the intervention group. No participants mobilised prior to their physiotherapy session the morning following their surgery.

Table 4.6 outlines the clinical outcomes as measured in the cohort as a whole and respective groups.

Table 4.6 Comparison of Clinical Parameters

Clinical Parameter Mean (± SD) or Median (IQR) or % (n)	**Cohort (n=12)**	**Control (n=6)**	**Intervention (n=6)**	**P-value**	**Effect Size** g (95% CI)
LOS Hospital (days)	4 (3.25 – 4)	4 (2.50 – 4)	4 (3.50 – 4)	0.59	-0.30 (-1.34;0.76)
Surgery Duration (minutes)	181.50 (164 – 209.25)	184 (125.75 – 203.75)	181.50 (154.75 – 219)	0.59	-0.30 (-1.34;0.76)
PPC incidence (% Yes, n)	50 (6)	66.7 (4)	33.3 (2)	0.57	0.60 (-0.49;1.66)
Time from surgery to first mobilisation (hours. minutes)	20 (± 2.44)	20.21 (± 2.16)	19.41 (± 2.83)	0.59	0.29 (-0.76;1.34)
Distance of first mobilisation (meters)	130 (85 – 225)	90 (60 – 245)	177 (100 – 242.50)	0.86	-0.10 (-1.14;0.95)

LOS (Length of Stay), PPC (Post-operative Pulmonary Complications)

No statistical differences between-groups were observed with the clinical outcomes measured in this study. It is however important to highlight that less incidence of PPC was noted in the intervention group and this group also walked further during their first time out of bed.

4.2.3.2 Effect of pre-operative education and exercise programme on physical function and daily living status

Physical function (DEMMI and 6MWT) was measured at three time points; baseline, hospital discharge and with doctor's follow-up after hospital discharge. The other two parameters were measured twice; FCI at baseline and hospital discharge and IADL at baseline and follow-up after hospital discharge.

4.2.3.2.1 Analysis between Groups at Hospital Discharge and Final Follow-Up

Table 4.7 provides information of the physical function parameters of study participants at hospital discharge.

Table 4.7 Comparison of Physical Parameters as Measured at Hospital Discharge

Physical Parameter Mean (± SD) or Median (IQR)	**Cohort (n=12)**	**Control (n=6)**	**Intervention (n=6)**	**P-value**	**Effect Size** g (95% CI
FCI (conditions)	2.67 (± 1.03)	3.17 (± 1.53)	3.67 (± 1.86)	0.28	-0.61 (-1.68;0.48)
DEMMI (score out of 100)	74 (74 – 82.25)	74 (69.75 – 76.75)	74 (69.75 – 85)	0.71	-0.21 (-1.25;0.85)
6MWT Distance (meters)	347 (336.25 – 380)	340.50 (318.75 – 353)	376 (319.5 – 382.75)	0.61	-0.28 (-1.32;0.78)
6MWT % of Predicted Distance (%)	64.69 (54.84 – 72.77)	60.24 (53 – 66.68)	70.78 (59.85 – 74.67)	0.27	-0.63 (-1.69;0.47)

6MWT (Six minute walk test), DEMMI (DeMorton Mobility Index), FCI (Functional Comorbidity Index)

Control and intervention groups were comparable ($p \geq 0.05$) at hospital discharge. It is important to highlight that clinically the intervention group was able to walk further during the 6MWT at hospital discharge and also reach a higher percentage of their predicted value of the 6MWT at this time point.

Table 4.8 provides information on the physical function parameters as measured at follow-up after hospital discharge. The mean time from discharge to follow-up was 29.75 (± 5.58) days.

Table 4.8 Comparison of Physical Parameters as Measured with Follow-up

Physical Parameter Median (IQR)	**Cohort (n=12)**	**Control (n=6)**	**Intervention (n=6)**	**P-value**	**Effect Size** g (95% CI
DEMMI (score out of 100)	100 (85 – 100)	92.50 (82.25 – 100)	100 (93.50 – 100)	0.63	-0.26 (-1.31;0.79)
6MWT Distance (meters)	413 (369.75 – 439.25)	422.50 (368.25 – 440)	397 (333 – 426)	0.84	0.47 (-0.60;1.52)
6MWT % of Expected Distance (%)	74.60 (63.73 – 83.24)	74.27 (62.65 – 83.35)	74.60 (63.45 – 83.32)	0.15	0.1 (-0.94;1.15)
Lawton-Brody IADL (score out of 100)	100 (92.50 – 100)	95 (81.25 – 100)	100 (100 – 100)	0.15	-0.90 (-1.99;0.24)

6MWT (Six minute walk test), DEMMI (DeMorton Mobility Index), IADL (Instrumental Activities of Daily Living)

Control and intervention groups were comparable ($p \geq 0.05$) at follow-up after hospital discharge.

4.2.3.2.2 The effect of time and pre-operative intervention on physical function

Analysis within groups (cohort (n=12), control (n=6) and intervention (n=6)) at different time points (baseline, hospital discharge and follow-up) was also done to determine the effect of the intervention on physical function as measured by the DEMMI and 6MWT, when taking into account the time factor.

Analysis over time looked at the change in the cohort as a whole (n=12). A repeated measure ANOVA determined that the overall DEMMI score differed statistically between time points ($F(2,22)=8.19$, $p=0.002$). Post hoc tests using the Bonferroni correction revealed that physical mobility as measured by the DEMMI, decreases following surgery (81.08 (± 4.32) at baseline to 73.92 (± 2.67) at discharge), however it was not statistically significant ($p=0.72$). From discharge to follow-up (93.17 (± 3.07)) mobility again increased ($p=0.002$).

When analysing the control and intervention group separately to highlight between-group differences the DEMMI score did not differ between time points for the control group (F(2,10)=2.19, p=0.16), but did differ for the intervention group (F(2,10)=8.96, p=0.006). A visual presentation of this difference can be seen in Figure 4.2. The Bonferroni correction showed that mobility decreased slightly from baseline to hospital discharge. It should be noted that the intervention group's (79.50 (± 2.46) to 74.83 (± 4.19)) reduction in function was less than the control group's (82.67 (± 8.67) to 73 (± 3.67)) reduction. The DEMMI scores improved following hospital discharge to follow-up after hospital discharge for both the control and intervention groups (90.67 (±4.49), p=0.10 and 95.67 (± 4.33), p=0.05) respectively. The intervention group's mobility improved significantly more than the baseline finding with follow-up assessment (p=0.03) compared to the control group's (p=1.00).

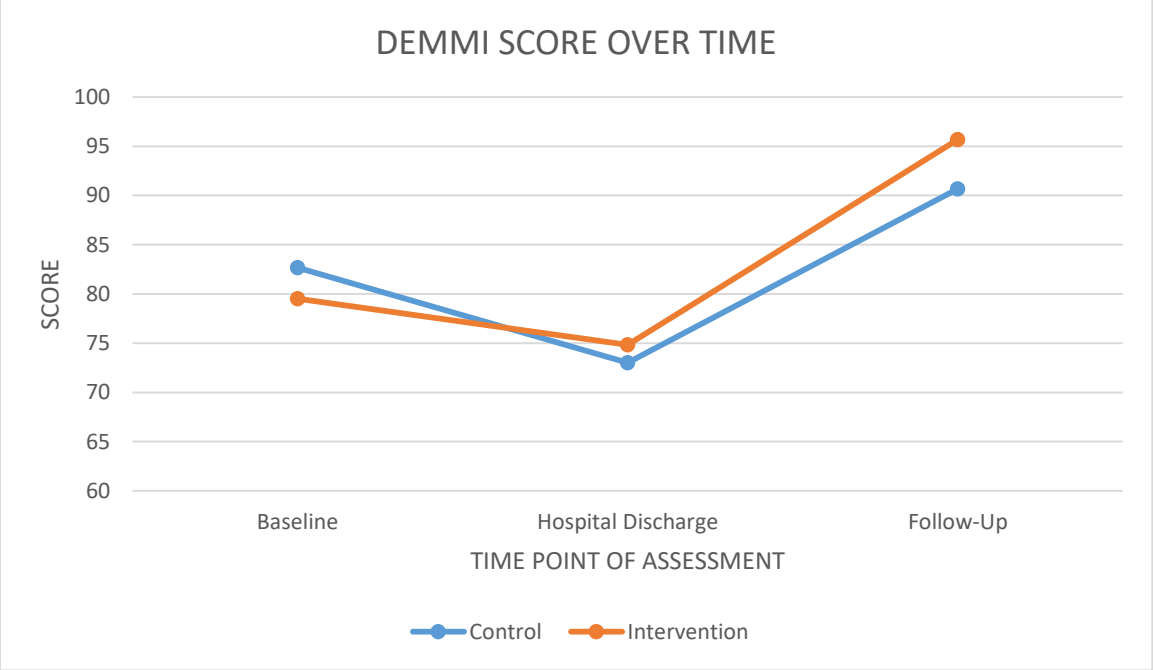


Figure 4.2 DEMMI Score Over Time

A repeated measure ANOVA with a Greenhouse-Geisser correction, determined that the overall 6MWT (n=12) score did not differ statistically between time points (F(1.23,13.51)=4.24, p=0.05). Further analysis however revealed statistical differences between control and intervention groups. The control group did not differ between time points when analysed with the repeated measure ANOVA and Greenhouse-Geisser correction (F(1.06,5.29)=1.64, p=0.25). On the other hand, the intervention group conformed to sphericity and differed significantly (F(2,10)=18.18, p < 0.0005).

Post hoc tests with the Bonferroni correction revealed that physical capacity as measured with the 6MWT, decreased following surgery (413.33 (± 22.85) at baseline to 350.17 (± 25.07) at discharge, $p < 0.0005$). From discharge to follow-up (376.33 (± 32.13)) mobility again increased though not statistically significantly ($p=0.20$) and not more than baseline as can be seen in Figure 4.3.

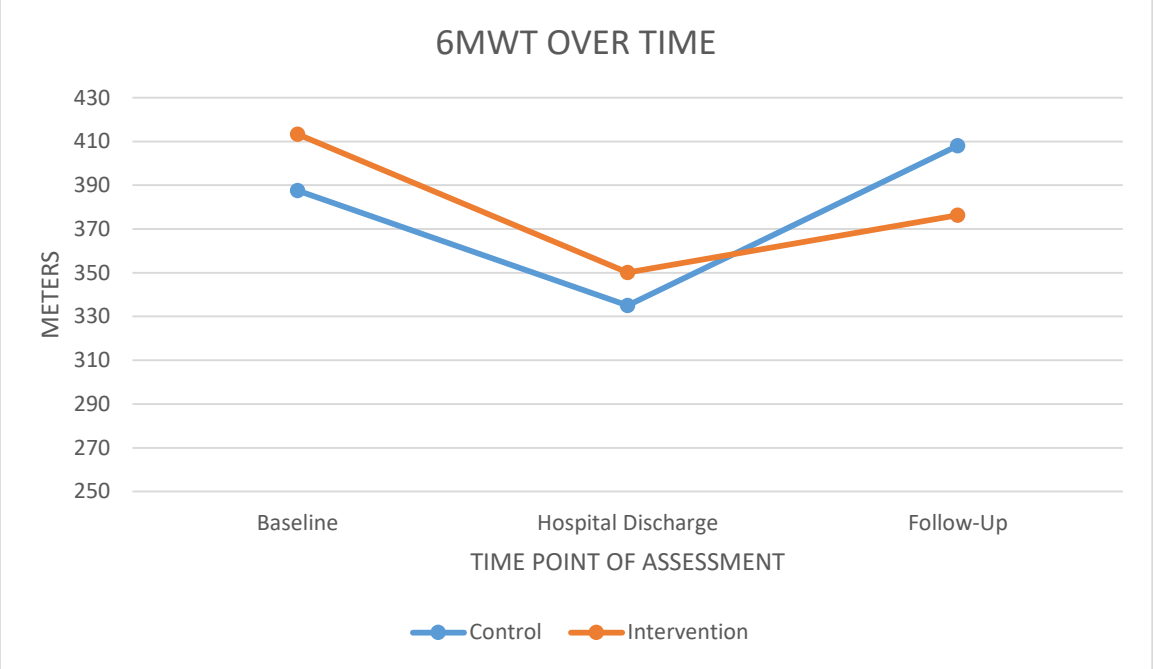


Figure 4.3 6MWT Distance Over Time

4.2.4 Relationship Between PPC and Physical Function

Physical function was measured with the DEMMI and 6MWT. PPC incidence was reported in Section 4.2.3.1. When applying the Pearson Chi-square test it indicated that the baseline DEMMI score was associated with PPC incidence ($p=0.03$) but the 6MWT distance was not ($p=0.440$). The higher the DEMMI score, the less likely the participant was to develop a PPC.

4.2.5 Adherence to Protocol Exercises

From the six participants in the intervention group, four participants (66.67%) completed the exercise feedback form. Participants were asked to exercise twice daily and record their walking time. Exercises started from baseline evaluation up to surgery and continued from hospital discharge to follow-up. Pre-surgical adherence to the intervention group instructions was calculated using the amount of exercise days self-

reported divided by the days from baseline evaluation to surgery. Similarly post-surgical adherence was calculated using self-reported exercise days from discharge to final evaluation. The mean adherence to exercise was 53.78% (± 30.45%) before surgery and 62.83% (± 30.36%) following surgery.

Two participants walked for shorter times more often, where the other two walked longer less regularly. The mean time mobilised per day prior to and after surgery can be seen in Figure 4.4. Three participants mobilised more or less the same amount of time per day pre- and post-operatively. One participant mobilised considerably less post-surgery.

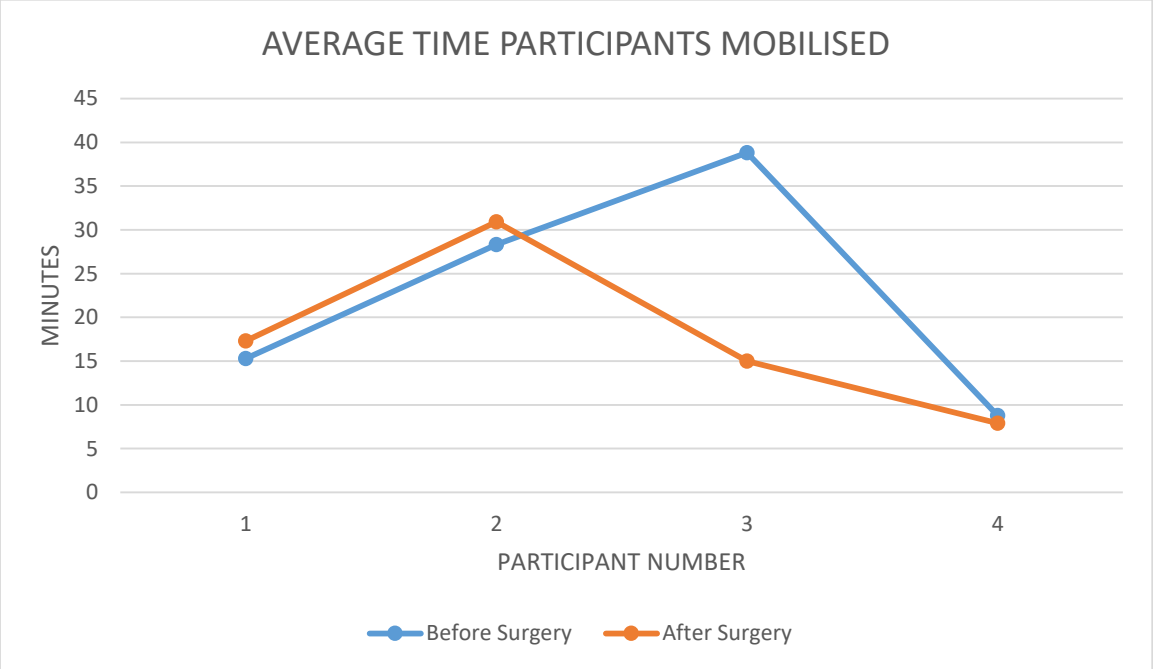


Figure 4.4 Average Time Participants Mobilised per Day

4.3 CHALLENGES

Recruitment rate was low, as only 10.95% of surgical patients were referred for possible participation. A further 47.82% of referred patients did not give consent for participation. Surgeons (n=9) and their receptionists (n=8) were approached to discuss issues with recruitment using the developed questions as guidance, thus a total of 17 respondents. About half of the respondents (n=9, 52.94%) were able to be interviewed face to face (n=8) or telephonically (n=1). Emails were sent to the remaining respondents (n=8). Emailed feedback was received from only one more respondent.

According to respondents, referrals were decreased for a number of reasons. One of the main reasons (n=6) was that the surgeons' patient profile did not align with this study as patients tended to be much younger. Respondents also commented that elderly patients were more apprehensive (n=5) regarding physiotherapy prior to surgery especially if the doctor did not specifically communicate (n=2) the importance during consultations. Elderly patients easily become overwhelmed (n=1) once surgery is mentioned and want to focus more on what they consider important (such as medical aid payments and authorisations). Four respondents admitted that they forgot about this study while consulting and three quoted time constraints as reasons why referral was low. One respondent theorized that recruitment issues are typical in the medical world and a symptom of a disease where research is not a priority. Another reported cancelling high risk surgeries due to COVID-19.

Due to the COVID-19 pandemic, South Africa was placed in a state of hard lockdown (Level 5) on March 26, 2020. The South African Government requested that all elective surgeries be postponed until further notice. Elective surgeries only resumed again in October 2020.

When asked what the researcher could change to improve recruitment some suggested more reminders (n=3) such as weekly messages. Other suggestions were to phone patients a week prior to surgery (n=1) or work with appointments (n=1). However, most respondents (n=6) said that nothing more could be done and that engagement and follow-up was outstanding.

Suggestions for recruitment mostly involved editing the study design in terms of inclusion and exclusion criteria (n=4) or doing baseline evaluations in hospital prior to surgery (n=2). Four respondents mentioned that the only way to recruit for this type of study was with surgeon referrals and that they do not know how else to recruit participants.

4.4 CONCLUSION

This chapter covered the methodology, procedure and results of the pre-operative education and exercise programme. In the following chapter the results mentioned above will be discussed.

Chapter 5

5 DISCUSSION

This study aimed to determine the effect of a single pre-operative physiotherapy session on post-operative physical function in elderly patients following abdominal surgery. As can be seen from the results in the previous chapter, this study demonstrates that intervention may have a role to play in influencing post-operative function. This will be discussed in detail throughout this chapter.

5.1 EDUCATION PAMPHLET

Pre-operative education can be given via a pamphlet or face to face consultation as reported in the literature. The pre-operative education and exercise programme introduced in this study made use of a pamphlet designed from current literature as discussed in Chapter 3. A systematic review of physical prehabilitation in elderly patients undergoing colorectal surgery reported that out of the six studies included in the review, the following interventions were applied (Bruns *et al.*, 2016):

- All studies included some form of aerobic exercise e.g. walking
- Four included resistance training
- Three studies included respiratory exercise

All three of the interventions above was thus included in the pamphlet used in the current study. It has previously been reported that participants often use pamphlets with pictures more as they find it more explanatory than pamphlets consisting of excessive pre-operative reading material (Boden, El-Ansary, *et al.*, 2017). For this reason, photos of each exercise was added to the education pamphlet.

A study by Boden *et al.*, (2017) found that participants who consulted with a physiotherapist prior to surgery, were six times more likely to remember the exercises compared to those who only received a pamphlet (94% vs 15% recall rate, 95%CI 1.7 to 22). This aligns with the reasoning for this study where the control group received only the education pamphlet, whereas the intervention group received a face to face physiotherapy session in addition to the education pamphlet.

One study in Pakistan reported that 68.14% of participants considered counselling effective in providing motivation for early ambulation post-surgery (Samnani *et al.*,

2014). These participants underwent abdominal surgery and had a mean age of 36.7 (± 8.69) years (Samnani *et al.*, 2014). Similarly, another study in Australia and New Zealand, found that pre-operative counselling helps to improve motivation by assisting patients to embrace the role they have in their postoperative recovery (Boden, El-Ansary, *et al.*, 2017). This in turn affects clinical outcomes such as time to first mobilisation and the prevention of PPC (Boden, El-Ansary, *et al.*, 2017). Despite the age difference from the Pakistani study, this was supported by the results of the current study as intervention group participants showed improved clinical outcomes *(see Section 5.4.1).*

5.2 DEMOGRAPHIC INFORMATION

The mean age in this study was 65.75 (± 4.47) years and 91.67% were women. This is younger than the reported age in most studies involving the elderly. Within studies amongst the elderly, women tend to be more prevalent. Steadman *et al.*, (2003) explored the effect of enhanced balance training of elderly patients prone to falls and reported a mean age of 82 years with 80% female participants. When looking into how to recondition elderly patients following abdominal surgery, McComb *et al.'s* (2018) population consisted of 67% women with a mean age of 76.2 (± 8.78) years. In a study investigating pre-operative markers within the elderly population and how it relates to post-operative clinical outcomes, the mean age was 72 (± 6) years, however 95% of participants were male (Rangel *et al.*, 2017). A study on community dwelling elderly had a mean age of 73 (± 8) years and 62% women (Steffen *et al.*, 2002). The same study reported that 98% of participants stated that they still do household chores (Steffen *et al.*, 2002). This differs from the findings in our study where 83.33% reported being active but only 16.67% named house chores and gardening as their preferred physical activity. This could be due to most participants interpreting physical activity as walking (50%) or some type of exercise (16.67%) rather than chores.

When examining the impact of postoperative complications on the recovery of elderly patients undergoing abdominal surgery, Tahiri *et al.*, (2016) reported that most participants (57.7%) underwent colorectal surgery, classified as an open laparotomy and UAS. In this study the majority of participants (83.33%) underwent gynaecological surgery, also classified as an open laparotomy but LAS.

There are multiple studies specifically focussed on community dwelling elderly persons, but very few studies regarding surgery among the elderly population in general, report on living conditions and independence. Since 75% of the participants in this study lived independently, comparisons will be made with studies where the population consisted of community dwelling elderly, as far as possible.

5.3 PRE-OPERATIVE PHYSICAL FUNCTION AND DAILY LIVING STATUS

5.3.1 Functional Comorbidity Index (FCI)

On average, participants had 3.1 comorbidities. This is more than the 2.1 comorbidities per elderly person, previously reported among frail community-dwelling individuals (Gill *et al.*, 2003). Using the Charlson Comorbidity Index (CCI), Tahiri *et al.*, (2016) reported a median comorbidity score of 3 (IRQ 2 – 6). The CCI is slightly more complex than the FCI and measures the one year mortality for a patient who may have chronic conditions (Groll *et al.*, 2006). While the FCI and CCI correlated fairly strongly (Spearman rho = 0.62, $p < 0.001$) the FCI was better at predicting physical function (Groll *et al.*, 2006).

As the above data suggest, a comorbidity score of 3.1 is representative of the elderly community, however the researcher expected more comorbidities among the participants. The relatively low FCI score could be due to the younger sample of elderly participants (65.75 (± 4.47) years), as Waite *et al.*, (2017) suggested that older age leads to more chronic conditions. A systematic review of RCTs investigating complications following surgery found that comorbidities were generally reported poorly in the literature (Schiphorst *et al.*, 2015).

Two studies investigating prehabilitation programmes among the elderly specifically reported the conditions of participants (Bousquet-Dion *et al.*, 2018; Hulzebos, Helders, *et al.*, 2006). The main comorbidities reported were COPD (9.52% and 30.77%), Diabetes Mellitus (22.22% and 19.23%) and Hypertension (53.97% and not reported (Bousquet-Dion *et al.*, 2018; Hulzebos, Helders, *et al.*, 2006). This differs from the participants in this study where 58.33% of participants complained of back pain and arthritis and only one participant (8.33%) reported COPD or DM respectively. Hypertension is not a condition included in the FCI and was thus not reported as part of this study.

The FCI was designed to predict physical function (Groll *et al.*, 2006). The results of this study agree, as percentage of expected 6MWT decreased the higher the number of comorbidities reported (r= -0.792, p=0.002). This makes the FCI an effective screening tool.

5.3.2 DeMorton Mobility Index (DEMMI)

Macri *et al.*, (2012) reported on normative values for the DEMMI in community-dwelling elderly participants from Canada and Australia. Half of their sample lived independently and the average age was 74.6 (± 6.7) years. The median DEMMI score was 81.0, the lowest score was 44 and 17.5% of participants scored the maximum 100 (Macri *et al.*, 2012). Mobility aids were used by 15% of the sample (Macri *et al.*, 2012).

Davenport & De Morton, (2011) investigated the clinimetric properties for the DEMMI among community-dwelling elderly individuals in Australia. Almost half of the participants (48.3%) lived alone and the average age was 76.8 (± 5.5) years (Davenport & De Morton, 2011).The mean DEMMI score was 76.8 (±14.1), the lowest score reported was 44 and 13.1% of participants scored the maximum possible score of 100 (Davenport & De Morton, 2011). Among this Australian sample, 31.1% of participants required a gait aid (Davenport & De Morton, 2011).

The above results are similar to the results of this study where the median score was 79.50 and the lowest score was 48. Slightly more participants scored 100 (25%) than reported among elderly participants in Australia or Canada, and fewer participants required mobility aids (8.33%). A possible explanation for the slightly better mobility of participants at baseline, could be that more participants lived independently and the sample age is again much younger than the Australian or Canadian sample. Macri *et al.*, (2012) reported statistically significant differences in mobility between age groups (p=0.02; 60 – 69 years vs 70 – 79 years).

5.3.3 Six Minute Walk Test (6MWT)

The 6MWT is widely used to measure functional or physical exercise capacity. Most studies report the distance mobilised during testing, some report change from baseline and a few report the percentage of expected distance walked. As can be seen below,

distances vary quite meaningfully and it is therefore advisable to use the percentage of expected distance for comparison. This was done where possible.

A study investigating the relation between post-operative complications and physical performance and recovery of patients undergoing abdominal surgery reported baseline 6MWT data as follows: mean distance was 513 (±133.3) meters resulting in 96 (±21.8) % of expected distance (Flahive, 2018). It should be noted that the mean age for this study was 59.51 (±14.65) years (Flahive, 2018).

Minnella *et al.*, (2017) had an older sample of participants 68.5 (±11.8) years and a reported baseline 6MWT distance of 428 (±105) meters in their prehabilitation group. Similarly, Barberan-garcia *et al.*, (2018) reported an average 6MWT distance of 472 (±94) meters among their 71 year old (±11 years) intervention group. Also comparable, Pecorelli *et al.*, (2016) found that participants (67 (65 – 69) years) walked 429 (411 – 447) meters or 66 (64 – 69)% of their expected 6MWT distance.

Even though the participants scheduled for colorectal surgery in the van Rooijen *et al.*, (2019) study were older (71 (IQR 46 – 89) years), their functional capacity at baseline (568 (518m – 598) meters) was much better compared to the above mentioned studies. In contrast, among frail cardiac patients over the age of 65 years, the 6MWT distance is much lower (Waite *et al.*, 2017). Waite *et al.*, (2017) reported a baseline distance of 236.64 (± 146.66) meters.

It can therefore be surmised that the participants in this study performed on par with the participants from other similar studies at baseline. The participants were neither fit nor frail, as they were able to walk 81.9 (64.63 – 89.62) % of their expected distance at baseline. This equates to 435.5 (364.75 – 458.50) meters walked within six minutes. It should be noted that none of the cited studies recorded any adverse events and dyspnoea, fatigue, pain or rests taken during testing was not reported.

5.3.4 Lawton-Brody Instrumental Activities of Daily Living Scale (IADL)

Multiple studies report on ADL status of patient before and after surgery but very few studies report on IADL status. Additionally, the IADL scale has different implementations and ways of reporting thus hindering comparison between studies.

When validating the Spanish version of the Lawton-Brody IADL scale, Vergara *et al.*, (2012) reported a mean score of 5.56 (± 2.84) among 1965 participants, aged 80.04 (± 8.04 years) with 84.53% women. They did not report it as a percentage but rather used factor loading to account for the differences in total score between women and men (Vergara *et al.*, 2012). This population was much older than the participants of the current study, explaining the high level of independency recorded.

Lawrence *et al.*, (2004) used a modified IADL scale, where a score of 8 meant total independency and a score of 24 meant total dependency. They reported that prior to surgery, participants (age 69 (±6) years), 44% female) were largely independent with a score of 9.6 (± 2.4) (Lawrence *et al.*, 2004). This corresponds with the results of the current study.

In contrast to the results of the current study, Luciani *et al.*, (2008) reported more dependence. They investigated the effect of fatigue on ADL and IADLs among elderly patients with cancer. In a 78 year old (± 4.73 years) population with 63% females, they found that 13% of participants had at least one dependency of an IADL (Luciani *et al.*, 2008). Furthermore, dependency in one or more IADLs mean that the patient can no longer safely live unaided (Luciani *et al.*, 2008).

As 75% of the population in this study lived independently it is understandable that most participants (91.66%) scored 100%, indicating full independency. Only one participant (8.33%) was dependent at baseline.

5.3.5 Baseline Summary

The participants in this study were quite healthy, with good mobility and fairly normal functional capacity allowing them to partake independently with IADL. All participants were considered high risk due to their age but the sample was relatively young bearing in mind the population. The researcher would have preferred a wider range in age and more frail participants (more comorbidities, decreased mobility and lower functional capacity), as it was suspected that older, more frail patients would benefit more from such a programme. This will be further discussed in Chapter 6.

5.4 PRE-OPERATIVE EDUCATION AND EXERCISE PROGRAMME

Measuring the effect of the pre-operative programme was twofold; determining the effect on clinical outcomes as well as on physical function.

5.4.1 Effect of Pre-operative Education and Exercise Programme on Clinical Outcomes

Clinical outcomes are widely researched and reported. Outcomes measured in this study included hospital LOS, ICU admission with or without MV, PPC incidence and first mobilisation parameters following surgery. Some of the most relevant study's results will be discussed in this section.

The LOS for high risk patients who had abdominal surgery was 10.4 (± 3) days as reported by Mackay *et al.*, (2005). Pre-operative intervention did not make a difference in hospital LOS (intervention 8 (6 – 11) days vs 9 (7 – 13) days; p=0.13) as noted by Boden, Skinner, *et al.*, (2017). Isik *et al.*, (2015), conversely found that pre-operative functional status directly affected hospital LOS (independent 8.10 (±8.45) days, partially dependent 15.38 (± 12.13) days and totally dependent 21.42 (±17.86) days; p<0.001) as did type of surgery (open laparotomy vs laparoscopic; 95% CI 1.31 (1.21 – 1.41); p<0.001). Hospital LOS can also be affected by the development of PPC, as reported by Paisani *et al.*, (2012). The participants who developed PPC (19.1 (± 9.2) days) stayed longer than the participants who did not (11.4 (±13.5) days; p=0.001) (Paisani *et al.*, 2012). The hospital LOS reported in the cited studies were much longer than the median of 4 days found with this current study. Similar to Boden, Skinner, *et al.*, (2017), pre-operative intervention did not make a difference to LOS (p=0.59; g= -0.30 95% CI (-1.34 – 0.76)). In contrast, Waite *et al.*, (2017) reported that change in 6MWT distance lead to a change in LOS (r=0.7; p=0.03). Based on the results of Waite *et al.*, (2017), it can be assumed that if a pre-operative intervention improves functional capacity then it should lead to a change in LOS. This, however was not the case with the current study. A plausible reason is set surgeon protocols with predetermined hospital LOS and discharge days. Patients potentially only stay longer if serious complications develop. The small sample size could also be a contributing factor.

Different to most studies, this study had no participants admitted to ICU or MV following surgery. Mackay *et al.*, (2005) reported that 21% of high risk participants were admitted

to the ICU following abdominal surgery and 17% required MV. A possible reason for the lack of ICU admissions is the younger, more fit sample included in this study, as was discussed in the previous section. Another study reported that there were minimal differences in ICU admission (43% and 46%) or MV (10% and 11%) between intervention and control groups, respectively (Boden, Skinner, *et al.*, 2017). The development of PPC also tends to lead to longer ICU stays (Shander *et al.*, 2011).

The incidence of PPC among high risk patients undergoing abdominal surgery was 16% - 20% (Boden, Skinner, *et al.*, 2017; Mackay *et al.*, 2005). The results of this study showed that the incidence of PPC symptoms was 50%. This is much higher than previously reported but could be because symptoms of PPC was reported, as no participants developed PPC, as diagnosed using the MGS. Boden, Skinner, *et al.*, (2017) noted a significant difference in the incidence of PPC between the preoperative physiotherapy group (12% incidence) and control group (27% incidence; $p<0.001$). They also noted that post-operative pneumonia was halved (8% vs 20%; $p<0.001$) between the intervention and control groups (Boden, Skinner, *et al.*, 2017). Though not statistically significant ($p=0.57$), the intervention group in the current study had half the amount of participants who developed symptoms of PPC (33.33%) as the control group (66.67%). Mackay *et al.*, (2005), found that the addition of DBE to an early mobilisation programme does not affect the incidence of PPC.

Following abdominal surgery patients tended to mobilise out of bed 1.9 (± 0.9) days (roughly 45 hours and 35 minutes (± 21 hours and 35 minutes)) after surgery (Mackay *et al.*, 2005). Boden, Skinner, *et al.*, (2017) reported an earlier uptime but no difference ($p=0.50$) in the time patients first mobilised between their pre-operative intervention group (23 (20 – 44) hours) and their control group (22 (20 – 39) hours). The results of this study was in line with the results from Boden, Skinner, *et al.*, (2017), as both groups were similar ($p=0.59$; $g=0.29$ 95% CI(-0.76 – 1.34)) and mobilised approximately 20 hours after surgery. Much quicker and in contradiction to this, Samnani *et al.*, (2014) found that pre-operative counselling regarding expectations resulted in earlier mobilisation following surgery (342.9 (± 105) minutes (equates to 5 hours and 42 minutes) ambulation counselling group vs 1511.1 (± 680) minutes (equates to 25 hours and 11 minutes) only information regarding surgery) in participants who underwent abdominal surgery.

The distance participants mobilised with first uptime is very rarely reported, most studies only differentiate between less or more than 30 meters. It should be noted that participants in this RCT initially mobilised much further than 30 meters (130 (85 – 225) meters). Also of clinical note (-0.10, 95% CI (-1.14 – 0.95)) if not statistically so (p=0.86), participants in the intervention group (177 (100 – 242.5) meters) mobilised almost double the distance of those in the control group (90 (60 – 245) meters). The added distance to their first time up could be due to them realising the importance of ambulation post-operatively as an outcome of the education programme but potentially also due to engaging in more ambulation activity prior to surgery benefitting them post-operatively.

To summarise, the pre-operative education and exercise programme had no statistically significant impact on clinical outcomes but did show some clinically significant differences in regards to PPC and the distance mobilised with initial uptime.

5.4.2 Effect of Pre-operative Education and Exercise Programme on Physical Function and Daily Living Status

This effect was measured in two ways; by comparing the intervention and control group at hospital discharge and follow-up as well as by the change in parameter from baseline to discharge and follow-up.

5.4.2.1 Analysis between Groups at Hospital Discharge and Final Follow-Up

When participants were discharged from hospital, there were no significant differences between the intervention and control groups, as measured by the FCI (p=0.28), DEMMI (p=0.71) and 6MWT (p=0.61). Dronkers *et al.*, (2010) also reported that the preoperative programme did not significantly change the functional exercise capacity (6MWT) between groups. Even though the differences in 6MWT between the groups was not statistically significant, it is worth noting (6MWT percentage g=-0.63, 95% CI (-1.69 – 0.47)) that the intervention group (376 (319.5 – 382.75) meters) mobilised further and achieved a greater percentage (70.78 (59.85 – 74.67) %) of their expected distance than the control group (340.50 (318.75 – 353) meters; 60.24 (53 – 66.68) %).

Rønning *et al.*, (2014) reported that 69% of participants showed a decrease in IADL (using the Nottingham Extended ADL scale) following surgery. Lawrence *et al.*, (2004) also noted a marked decrease in IADL (as measured with an adjusted Lawton-Brody

IADL scale) a week after surgery (9.6 (±2.4) vs 17.3 (±4.8); p<0.0001). However, IADL (as measured with the Lawton-Brody IADL scale) did not change during a five week hospital rehabilitation (Zasadzka *et al.*, 2016). Activity of daily living recovered between six weeks and three months but IADL only recovered three to six months after surgery (Lawrence *et al.*, 2004). The greater the cognition, endurance or muscle group recruitment needed for the activity the later the recovery to baseline was achieved (Lawrence *et al.*, 2004).

Statistically this does not align with the results of this study as participants showed minimal loss of IADL following surgery (control group 95 (81.25 – 100) %, intervention group 100%; p=0.15). A possible explanation for the greater independence in IADL is that participants were relatively young, healthy and fit compared to similar studies. Clinically, however a large difference can be seen when analysing effect sizes (g=-0.90 95% CI (-1.99 – 0.24)), surprisingly reflecting the results discussed above.

5.4.2.2 The effect of time and pre-operative intervention on physical function

For the purpose of this study physical function was measured using the DEMMI (mobility) and the 6MWT (functional capacity). No studies could be found on the recovery of mobility (as measured with the DEMMI or other outcomes) following abdominal surgery. As seen in Chapter 4, prehabilitation participants recovered passed baseline in terms of mobility (79.5 (± 2.46) at baseline; 95.67 (±4.33) at four week follow-up). The results of the current study, therefore suggest that prehabilitation leads to improved recovery following surgery. Said *et al.*, (2012), reported that following two weeks of hospital rehabilitation, DEMMI scores among 80 year old patients with mobility issues, improved with 9.6 (± 8.8) points. This suggests that mobility improves with prehabilitaion as well as rehabilitation.

Prehabilitation had a positive effect on functional capacity as measured by the 6MWT throughout the perioperative period (Minnella *et al.*, 2017). In contrast, Barberan-garcia *et al.*, (2018) found almost no difference between baseline and before surgery 6MWT distances (472 (± 94) meters vs 473 (± 91) meters; p=0.953) among their intervention group. Minnella *et al.*, (2017), however measured statistically significant differences in 6MWT distance change (in relation to baseline) between prehabilitation and rehabilitation groups prior to surgery (30 (±46.7) meters vs -5.8 (±40.1) meters;

p<0.001), at 4 weeks follow-up (-11.2 (±72) meters vs -72.5 (±129) meters; p<0.01) and 8 weeks follow-up (17 (±84) meters vs -8.8 (±74) meters; p=0.047).

Likewise, van Rooijen *et al.*, (2019) found that 64% of their intervention group improved with at least 20m (mean increase of 67m) during prehabilitation. These participants, however recovered passed baseline quicker than the participants in the Minnella *et al.*, (2017) study. At four weeks post-surgery, prehabilitation participants had improved with 30.3 meters, whereas the control group had not yet recovered to baseline (-16.3 meters; p<0.05) (van Rooijen *et al.*, 2019). Pecorelli *et al.*, (2016), however reported that at four weeks post-operatively the 6MWT distance (404 (384 - 422) meters) had not yet returned to baseline (429 (411 – 447) meters). Another study stated that at 60 days following surgery participants had also not physically recovered back to baseline (Flahive, 2018).

The current study found that 6MWT distance decreased following surgery for both groups as was expected. However, interestingly the decrease was more significant in the intervention group. Both groups improved but at four weeks following discharge the intervention group had not yet returned to baseline, surprisingly, the control group improved passed baseline. This suggests that other factors play an important role in the recovery of functional capacity. Minnella *et al.*, (2017) suggests that prehabilitation enhances the recovery of functional capacity. Unfortunately, this study did not measure change in 6MWT distance during prehabilitation, as it would be interesting to know if preoperative gain, influenced the recovery of functional capacity.

5.5 RELATIONSHIP BETWEEN PPC AND PHYSICAL FUNCTION

Several studies report that prehabilitation is a protective factor against complications among high risk patients undergoing elective abdominal surgery (Barberan-garcia *et al.*, 2018; Boden, Skinner, *et al.*, 2017; Reeve & Boden, 2016). Boden, Skinner, *et al.*, (2017) reported that prehabilitation reduced the risk of PPC by 52% and Tahiri *et al.*, (2016) reported that participants who developed PPC took longer to return to baseline functional status.

The 6MWT has shown to be effective in predicting the incidence of PPC in high risk patients (Keeratichananont *et al.*, 2016). Keeratichananont *et al.*, (2016) found that a baseline 6MWT distance of 325 meters or less, predicted PPC with 77% sensitivity and

100% specificity. Flahive, (2018) also reported a statistically significant difference (p=0.019) in the distance walked with the baseline 6MWT between participants who developed post-operative complications (median 490m (IQR 420 – 561.25); age 71 years) and those who did not (570m (502.5 – 630); age 60 years). In contrast to these two studies, Paisani *et al.*, (2012) found no difference (p=0.57) in 6MWT distance between the participants who developed PPC (466 (±97) meters; 67 (±12) years) and those who did not (485.3 (±107.1) meters; 57 (± 14) years). In line with Paisani *et al.*, (2012), the results of this study also indicates no association (p=0.44) between baseline 6MWT distance and the development of PPC.

The results of this study do however, indicate that the baseline DEMMI score, significantly correlates with PPC incidence (p=0.03). No other studies have reported on the relationship between DEMMI score and PPC incidence. Lawrence *et al.*, (2004) did however report that better pre-operative function and serious PPC regularly predicted recovery. The data thus suggest that pre-operative physical function status may affect PPC incidence, but further research is needed.

5.6 ADHERENCE TO PROTOCOL EXERCISES

Prehabilitation can only be successful if participants adhere to the prescribed programme and exercises. The results indicate that 66.67% of participants followed the suggested exercises to varying degrees. Prior to surgery exercise compliance was 53.78 (± 30.45) % and following surgery it increased to 62.83 (± 30.36) %. Minnella *et al.*, (2017) had a very high rate of adherence (99%) during prehabilitation but reported that compliance declined after surgery. Waite *et al.*, (2017) also noted a high adherence rate (90%) among frail elderly patients. They suggest that the high rate of adherence was the result of weekly phone calls and constant encouragement by the researchers (Minnella *et al.*, 2017; Waite *et al.*, 2017). Due to blinding in this study, such follow-up was not possible.

A systematic review of prehabilitation programmes reported that adherence varied from 16% to 97% among the five included studies (Bruns *et al.*, 2016). More recent studies show better compliance for contact sessions (89.6% (Northgraves *et al.*, 2020)) compared to home exercise programmes (76% (Brahmbhatt *et al.*, 2020)). McComb *et al.*, (2018) suggested that a logbook motivated patients and thereby increased

compliance. Though adherence rates tend to be high, recruitment can be challenging, especially among the geriatric population (Kosse *et al.*, 2013).

5.7 CHALLENGES

The recruitment rate for this study was very low (10.95%) and the non-consent rate was high (47.82%). Northgraves *et al.*, (2020) also reported recruitment difficulty as 42% of possible participants were ineligible and only 18.4% of participants consented to participation. Other studies reported a recruitment rate of 35% (Karlsson *et al.*, 2019) and consent rates of 47% (Tew *et al.*, 2020).

The explanations for non-consent was not formally collected but included limited time following consultations, difficulty in travel arrangements and other commitments prior to surgery. This was despite flexible timeslots and a travel reimbursements given to all participants. Northgraves *et al.*, (2020) and Tew *et al.*, (2020) stated similar findings. Karlsson *et al.*, (2019) also named stress prior to surgery as a reason for non-consent. Though this was not specifically mentioned by potential participants, respondents from the surgeon's offices seemed to agree.

Similar to this study, Tew *et al.*, (2020) relied on the referral of participants from surgeons (65%). They however, also received referrals from anaesthetists, specialised nurses and screening programmes (Tew *et al.*, 2020). Unfortunately, in South Africa, patients usually consult with anaesthetists and other medical personnel only once admitted for surgery.

As mentioned by respondents, COVID-19 influenced recruitment for this study. Regions with the highest volumes of surgeries per person are also the regions most intensely affected by COVID-19 (Søreide *et al.*, 2020). This lead to an unprecedented number of operations being cancelled or indefinitely postponed, especially where high risk patients are concerned (Søreide *et al.*, 2020).

5.8 CONCLUSION

The exercises included in the pamphlet was effective as the results clearly show that a single pre-operative education and exercise session clinically reduces the incidence of PPC and improves post-operative recovery of function. This was demonstrated through the clinically significant results of the intervention group, including:

- Less PPC symptoms.
- Longer distance mobilised with first uptime.
- Walked further in 6 minutes at hospital discharge.
- Recovered mobility beyond baseline at four week follow-up.

Limitations of this study and recommendations for further research will be discussed in Chapter 6.

Chapter 6

6 CONCLUSION AND RECOMMENDATIONS

This chapter will conclude this dissertation with a short summary of the key findings, several recommendations and a discussion of the strengths and limitations of this study.

6.1 CONCLUSION

This study set out to answer the question: What is the effect of a single pre-operative physiotherapy session on post-operative physical function in elderly patients following abdominal surgery? The objectives of this study were thus two-part; 1) to create a pamphlet that could be used in the chosen population and 2) a pilot study to investigate findings and to highlight challenges that needed to be considered when conducting a larger project.

Based on the quantitative analysis of physical function following intervention, it can be suggested that a single pre-operative physiotherapy session may result in some clinically significant changes. As hypothesised in Chapter 1, prehabilitation improved the uptake of early mobilisation when considering the distance mobilised and it reduced the number of PPC symptoms experienced by the intervention group. This lead to a better 6MWT distance at hospital discharge and the recovery of mobility passed baseline at four week follow-up for participants in the intervention group.

Even though these changes were not statistically significant, the results still suggest clinical importance. As mentioned in Chapter 2, physical function is a major indicator of surgical success for the elderly patient. Therefore, even though the difference in PPC symptoms and distance initially mobilised were not statistically significant, it could make a psychological difference to the elderly patient. Additionally, recovery of physical function was significantly improved among our intervention group. These results contribute to the known literature related to the paradigm shift in elderly surgical care.

The fact that most differences between groups were not statistically significant, might suggest that an education pamphlet (Chapter 3) is also relatively effective in aiding the recovery of function among elderly patients. Therefore the face-to-face with a

physiotherapist pre-operatively might not be necessary. This could potentially be beneficial considering the challenges experienced with recruitment and consent as discussed in Chapter 5.

6.2 CLINICAL/PRACTICAL RECOMMENDATIONS

As stated in Chapter 4, the FCI predicts physical function. Based on these conclusions, surgeons should consider using the FCI, to screen elderly patients. Frail patients; those with suspected reduction in physical function due to increased FCI score, could then be referred for prehabilitation. Van Cleave *et al.*, (2011), suggested that three or more comorbidities indicates a marked decrease in function. Should patients not be able to participate in prehabiltation for any reason (reasons for non-consent to this study discussed in Chapter 5), an education pamphlet would be more effective than the current practice of no physical preparation for surgery.

Internationally, pre-operative clinics exist to aid in screening and evaluation of patients prior to surgery. It is at these clinics where trimodel prehabilitation (physical, nutritional and psycosocial preparation for surgery) might take place. Current literature suggest high feasibility and recruitment at such clinics. South Africa presently does not have pre-operative clinics but an institution based trial clinic could potentially improve efficacy of prehabilitation and aid in recruitment for further research.

6.3 RECOMMENDATION FOR FUTURE RESEARCH

The current study presented findings of a pilot study and therefore a full scale study; with a larger sample size, is required to confirm these preliminary findings.
Some areas where further research is still needed include:

- This project provided some information on the private sector. A public sector research with regards to this topic is also required as such individuals' physical activity requirements might be a lot different to the private sector.
- Future research might investigate the feasibility of a pre-operative clinic in the South African context, as mentioned in the previous section.
- The economic implications of prehabilitation among the elderly population could also be studied.
- Alternatively, further research is needed to determine the effect of surgery on the mobility of elderly patients as well as the recovery of mobility as measured

by the DEMMI. The results, of this study, suggest that prehabilitation could have a larger effect on post-operative mobility (DEMMI) compared to functional capacity (6MWT).

- Follow-up was done at four weeks post-surgery. A longitudinal study could be done over an extended period to further investigate the effects of prehabilitation on long term recovery of function.
- The education and exercise pamphlet could be tested for validity and reliability among different types of surgeries. Using a more standardised intervention could lead to a wider scope and generalisability of results.
- Additionally, the effect of only an education pamphlet prior to surgery could be measured as it relates to physical function.
- An older more frail study sample could result in more statistically significant results as suggested by Figure 2.4 from Kow, (2019).
- Research is needed to determine what prehabilitation method is most effective. Suggestions include but are not limited to the following – supervised programmes vs home programmes, uni-model vs trimodel or pre-operative time needed for efficacy.
- To better understand the implications of these results, future studies could address recruitment issues, non-consent and other influencing factors in an effort to increase the study sample size.

6.4 STRENGTHS AND LIMITATIONS

This study was well designed and planned with adequate blinding and a low risk for bias. Unfortunately, the generalisability of the results are limited due to the small sample. As discussed in Chapter 5, recruitment challenges, non-consent and COVID-19 drastically impacted data collection.

A successful prehabilitation programme should involve the entire multi-disciplinary team in order to optimise the short time frame from when the decision to operate is made to surgery. For the purpose of this study, surgeons were approached to refer possible participants but they were not actively involved in the study. Another limitation is that patients referred for participation were more fit rather than frail. As previously discussed, Kow, (2019) suspected that frail patients have more to gain from prehabilitation than fit or previously frail patients.

Two weeks prehabilitation is the minimum time frame needed for patients to feel engaged and as if they worked to optimise their outcome (Shaughness *et al.*, 2017). Due to short theatre wait times, the time available for prehabilitation was limited. It would have been interesting to know which aspects of physical function had improved during prehabilitation and by how much. This was also not feasible as participants were only admitted the morning of surgery.

The exercise programme was a general programme and was not tailored to each participant. The reasoning for a fixed intervention was to improve comparison between participants in this study and ensure blinding. Comparative studies, advice that prehabilitation protocols are tailored to each individual patients specific needs however the lack of a standardized programme limits comparison between similar studies.

Another limitation was that adherence and compliance to the exercise programme was self-reported and thus reliant on truthfulness. This may have led to a possible margin of error in the results.

To conclude, the results of this pilot study show that a single physiotherapy session prior to surgery could improve recovery of physical function among the high-risk elderly patient but further research is needed to confirm these results. Furthermore, the feasibility of a large prehabilitation study in the current South African climate is poor.

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Appendices

APPENDIX A ETHICS CLEARANCE CERTIFICATE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Ms Rozelle Labuschagne

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180561

NAME: (Principal Investigator)	Ms Rozelle Labuschagne
DEPARTMENT:	Physiotherapy Marius de Bruyn and Gian Jacobs Physiotherapy Peglerae Life Hospital - surgical ward, ICU, high-care Medicare Hospital - surgical ward, ICU, high-care
PROJECT TITLE:	The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery
DATE CONSIDERED:	25/05/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Ronel Roos
APPROVED BY:	Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	20/08/2018

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 Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. 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.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **May** and will therefore be due in the month of **May** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

26/08/2018
Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX B ETHICS AMENDMENT APPROVAL

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

16/07/2019

Ms R Labuschagne
School of Theapeutic Sciences
Department of Physiotherapy
Medical School
University

Sent by e-mail to: rozelle.labuschagne@gmail.com

Dear Ms Labuschagne

Re: **Protocol Ref No: M180561**
Protocol Title: *The effect of a pre-operative physiotherapy session on physical function in elderly patients following abdominal surgery*
Principal Investigator: Ms R Labuschagne

Thank you for your letter of 08/07/2019.

I confirm that the proposal to relocate your study site to the Mediclinic Midstream has been noted and approved.

Thank you for keeping us informed.

Yours Sincerely

.....
Mr I Burns
For the Human Research Ethics Committee (Medical)

cc Ronel.Roos@wits.ac.za

APPENDIX C TRIAL APPROVAL

13 September 2018

To Whom It May Concern:

RE: The effect of a single pre-operative physiotherapy session on physical function in elderly patients following abdominal surgery.

As project manager for the Pan African Clinical Trial Registry (www.pactr.org) database, it is my pleasure to inform you that your application to our registry has been accepted. Your unique identification number for the registry is **PACTR201809874713904**.

Please be advised that you are responsible for updating your trial, or for informing us of changes to your trial.

Additionally, please provide us with copies of your ethical clearance letters as we must have these on file (via email or post or by uploading online) at your earliest convenience if you have not already done so.

Please do not hesitate to contact us at +27 21 938 0835 or email epienaar@mrc.ac.za should you have any questions.

Yours faithfully,

Elizabeth D Pienaar
www.pactr.org Project
Manager
+27 021 938 0835

APPENDIX D PARTICIPANT INFORMATION DOCUMENT

Study Title: The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery

Dear Potential Participant,

I, Rozelle Labuschagne, am a qualified physiotherapist doing my Masters degree in physiotherapy at the University of Witwatersrand. I am doing research on how a once-off physiotherapy education and exercise session before surgery will affect your physical function after surgery. Research is the process to learn the answer to a specific question. In this study we want to learn how specific exercises will affect how you move and go about your normal activities after surgery. It is normal after surgery for older patients to feel a bit weaker and move a bit slower until they have recovered from surgery. I want to see if the once-off physiotherapy education and exercise session before surgery can influence the recovery after surgery.

You may take part in this study if you are older than 60 years and if you will be having abdominal surgery in Mediclinic Midstream. You must be able to walk, with or without a walking aid and you must understand English.

I am asking you to take part in this research. Please note that your participation is voluntary and that refusal to participate will not lead to any penalties or influence the care that you receive in the hospital. You are also allowed to withdraw your participation at any time from the research study.

This study will need 100 participants, separated into two groups. The research study will require you to attend two appointments at the practice rooms. One appointment before you are admitted to hospital and the second once you are discharged from the hospital.

On your first appointment at the practice rooms, you will be asked to fill in a basic information questionnaire and a tick list. These documents will take you about 15 minutes to complete. During the next half an hour I will test how well you move, how fit you are with

a walking test and how you perform activities at home. I will measure your heart rate, blood pressure and oxygen level at the beginning of the session and again at the end. We will discuss how you go about your day and which activities you do. Two tests will then be done, the DeMorton Mobility Index (DEMMI) and the six minute walk test (6MWT). I will explain both in more detail before we do them. After the evaluation, the receptionist will tell you in which treatment group you will be. One group will receive the education pamphlet. The other treatment group will receive another education pamphlet and instructions from the research assistant. These instructions will take another 30 minutes. Please note that your first appointment will therefore take at least 45 minutes and may be as long as 1.5 hours.

Both groups will receive physiotherapy in hospital. Please take note that the physiotherapy services received in hospital do not form part of the research study and you will thus be required to pay as usual for the in-hospital services received.

The day that you are discharged from the hospital I will come to the hospital to do the same two tests that you performed before hospital admission (DEMMI and 6MWT. This will take about 20 minutes. With your permission, I will look through your hospital file for details related to this study, e.g. how long you were in hospital, if you were in intensive care and how many days you were in intensive care, if you required any additional oxygen support such as mechanical ventilation and how soon you were getting up out of bed after surgery. I will also give you a half an hour appointment in two weeks' time after hospital discharge at this time. During this second appointment we will do the same evaluation we did the first time before your hospital admission. Please wear the same shoes to this appointment.

You will be paid back R50 per visit to the practice rooms to cover your travel expenses (R100 in total).

This study has very little risk to you. The highest risk test we will do is the 6MWT. To make sure you are safe you will be allowed to rest when you want to for as long as you want. All the exercises are safe and should not cause any injuries.

All relevant information will be given to you while you are in the study and your results will be made available to you. Efforts will be made to keep your personal information confidential as your name and surname will not be recorded on the study evaluations sheets but only on the study coding form. These records will be kept in a locked container for two years (if results are published) and six years (if results are not published). Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law. The Research Ethics Committee may inspect the research records.

If you have any questions or want to report study related issues please phone me at any time. You can also phone the Research Ethics Committee administrator if you have any complaints or problems.

Rozelle Labuschagne: 072 474 2248
Research Ethics Committee administrator, Mr Rhulani Mkansi: 011 717 1252
Thank you.

Participant Consent Form

I _____ consent to participate in the study as described to me in the information sheet by the researcher Rozelle Labuschagne. I also understand and consent that my hospital files can be accessed to obtain information regarding my hospital stay that forms part of this study.

I am aware that I will be protected to the best ability of the researcher against potential risks, but realize that not all risks can be foreseen. I understand that my participation in this study is voluntary and that I can withdraw from the study at any time without any penalties.

I understand that my travel costs will be reimbursed at R50 per visit (total R100) but that I will not be paid for my participation in this study and will also not be charged for participation in this research study.

Signature of participant: _____

Date: _____

Signature of researcher: _____

APPENDIX E PEER REVIEW COVER LETTER AND TABLE

To whom it may concern,

29/08/2018

Re: MSc Dissertation Protocol – Phase 1 (Exercise Pamphlet Validation)

THE EFFECT OF A SINGLE PRE-OPERATIVE PHYSIOTHERAPY SESSION ON PHYSICAL FUNCTION IN ELDERLY PATIENTS FOLLOWING ABDOMINAL SURGERY

Thank you for your assistance with the peer review of this exercise pamphlet. Please make track changes in the document or give feedback in the e-mail regarding the content and quality of the pamphlet. Please give your feedback within 2 weeks. After suggestions has been implemented it will be distributed a second time for further suggestions.

The education section of this pamphlet will be given to all participants in this study, for both the control and intervention groups.

The exercise section will only be given to the intervention group. These exercises will be explained and demonstrated to elderly participants in an attempt to improve physical function prior to surgery. Participants will be encouraged to perform all exercises with the supervision of the research assistant. Participants will be asked to do the exercises twice a day until the day of surgery, during hospitalisation and for two weeks post-surgery. They will be asked to keep a record of when they exercise or why they missed a session on the chart included.

I have also attached a table to this email displaying literature and the reasoning that prompted the inclusion of the content in both the education and exercise sections.
Please feel free to email or phone me should you have any further questions.

Thank you
Rozelle Labuschagne
1948195

Literature for inclusion of content in Pamphlet

	Description	Reasoning	Reference
Education			
Rolling in and out of bed	Roll onto the side and push up with the arms to protect abdominal incisions.	Assists mobility by decreasing pain with movement and thereby improves amount of mobilisation after surgery.	(Alexander *et al.*, 2001; Cassidy *et al.*, 2013)
Deep breathing	Take a deep breath to fill the lungs, this decreases pain and helps maintain lung compliancy.	Prevents PPC and maintains lung function	(Bruns *et al.*, 2016; Cassidy *et al.*, 2013; Dronkers *et al.*, 2010; Qaseem *et al.*, 2006; Reeve & Boden, 2016)
Coughing with wound support	Support abdominal incisions using a pillow for a better cough effort.	Strong cough clears phlegm and helps to prevent PPC.	(Cassidy *et al.*, 2013)
Exercise			
Walking	Increase distance and speed daily	Improves exercise capacity and endurance that helps with ADL. Improves circulation.	(Bruns *et al.*, 2016; Cassidy *et al.*, 2013; Dronkers *et al.*, 2010; Reeve & Boden, 2016; Said *et al.*, 2012)
Bridging	Lie down in supine with the knees bend and lift the buttocks.	Functional exercise that strengthens gluteus muscles important for bed mobility and walking	(Alexander *et al.*, 2001; Barberan-garcia *et al.*, 2018; Said *et al.*, 2012; Steadman *et al.*, 2003)
Thoracic Movements	Cross arms over the chest and move the upper trunk.	Improves lung expansion, flexibility and prevents diaphragm dysfunction and stiffness.	(Alexander *et al.*, 2001)
Upper limb mobility Shoulder flexion Shoulder extension Elbow flexion Elbow extension	Secure the theraband and pull in the opposite direction. This supplies resistance to a specific movement.	Improves joint mobility, strength, hand grip and coordination, all important in the performance of ADL. Improved upper limb Mobility and strength assists with rolling out of bed or sit to stand post-surgery.	(Alexander *et al.*, 2001; Bruns *et al.*, 2016; Carli *et al.*, 2010; Steadman *et al.*, 2003; Zasadzka *et al.*, 2016)

APPENDIX F DEMOGRAPHIC QUESTIONNAIRE

Patient Number: _____

Date: _____

Date of surgery: _____

Basic Information	
Gender	
Age	
Weight	
Height	
Race	
Smoking History	
Home Language	
Living conditions	
Daily activity/Sport	
Surgical Information	
Surgeon Name	
Reason for Surgery	
Medical Information	
Medical History	
Chronic Medications	

APPENDIX G CLINICAL RECORD EVALUATION FORM

Patient Number: _____

Date: _____

Date of surgery: _____

Admission details	
Date of Admission	
Date of Discharge	
Surgery details	
Date of Surgery	
Type of Surgery	
Duration of Surgery	
Time Surgery Completed	
ICU details	
ICU Admission date	
Duration of mechanical ventilation	
Date of transfer to ward	
Physiotherapy details	
First time participant mobilised out of bed	
Distance participant mobilised out of bed	
Date of PPC clinical signs developed	
Which PPC clinical signs	
Other comments from treating physiotherapist as per hospital file	

APPENDIX H THE FUNCTIONAL COMORBIDITY INDEX (FCI)

(Groll *et al.*, 2005)

Patient Number: _____

Date: _____

Date of surgery: _____

	Comorbidity	Yes/No
1	Arthritis (rheumatoid and osteoarthritis)	
2	Osteoporosis	
3	Asthma	
4	Chronic Obstructive Pulmonary Disease (COPD), acute respiratory distress syndrome (ARDS) or emphysema	
5	Angina	
6	Congestive heart failure (or heart disease)	
7	Heart attack (myocardial infarction)	
8	Neurological disease (e.g. Multiple sclerosis or Parkinson's disease)	
9	Stroke or transient ischemic attack (TIA)	
10	Peripheral vascular disease	
11	Diabetes (type I and II)	
12	Upper gastrointestinal disease (e.g. ulcer, hernia, reflux)	
13	Depression	
14	Anxiety or panic disorders	
15	Visual impairment (e.g. cataracts, glaucoma, macular degeneration)	
16	Hearing impairment (i.e. very hard of hearing even with hearing aids)	
17	Degenerative disc disease (e.g. back disease, spinal stenosis or severe chronic back pain)	
18	Obesity defined as Body mass index (BMI) >30 (weight in kilograms divided by height ^{2} in meters = w/h^2)	
	TOTAL SCORE	

APPENDIX I DEMORTON MOBILITY INDEX (DEMMI)

Patient Number: _____
Date: _____
Date of surgery: _____

	0	1	2
Bed			
1. Bridge	□ Unable	□ Able	
2. Roll unto side	□ Unable	□ Able	
3. Lying to sitting	□ Unable	□ Min assist □ Supervision	□ Independent
Chair			
4. Sit unsupported in chair	□ Unable	□ 10 sec	
5. Sit to stand from chair	□ Unable	□ Min assist □ Supervision	□ Independent
6. Sit to stand without using arms	□ Unable	□ Able	
Static balance (no gait aid)			
7. Stand unsupported	□ Unable	□ 10 sec	
8. Stand feet together	□ Unable	□ 10 sec	
9. Stand on toes	□ Unable	□ 10 sec	
10. Tandem stand with eyes closed	□ Unable	□ 10 sec	
Walking			
11. Walking distance +/- gait aid *Gait aid (circle): nil/frame/stick/other*	□ Unable □ 5m	□ 10m □ 20m	□ 50m
12. Walking independence	□ Unable □ Min assist □ Supervision	□ Independent with gait aid	□ Independent without gait aid
Dynamic balance (no gait aid)			
13. Pick up pen from floor	□ Unable	1. Able	
14. Walks 4 steps backwards	□ Unable	2. Able	
15. Jump	□ Unable	3. Able	
Column total score			

Comments:

Raw score total (sum of column total scores) /19

Demmi score (mdc$_{90}$ = 9 points; mcid = 10 points) /100

Easiest
Sit unsupported
Bridge
Stand unsupported
Sit to stand
Roll
Lie to sit
Standing feet together
Pick up pen from floor
Walk backwards
Walking distance
Sit to stand no arms
Walking independence
Jump
Stand on toes
Tandem stand eyes closed
Hardest

Raw-DEMMI Score Conversion Table

RAW SCORE	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
DEMMI SCORE	0	8	15	20	24	27	30	33	36	39	41	44	48	53	57	62	67	74	85	100

APPENDIX J LAWTON INSTRUMENTAL ACTIVITIES OF DAILY LIVING (IADL)

Patient Number: _____
Date: _____
Date of surgery: _____

Scoring: For each category, circle the item description that most closely resembles the client's highest functional level (either 0 or 1).

Ability to Use Telephone

1. Operates telephone on own initiative – looks up and dials numbers etc.	1
2. Dials a few well known numbers	1
3. Answers telephone but does not dial	1
4. Does not use telephone at all	0

Shopping

1. Takes care of all shopping needs independently	1
2. Shops independently for small purchases	0
3. Needs to be accompanies on any shopping trip	0
4. Completely unable to shop	0

Food Preparation*

1. Plans, prepares and serves adequate meals independently	1
2. Prepares adequate meals if supplied with the ingredients	0
3. Heats, serves and prepares meals or prepares meals but does not maintain adequate diet	0
4. Needs to have meals prepared and served	0

Housekeeping *

1. Maintains house alone or with occasional assistance (e.g. heavy work domestic help)	1
2. Performs light daily tasks such as dish washing, bed making	1
3. Performs light daily tasks but cannot maintain an acceptable level of cleanliness	1
4. Needs help with all home maintenance tasks	1
5. Does not participate in any housekeeping tasks	0

(Graf, 2008)

Laundry*

1. Does personal laundry completely	1
2. Launders small items (rinses stockings etc.)	1
3. All laundry must be done by others	0

Mode of Transportation

1. Travels independently on public transportation or drives own car	1
2. Arranges own travel via taxi, but does not otherwise use public transport	1
3. Travels on public transportation when accompanied by another	1
4. Travel limited to taxi or automobile with assistance of another	0
5. Does not travel at all	0

Responsibility for Own Medications

1. Is responsible for taking medication in correct dosages at correct time	1
2. Takes responsibility if medication is prepared in advance in separate dosages	0
3. Is not capable of dispensing own medication	0

Ability to Handle Finances

1. Manages financial matters independently (budgets, writes checks, pays rent, bills, goes to bank), collects and keeps track of income.	1
2. Manages day-to-day purchases, but needs help with banking, major purchases, etc.	1
3. Incapable of handling money.	0

SCORE Ranges from 0 (low function, dependent) to 8 (high function, independent) for women and 0 through 5 for men when relevant.	

APPENDIX K SIX MINUTE WALK TEST

Patient Number: _____
Date: _____
Date of surgery: _____

	Baseline	End
Time (hr:min)		
Dyspnoea (Borg scale)		
Fatigue (Borg scale)		
	Laps	**Distance (m)**
Total tick marks		
Final lap	----------	
Total distance	----------	
	Comments	
Medications (dose and time taken)		
Stopped to rest during testing (time stopped, length of rest, reason)		
Stopped and discontinued testing (time stopped, reason)		
Assistive device used during the test	☐ None ☐ Cane/walking stick ☐ Crutches ☐ Walking frame	

The Borg Scale	
0	Nothing at all
0.5	Just noticeable
1	Very slight
2	Slight/light
3	Moderate
4	Somewhat severe
5	Severe/heavy
6	
7	Very severe
8	
9	
10	Maximal

0 1 3 5 7 10

Modified from: (Crapo *et al.*, 2002),
Images from Google

APPENDIX L RANDOMISATION LISTS

MSc Ms Rozelle Labuschagne - Randomisation

Category 1 (strata 1)	Age 60-69 yrs; FCI score 0-9
Category 2 (strata 2)	Age 60 -69 yrs; FCI score 10-18
Category 3 (strata 3)	Age 70-79 yrs; FCI score 0-9
Category 4 (strata 4)	Age 70-79 yrs; FCI score 10-18
Category 5 (strata 5)	Age 80 and older; FCI score 0-9
Category 6 (strata 6)	Age 80 and older: FCI score 10-18

Category 1 (Age 60-69 yrs; FCI 0-9)

control	0,549894	Block 1	1 Sort smallest to largest
control	0,212892		2
control	0,302554		3
intervention	0,485628		4
intervention	0,42183		5
control	0,546496		6
intervention	0,845436		7
control	0,58805		8
intervention	0,071181		9
intervention	0,452774		10
intervention	0,771863	Block 2	11
intervention	0,278531		12
intervention	0,728743		13
control	0,995274		14
control	0,910103		15
intervention	0,78132		16
intervention	0,771563		17
control	0,515425		18
control	0,473739		19
control	0,417603		20
intervention	0,602085	Block 3	21
control	0,558027		22
control	0,79909		23
control	0,045111		24
control	0,890831		25
intervention	0,211858		26
intervention	0,454907		27
intervention	0,087759		28
control	0,919157		29
intervention	0,07488		30
intervention	0,364238	Block 4	31
intervention	0,298245		32
control	0,33659		33
control	0,398008		34
control	0,977901		35
control	0,941775		36
intervention	0,693622		37
intervention	0,398118		38
control	0,776056		39
intervention	0,336056		40
intervention	0,796448	Block 5	41
intervention	0,484675		42
intervention	0,88765		43
control	0,255144		44
control	0,536914		45
control	0,534899		46
intervention	0,591645		47
intervention	0,281281		48
control	0,65832		49
control	0,185485		50
intervention	0,732398	Block 6	51

intervention	0,058741		52
control	0,646458		53
intervention	0,428129		54
control	0,817325		55
intervention	0,373451		56
control	0,730632		57
control	0,058441		58
control	0,208837		59
intervention	0,908548		60
control	0,739451	Block 7	61
control	0,121566		62
intervention	0,396192		63
control	0,143763		64
intervention	0,625259		65
intervention	0,013498		66
control	0,58408		67
control	0,589054		68
intervention	0,816459		69
intervention	0,599827		70
control	0,06161	Block 8	71
intervention	0,357372		72
control	0,305687		73
intervention	0,234439		74
intervention	0,598223		75
control	0,627173		76
control	0,887551		77
control	0,710069		78
intervention	0,877912		79
intervention	0,688099		80
intervention	0,18259	Block 9	81
control	0,107431		82
intervention	0,712372		83
intervention	0,503254		84
control	0,171096		85
intervention	0,934995		86
control	0,193511		87
control	0,318914		88
control	0,755669		89
intervention	0,46579		90
control	0,734398	Block 10	91
intervention	0,761288		92
control	0,755377		93
intervention	0,272989		94
control	0,484085		95
control	0,403778		96
intervention	0,6676		97
intervention	0,01875		98
intervention	0,454678		99
control	0,77642		100

Category 2: Age 60-69; FCI 10-18

control	0,516893	Block 1	1
intervention	0,632261		2
control	0,575955		3
intervention	0,191149		4
control	0,272193		5
control	0,581629		6
intervention	0,435849		7
intervention	0,302186		8
control	0,618014		9
intervention	0,4759		10
intervention	0,041221	Block 2	11
control	0,244078		12
intervention	0,634809		13
control	0,509513		14
control	0,541612		15
intervention	0,633272		16
intervention	0,811107		17
intervention	0,640908		18
control	0,710173		19
control	0,106764		20
intervention	0,030973	Block 3	21
control	0,090977		22
intervention	0,673363		23
control	0,830442		24
control	0,074306		25
intervention	0,718667		26
intervention	0,131104		27
intervention	0,296751		28
control	0,832492		29
control	0,266397		30
control	0,201045	Block 4	31
intervention	0,102657		32
intervention	0,591422		33
intervention	0,207304		34
control	0,116705		35
control	0,095934		36
control	0,404801		37
intervention	0,011123		38
intervention	0,196201		39
control	0,467039		40
control	0,815164	Block 5	41
intervention	0,145527		42
control	0,567821		43
intervention	0,39598		44
control	0,787535		45
control	0,210743		46
control	0,404793		47
intervention	0,789848		48
intervention	0,476596		49
intervention	0,889625		50
control	0,835803	Block 6	51

control	0,568539		52
intervention	0,703212		53
control	0,967206		54
intervention	0,346785		55
intervention	0,978009		56
intervention	0,52124		57
control	0,103775		58
control	0,864869		59
intervention	0,198355		60
control	0,748007	Block 7	61
intervention	0,390716		62
intervention	0,450956		63
control	0,752387		64
intervention	0,501922		65
control	0,92897		66
control	0,099947		67
intervention	0,277633		68
control	0,03418		69
intervention	0,799632		70
intervention	0,321765	Block 8	71
control	0,530803		72
control	0,113169		73
intervention	0,095827		74
intervention	0,968862		75
control	0,207762		76
control	0,098124		77
control	0,179291		78
intervention	0,518866		79
intervention	0,842682		80
intervention	0,590469	Block 9	81
intervention	0,380051		82
control	0,26124		83
intervention	0,904932		84
control	0,005514		85
intervention	0,316859		86
intervention	0,868786		87
control	0,217197		88
control	0,532884		89
control	0,004773		90
intervention	0,387977	Block 10	91
intervention	0,13245		92
control	0,897539		93
control	0,912182		94
intervention	0,549542		95
intervention	0,562609		96
control	0,333961		97
control	0,620424		98
control	0,713682		99
intervention	0,650994		100

Category 3: Age 70-79 yrs; FCI 0-9

control	0,51613	Block 1	1
intervention	0,645367		2
control	0,584747		3
intervention	0,004882		4
control	0,554818		5
control	0,544123		6
intervention	0,412561		7
intervention	0,667556		8
intervention	0,780984		9
control	0,80962		10
control	0,123755	Block 2	11
intervention	0,668528		12
intervention	0,290032		13
control	0,897191		14
intervention	0,392664		15
control	0,568051		16
control	0,595681		17
intervention	0,06865		18
intervention	0,170436		19
control	0,452856		20
control	0,105995	Block 3	21
intervention	0,593436		22
control	0,621995		23
intervention	0,845801		24
intervention	0,264915		25
control	0,339342		26
intervention	0,607448		27
intervention	0,974419		28
control	0,229579		29
control	0,879291		30
intervention	0,358044	Block 4	31
intervention	0,276447		32
control	0,388615		33
control	0,156551		34
control	0,388894		35
intervention	0,821729		36
intervention	0,187432		37
control	0,408918		38
intervention	0,453038		39
control	0,412943		40
control	0,648658	Block 5	41
intervention	0,304509		42
control	0,541178		43
control	0,696352		44
intervention	0,851063		45
control	0,881435		46
intervention	0,306723		47
intervention	0,451231		48
intervention	0,191862		49
control	0,650359		50
intervention	0,83294	Block 6	51

control	0,399642		52
control	0,365874		53
intervention	0,58027		54
control	0,484941		55
intervention	0,49752		56
control	0,957029		57
intervention	0,162479		58
control	0,361651		59
intervention	0,275339		60
intervention	0,421849	Block 7	61
control	0,905141		62
intervention	0,990962		63
intervention	0,633152		64
control	0,800334		65
control	0,315314		66
intervention	0,65541		67
intervention	0,091818		68
control	0,637064		69
control	0,668239		70
intervention	0,197421	Block 8	71
control	0,389871		72
control	0,611255		73
intervention	0,234766		74
intervention	0,990833		75
control	0,352598		76
control	0,300346		77
intervention	0,273506		78
intervention	0,291342		79
control	0,468184		80
control	0,54684	Block 9	81
intervention	0,856976		82
intervention	0,135803		83
control	0,911906		84
control	0,911795		85
control	0,792128		86
control	0,292957		87
intervention	0,183764		88
intervention	0,590394		89
intervention	0,065144		90
intervention	0,32864	Block 10	91
intervention	0,116409		92
control	0,880423		93
control	0,580836		94
intervention	0,240984		95
control	0,812842		96
control	0,413596		97
intervention	0,658818		98
control	0,012378		99
intervention	0,032148		100

Category 4: Age 70-79 yrs: FCI 10-18

intervention	0,097949	Block 1	1
control	0,151557		2
intervention	0,544438		3
intervention	0,164439		4
control	0,987198		5
control	0,237743		6
control	0,428774		7
intervention	0,98512		8
control	0,54893		9
intervention	0,159625		10
control	0,233623	Block 2	11
intervention	0,83703		12
intervention	0,942782		13
control	0,512578		14
control	0,737194		15
intervention	0,69178		16
intervention	0,800185		17
control	0,334039		18
control	0,648381		19
intervention	0,455765		20
control	0,96532	Block 3	21
intervention	0,713673		22
intervention	0,983553		23
intervention	0,492346		24
control	0,698357		25
control	0,463177		26
control	0,185968		27
intervention	0,197563		28
intervention	0,778013		29
control	0,389029		30
intervention	0,157566	Block 4	31
control	0,432836		32
control	0,543104		33
intervention	0,290202		34
control	0,321878		35
control	0,204285		36
intervention	0,939394		37
intervention	0,960882		38
intervention	0,367108		39
control	0,998631		40
control	0,565577	Block 5	41
control	0,288215		42
intervention	0,536632		43
control	0,257633		44
intervention	0,904687		45
intervention	0,279486		46
control	0,564202		47
intervention	0,138073		48
intervention	0,654183		49
control	0,944825		50
control	0,903975	Block 6	51

intervention	0,84294		52
intervention	0,366222		53
control	0,385745		54
control	0,042808		55
intervention	0,839971		56
intervention	0,888097		57
control	0,89673		58
control	0,47054		59
intervention	0,311451		60
control	0,3126	Block 7	61
intervention	0,555651		62
control	0,544215		63
intervention	0,470577		64
control	0,762633		65
control	0,538214		66
intervention	0,402139		67
intervention	0,153856		68
control	0,859786		69
intervention	0,686695		70
intervention	0,563353	Block 8	71
intervention	0,968684		72
control	0,024197		73
intervention	0,68515		74
control	0,955257		75
control	0,801476		76
control	0,310296		77
control	0,680083		78
intervention	0,470802		79
intervention	0,010321		80
control	0,087146	Block 9	81
intervention	0,436836		82
intervention	0,663479		83
control	0,815394		84
intervention	0,477629		85
control	0,501179		86
intervention	0,90416		87
intervention	0,419083		88
control	0,810478		89
control	0,790064		90
control	0,69013	Block 10	91
intervention	0,776984		92
control	0,00628		93
intervention	0,353124		94
intervention	0,604188		95
control	0,720782		96
intervention	0,420614		97
intervention	0,957842		98
control	0,952423		99
control	0,53696		100

Category 5: 80 years and older: FCI 0-9

intervention	0,258977	Block 1	1
control	0,871693		2
intervention	0,533668		3
control	0,128773		4
intervention	0,309865		5
intervention	0,826061		6
intervention	0,281691		7
control	0,933916		8
control	0,249371		9
control	0,018738		10
control	0,494471	Block 2	11
intervention	0,443278		12
control	0,780027		13
control	0,596125		14
intervention	0,656024		15
control	0,390868		16
intervention	0,026717		17
control	0,662167		18
intervention	0,234239		19
intervention	0,298893		20
control	0,482237	Block 3	21
control	0,441916		22
intervention	0,458305		23
intervention	0,529682		24
intervention	0,877908		25
control	0,788145		26
control	0,24679		27
control	0,642412		28
intervention	0,01373		29
intervention	0,259528		30
control	0,70318	Block 4	31
intervention	0,122045		32
intervention	0,404623		33
control	0,084234		34
intervention	0,203931		35
control	0,54857		36
control	0,700242		37
intervention	0,060493		38
control	0,162772		39
intervention	0,373142		40
control	0,41225	Block 5	41
intervention	0,96392		42
control	0,214703		43
control	0,245097		44
control	0,327635		45
control	0,541588		46
intervention	0,82578		47
intervention	0,788988		48
intervention	0,610061		49
intervention	0,434513		50
control	0,69155	Block 6	51

control	0,140143		52
intervention	0,648626		53
intervention	0,580387		54
intervention	0,350905		55
control	0,243744		56
control	0,325666		57
control	0,190063		58
intervention	0,405143		59
intervention	0,103163		60
control	0,700654	Block 7	61
intervention	0,773515		62
intervention	0,538749		63
control	0,944491		64
intervention	0,837269		65
intervention	0,292487		66
control	0,212131		67
control	0,080054		68
intervention	0,99664		69
control	0,205895		70
control	0,9943	Block 8	71
intervention	0,016291		72
control	0,782734		73
control	0,459482		74
intervention	0,940753		75
intervention	0,654627		76
control	0,483398		77
intervention	0,642085		78
intervention	0,184306		79
control	0,827713		80
control	0,277104	Block 9	81
control	0,921273		82
intervention	0,489367		83
control	0,124054		84
control	0,576207		85
intervention	0,92423		86
intervention	0,837824		87
intervention	0,860526		88
control	0,745803		89
intervention	0,130102		90
intervention	0,486157	Block 10	91
control	0,918421		92
control	0,46971		93
control	0,936918		94
intervention	0,691939		95
intervention	0,004842		96
intervention	0,808927		97
control	0,759137		98
control	0,308723		99
intervention	0,449315		100

Category 6: Older 80 years; FCI 10-18

intervention	0,980142	Block 1	1
control	0,258506		2
control	0,080874		3
intervention	0,952828		4
intervention	0,655013		5
intervention	0,683157		6
control	0,069642		7
control	0,292515		8
control	0,862195		9
intervention	0,566301		10
control	0,905049	Block 2	11
control	0,944088		12
intervention	0,268855		13
control	0,297263		14
intervention	0,120629		15
control	0,383021		16
intervention	0,890668		17
intervention	0,071766		18
control	0,508907		19
intervention	0,27338		20
control	0,924652	Block 3	21
control	0,628465		22
intervention	0,878062		23
intervention	0,600729		24
intervention	0,215631		25
control	0,334416		26
intervention	0,359469		27
control	0,220527		28
control	0,790524		29
intervention	0,244358		30
control	0,486317	Block 4	31
intervention	0,5212		32
control	0,975993		33
intervention	0,677523		34
intervention	0,779212		35
control	0,069934		36
intervention	0,024305		37
intervention	0,284215		38
control	0,587192		39
control	0,949732		40
intervention	0,798879	Block 5	41
control	0,122447		42
control	0,769679		43
control	0,976752		44
intervention	0,99863		45
intervention	0,855567		46
control	0,668054		47
intervention	0,454565		48
intervention	0,048844		49
control	0,771841		50
control	0,948873	Block 6	51

intervention	0,945062		52
control	0,906317		53
control	0,296946		54
intervention	0,398596		55
intervention	0,639296		56
control	0,280163		57
intervention	0,230774		58
intervention	0,636027		59
control	0,71553		60
intervention	0,680472	Block 7	61
intervention	0,000786		62
control	0,751196		63
control	0,86577		64
control	0,364219		65
intervention	0,8466		66
control	0,549922		67
control	0,489025		68
intervention	0,382097		69
intervention	0,309949		70
control	0,183769	Block 8	71
intervention	0,588129		72
intervention	0,991692		73
intervention	0,803485		74
control	0,718686		75
intervention	0,476181		76
intervention	0,786303		77
control	0,697154		78
control	0,104807		79
control	0,142218		80
intervention	0,879118	Block 9	81
intervention	0,453772		82
intervention	0,536179		83
control	0,33734		84
control	0,694628		85
control	0,184667		86
intervention	0,967827		87
control	0,418647		88
intervention	0,257421		89
control	0,783039		90
intervention	0,97864	Block 10	91
control	0,903872		92
control	0,617821		93
intervention	0,568765		94
intervention	0,712524		95
control	0,627288		96
intervention	0,311952		97
intervention	0,256461		98
control	0,692722		99
control	0,104629		100

APPENDIX M HOSPITAL INFORMATION DOCUMENT

Study Title: The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery

Dear Hospital Manager,

I, Rozelle Labuschagne, am doing research on the effect of a single pre-operative physiotherapy session on the physical function of elderly patients after abdominal surgery. Research shows that any patient, especially the old and frail, physically decline post-surgery. I want to determine if a single pre-operative physiotherapy exercise and education session can assist in the optimisation of physical function. Normal physiotherapy protocol calls only for post-surgical mobilisation and chest therapy. Research suggests that pre-operative intervention may decrease the prevalence of post-operative pulmonary complications and improve the amount of mobilisation in hospital.

I will evaluate the participants three separate times, twice will be at the private practice physiotherapy rooms, but the other evaluation will be in hospital. At discharge from hospital the DeMorton Mobility Index (DEMMI) and six minute walk test (6MWT) will be re-evaluated. This will take approximately 20 minutes. I will also need to look through the hospital file in order to complete the Functional Comorbidity Index (FCI) and document the clinical outcomes (length of hospital and ICU stay, length of mechanical ventilation, day of first mobilisation and development of PPC).

All participants will consent to participation prior to surgery and may withdraw at any time. Participants will not be billed for the evaluations. Surgeons all agree to involvement in the study.

I am asking for a letter of permission to evaluate these participants and access their files in your hospital. Should you have any queries please contact me. Thank you in advance.

Rozelle Labuschagne (0724742248)

APPENDIX N HOSPITAL APPROVALS RUSTENBURG

Life Peglerae Hospital
173 Beyers Naude Drive, Rustenburg 0299
PO Box 244, Rustenburg 0300
Telephone: +27 14 597 7200
www.pegleraehospital.co.za

Date: 4 July 2018

Rozelle Labuschagne

Email: rozelle.labuschagne@gmail.com

BY EMAIL

Re: Research project in Life Peglerae

To whom it may concern

We were approached by R Labuschagne for permission to evaluate the participants and access their files in your hospital.

We will grant her permission with the following conditions:

- No personal information may be disclosed in accordance with the POPI and PAYA acts.
- We will not recover files from archive for you to have access to the information
- You will only approach your own patients; no other physio practice patients will be involved.
- You must keep proof of all patients consent to participate in your study.

Yours sincerely,

Denise Botha
Hospital Manager

A subsidiary of Life Healthcare Group (Proprietary) Limited
Reg. no. 2001/022088/07 Registered address Oxford Manor, 21 Chaplin Road, Illovo 2196,
Private Bag X13, Northlands 2116 Directors: DB Le Roux, Dr CWS Mbekeni, JP Snyman, JR Holder, PF Theron
Peglerae Hospital (Pty) Ltd trading as Life Peglerae Hospital

Medi Care
Private Hospital

271 Beyers Naude Drive,Rustenburg
Tel: (014) 523 9300
Fax: (014) 5920516
PO Box 380. Rustenburg 0300
www.rustenburgmedicine.co.za

17/07/2018

To whom it may concern

Hereby Medicare Rustenburg is giving Rozelle Labuschagne consent to complete her research at our facility under the following conditions:

1. Patient information and condition privacy
2. Respect for patient's privacy
3. Respect for nursing staff to complete duties and responsibilities.
4. Behaving and practice in such a way to do no harm to the company nor patients.

We wish her well on her path.

Regards

Anja Moolman Markram

Hospital Matron/QRS

HOSPITAL PRACTICE NO. 041 7491

APPENDIX O EMPLOYER APPROVAL RUSTENBURG

Study Title: The Effect Of A Single Pre-Operative Physiotherapy Session On Physical Function In Elderly Patients Following Abdominal Surgery

Dear Marius and Gian,

I, Rozelle Labuschagne, am doing research on the effect of a single pre-operative physiotherapy session on the physical function of elderly patients after abdominal surgery. Research shows that any patient, especially the old and frail, physically decline post-surgery. I want to determine if a single pre-operative physiotherapy exercise and education session can assist in the optimisation of physical function. Normal physiotherapy protocol calls only for post-surgical mobilisation and chest therapy. Research suggests that pre-operative intervention may decrease the prevalence of post-operative pulmonary complications and improve the amount of mobilisation in hospital.

I am aiming for a sample of 100 participants. Half of the participants will be in the control group. The intervention group will receive a detailed explanation, demonstration and assistance with exercises (such as bridging, thoracic expansion and upper limb mobility) and education on the importance of early mobilisation, deep breathing exercises and coughing with wound support. Participants will be encouraged to continue these exercises pre-operatively, during hospitalisation (where all will receive protocol in patient physiotherapy) until two weeks after surgery.

I will determine physical function by using the Functional Comorbidity Index, Lawton-Brody Instrumental Activities of Daily Living (IADL), the DeMorton Mobility Index (DEMMI) and the six minute walk test (6MWT). At baseline (pre-operative) all outcomes will be evaluated. At discharge from hospital the DEMMI and 6MWT will be re-evaluated and the FCI will be retrospectively checked along with clinical outcomes (length of hospital and ICU stay, length of mechanical ventilation, day of first mobilisation and development of PPC). At the two week follow-up the Lawton-Brody IADL, DEMMI and 6MWT will be re-evaluated.

I need your permission to use consultation room one at the practice rooms during business hours for the baseline and follow-up evaluations of participants as well as for the intervention pre-surgery.

Should you have any queries please contact me. Thank you in advance.

Rozelle Labuschagne

0724742248

Study Title: The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery

We hereby agree to allow the researcher to use consultation room one at the practice rooms for the evaluation of participants at baseline and two week follow-up and for the intervention pre-surgery.

We are aware that the exercise and education session will be done by Rone Reynecke, a physiotherapist in our employ. We are aware that Rene Geldenhuys, a receptionist in our employ, will assist with administration.

We understand that the physiotherapeutic evaluation and intervention that form part of this study may not be billed to the participant. The protocol treatment in hospital may however be charged as normal. Participants will be reimbursed for their expenses in taking part in this study such as travel.

Signature Marius deBruyn: _____

Signature Gian Jacobs: _____

Practice Number: 7235585

Date: 12/7/2018

Signature of researcher: _____

APPENDIX P SURGEON INFORMATION DOCUMENT RUSTENBURG

Study Title: The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery

Dear Surgeon,

I, Rozelle Labuschagne, am a registered MSc student at the University of the Witwatersrand and doing research on the effect of a single pre-operative physiotherapy session on the physical function of elderly patients after abdominal surgery. Research shows that any patient, especially the elderly and frail, physically decline post-surgery. I want to determine if a single pre-operative physiotherapy exercise and education session can assist in the optimisation of physical function. Normal physiotherapy protocol calls only for post-surgical mobilisation and chest therapy. Research suggests that pre-operative intervention may decrease the prevalence of post-operative pulmonary complications and improve the amount of mobilisation in hospital. Please refer to the two articles attached.

I am asking you to consider referring patients (that fit the inclusion criteria as attached) to me as I need a sample of 100 participants, for this research study. I am a full-time employee at Marius deBruyn and Gian Jacobs Physiotherapists and my employers have agreed to assist me with my MSc project.

Participation in the research study will be voluntary and patients can choose whether they want to participate in the pre-operative physiotherapy programme. The research study will involve three physiotherapy assessments: one prior to hospital admission, one at hospital discharge and the last two weeks post hospital discharge. Participants will not be billed for any of these three assessments and will be reimbursed R100 for their travel expenses. The pre-operative physiotherapy intervention that they receive as part of the research study will be free to them. While patients are in hospital, your normal post-operative protocol in terms of physiotherapy services can be followed as this does not form part of my research study.

If you agree to assist with the referral of patients for this MSc research study, please sign the attached consent form as confirmation of your willingness. You are welcome to keep a copy for your own records.

If possible could potential participants be handed the information sheet of the study at your practice reception desk for them to consider participating in the study. The information sheet explains the purpose of the study and that they are free to choose whether or not to assist with this study.

Should you have any queries please contact me.

Thank you for considering my request.

Regards,

Rozelle Labuschagne

0724742248

Inclusion criteria

- 60 years and older
- Walking with or without a mobility aid
- Scheduled for elective abdominal surgery
- At least one week delay before surgery
- Proficient in English

Exclusion criteria

- Individuals with a known documented diagnosis of dementia or Alzheimer's disease
- Diagnosed with an acute respiratory infection within two weeks of potential study participation
- Cardiovascular instability (such as unstable angina and NYHA class 4 heart failure)
- Use of immunosuppressive medication for 30 days before surgery
- Surgery with associated chest wall manipulation

NOTE: The following articles will be attached for surgeons to review: (Boden *et al.*, 2015; Hoogeboom *et al.*, 2014)

APPENDIX Q SURGEONS CONSENT

Study Title: The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery

I _____ am willing to assist in this research study by referring suitable patients to Rozelle Labuschagne who is busy with a MSc research project. I understand the purpose of this study as described to me in the information letter.

Signature of surgeon: _____

Date: _____

Signature of researcher: _____

Stamp:

Physiotherapy Department

Faculty of Health Sciences · Private Bag 3, Wits, 2050, South Africa
Tel: +27 11 717 3723 · Fax: 0865703644 · E-mail: ronel.roos@wits.ac.za · www.wits.ac.za

2019-07-05

Dear Dr Penny,

Re: MSc protocol (M180561) – Ms Rozelle Labuschagne

Ms Rozelle Labuschagne is registered as MSc student in the Department of Physiotherapy at Wits University. Adjustments regarding the clinical site where her study will be conducted require change due to relocating to a different city in South Africa. Ms Labuschagne has updated her protocol to reflect the new clinical site and relevant related parties in her revised protocol.

I trust this is in order.

Regards,

……

Dr Ronel Roos

Supervisor

APPENDIX S HOSPITAL APPROVAL PRETORIA

MEDICLINIC

MEDICLINIC CORPORATE OFFICE
25 DU TOIT STREET
STELLENBOSCH
7600
SOUTH AFRICA

PO BOX 456
STELLENBOSCH
7599
SOUTH AFRICA

T +27 21 809 6500

www.mediclinic.co.za

06 June 2019

Mrs R Labuschagne
68 Nyala Rock Estate
Waterfall East Rustenburg
0299

rozelle. labuschagne@gmail.com

Dear Mrs Labuschagne

PERMISSION TO **CONDUCT RESEARCH** AT **MEDICLINIC MIDSTREAM**

Your research proposal entitled “The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery” refers.

It is in order for you to conduct your research at Mediclinic Midstream, and I wish you success with this project.

Yours sincerely

Chrd uPlessis

General Manager Clinical Services
MEDICLINIC SOUTHERN AFRICA

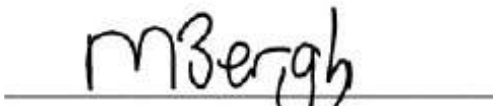
APPENDIX T EMPLOYER APPROVAL PRETORIA

Study Title: The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery

I hereby agree to allow the researcher to use consultation room one at the practice rooms for the evaluation of participants at baseline and two week follow-up and for the intervention pre-surgery.

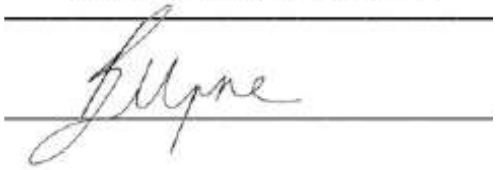
I am aware that the exercise and education session will be done by Monique Bergh or Tone Marais, a physiotherapist in my employ. I am aware that Alicia, a receptionist in my employ, will assist with administration.

I understand that the physiotherapeutic evaluation and intervention that form part of this study may not be billed to the participant. The protocol treatment in hospital may however be charged as normal. Participants will be reimbursed for their expenses in taking part in this study such as travel.

Signature Monique Bergh: 

Practice Number: 0575712

Date: 01/05/2019

Signature Researcher: 

APPENDIX U SURGEONS INFORMATION LETTER PRETORIA

Study Title: The Effect of a Single Pre-Operative Physiotherapy Session on Physical Function in Elderly Patients Following Abdominal Surgery

Dear Surgeon,

I, Rozelle Labuschagne, am a registered MSc student at the University of the Witwatersrand and doing research on the effect of a single pre-operative physiotherapy session on the physical function of elderly patients after abdominal surgery. Research shows that any patient, especially the elderly and frail, physically decline post-surgery. I want to determine if a single pre-operative physiotherapy exercise and education session can assist in the optimisation of physical function. Normal physiotherapy protocol calls only for post-surgical mobilisation and chest therapy. Research suggests that pre-operative intervention may decrease the prevalence of post-operative pulmonary complications and improve the amount of mobilisation in hospital. Please refer to the two articles attached.

I am asking you to consider referring patients (that fit the inclusion criteria as attached) to me as I need a sample of 100 participants, for this research study. I am a full-time employee at Bergh and Cilliers Physiotherapists and my employer has agreed to assist me with my MSc project.

Participation in the research study will be voluntary and patients can choose whether they want to participate in the pre-operative physiotherapy programme. The research study will involve three physiotherapy assessments: one prior to hospital admission, one at hospital discharge and the last two weeks post hospital discharge. Participants will not be billed for any of these three assessments and will be reimbursed R100 for their travel expenses. The pre-operative physiotherapy intervention that they receive as part of the research study will be free to them. While patients are in hospital, your normal post-operative protocol in terms of physiotherapy services can be followed as this does not form part of my research study.

If you agree to assist with the referral of patients for this MSc research study, please sign the attached consent form as confirmation of your willingness. You are welcome to keep a copy for your own records.

If possible could potential participants be handed the information sheet of the study at your practice reception desk for them to consider participating in the study. The information sheet explains the purpose of the study and that they are free to choose whether or not to assist with this study.

Should you have any queries please contact me.

Thank you for considering my request.

Regards,

Rozelle Labuschagne

0724742248

Inclusion criteria

- 60 years and older
- Walking with or without a mobility aid
- Scheduled for elective abdominal surgery
- At least one week delay before surgery
- Proficient in English

Exclusion criteria

- Individuals with a known documented diagnosis of dementia or Alzheimer's disease
- Diagnosed with an acute respiratory infection within two weeks of potential study participation
- Cardiovascular instability (such as unstable angina and NYHA class 4 heart failure)
- Use of immunosuppressive medication for 30 days before surgery
- Surgery with associated chest wall manipulation

NOTE: The following articles will be attached for surgeons to review: (Boden *et al.*, 2015; Hoogeboom *et al.*, 2014)

APPENDIX V RECEPTIONIST ALLOCATION CHART

The receptionist was asked to keep track of participants' numbers, names and allocated groups. This chart was given to the receptionist in electronic format and a printed version for ease of use. The researcher did not have access to this chart at any stage of data collection.

Participant Number	Participant Name and Surname	Allocated Group
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

APPENDIX W CODING FORM

This form was detached from the file and kept in a separate confidential folder.

Patient Number: _____

Date: _____

Date of surgery: _____

PLEASE NOTE THAT THE FOLLOWING INFORMATION IS HIGHLY CONFIDENTIAL.

Demographic Information	
Name	
Surname	
Home Address	
Home Telephone Number	
Cell Phone Number	
Proxy's Name	
Proxy's Contact Number	

APPENDIX X DEMMI STANDARD INSTRUCTIONS AND PROTOCOL

ITEM INSTRUCTIONS (De Morton *et al.*, 2008)

Bed

1. Person is lying supine and is asked to bend their knees and lift their bottom clear of the bed.
2. Person is lying supine and is asked to roll onto one side without external assistance.
3. Person is lying supine and is asked to sit up over the edge of the bed.

Chair

4. Person is asked to maintain sitting balance for 10 seconds while seated on the chair, without holding arm rests, slumping or swaying. Knees and feet are placed together and feet can be resting on the floor.
5. Person is asked to rise from sitting to standing using the arm rests of the chair.
6. Person is asked to stand with their arms crossed over their chest.

Static Balance

7. The person is asked if they can stand for 10 seconds without external support.
8. The person is asked if, for 10 seconds, they can stand with their feet together.
9. The person is asked if they can stand on their toes for 10 seconds.
10. The person is asked to place the heel of one foot directly in front of the other with their eyes closed for 10 seconds.

Walking

11. Persons will be asked to walk with their current gait aid to where they can without a rest. Testing ceases if the person stops to rest. The person uses the gait aid that is currently most appropriate for them. If either of two gait aids could be used, the aid that provides the person with the highest level of independence should be used. Testing ceases once the person reaches 50 meters.
12. Independence is assessed over the person's maximum walking distance up to 50m (from item 11).

Dynamic Balance

13. A pen is place 5 cm in front of the person's feet in standing. The person is asked to if they can pick the pen up off the floor.
14. Walks backwards 4 steps. Person remains steady throughout.
15. Person can jump. Both feet clear the ground. Person remains steady throughout.

Definitions

Minimal assistance = "hands on" physical but minimal assistance, primarily to guide movement.

Supervision = another person monitors the activity without providing hands on assistance. May include verbal prompting.

Independent = the presence of another person is not considered necessary for safe mobility.

The development of the DEMMI has been supported by a post graduate scholarship from the National Health and Medical Research Council of Australia (Dora Lush Postgraduate Scholarship, Grant no. 280632), funded by the HCF Health and Medical Research Foundation and also supported by The Northern Clinical Research Centre, Northern Health.
The DEMMI should be cited as: de Morton NA, Davidson M,

PROTOCOL FOR ADMINISTRATION OF THE DEMMI

(De Morton *et al.*, 2008)

1. Testing should be performed at the person's bedside.
2. Testing should be performed when the person has adequate medication e.g. at least half an hour after pain or Parkinson's disease medication.
3. The test should be administered in the sequence described in sections A-E: bed transfers, chair transfers, static balance, walking and dynamic balance.
4. Each item should be explained and, if necessary, demonstrated to the person.
5. Items should be ticked to indicate item success of failure. Reasons for not testing items should be recorded.
6. Items should not be tested if either the test administrator or the person performing the test are reluctant to attempt the item.
7. Persons should be scored based on their first attempts.
8. If an item is not appropriate given a person's medical condition, the item should not be tested and the reason recorded.
9. Persons can be encouraged but feedback should not be provided regarding performance.
10. Three equipment items are required: chair with 45cm seat height with arm rests, a hospital bed or plinth and a pen.
11. The person administrating the test manipulates person medical equipment during the testing (e.g. portable oxygen, drips, drains etc.) unless the person requires minimal assistance to perform the test and then a second person will be required to assist with medical equipment.
12. For persons that require a rest after each item due to shortness of breath, a 10 minute rest should be provided half way through the testing i.e. after completing the chair transfers section.
13. For person's who have low level mobility and require a hoist to transfer in/out of bed or chair, the chair section can be administered before the bed section for these persons.
14. **Bed transfers**: the bed height should be appropriate for the individual person. A standardised hospital bed or plinth should be used for testing. The person cannot use an external device such as the monkey bar, bed rail, edge of the bed or bed pole. Additional pillows may be provided for persons who are unable to lie flat in supine.
15. **Chair transfers**: a standardised chair height of 45cm is required, a firm chair with arms should be used.
16. **Balance**: shoes cannot be worn for balance testing. The person cannot use external support to successfully complete any balance items. For sitting balance, neither the arm rests nor can the back of the chair be used for external support. Standing balance tests should be performed with the person positioned between an elevated bed on one side and the test administrator on the other side. If a person displays unsteadiness or significant sway during testing, testing of that item should cease.
17. **Walking**: appropriate shoes can be worn for walking tests. The same shoes must be worn for repeat testing.
18. **Scoring**: using the conversion table provided, the raw score total must be converted to a DEMMI score.

The development of the DEMMI has been supported by a post graduate scholarship from the National Health and Medical Research Council of Australia (Dora Lush Postgraduate Scholarship, Grant no. 280632), funded by the HCF Health and Medical Research Foundation and also supported by The Northern Clinical Research Centre, Northern Health.

The DEMMI should be cited as: de Morton NA, Davidson M,

APPENDIX Y STANDARD PROTOCOL FOR ADMINISTRATION OF THE 6MWT

(Crapo et al., 2002)

Required Equipment

a. Worksheet and Pen
b. Countdown timer
c. A chair
d. Two markers to indicate turning points
e. Bean bag
f. Source of oxygen

Participant preparation

a. Participant to wear comfortable clothing
b. Participant to wear appropriate shoes for walking (same shoes to be worn on re-test)
c. Participant may use their usual walking aids
d. Participant's normal daily routine should have been followed prior to the test i.e. medication, meals, exercise

Measurement

a. Participant should be seated for at least 10 minutes before the test starts. During this time the Lawton-Brody IADL interview will be conducted, contraindications, clothing and shoes will be checked.
b. Participant will stand and rate their baseline dyspnoea and fatigue using the Borg scale
c. The researcher will set the timer to 6 minutes
d. The researcher and the participant will move to starting point
e. The researcher will give the following standard instruction to the participant:
   The object of this test is to walk as far as possible for 6 minutes. **You will walk back and forth in this hallway**. **Six minutes is a long time to walk**, **so you will be exerting yourself**. **You will probably get out of breath or become exhausted**. **You are permitted to slow down**, **stop**, **and rest as necessary**. **You may lean against the wall while resting but resume walking as soon as you are able**. **You will be walking back and forth around the cones**. **You should pivot briskly around the cones and continue back without hesitation**. **Now I am going to show you**. **Please watch the way I turn without hesitation**. (Demonstrate turning briskly) **Are you ready to do that? I am going to mark each lap to keep track of the**

number of laps you complete. I will make a mark each time you turn around at this starting line. Remember that the object is to walk as far as possible for 6 minutes but don't run or jog. Start now or whenever you are ready.

f. The researcher will stand with the participant at the starting line. When the participant starts to walk, the researcher will start the timer. The researcher will not walk with the participant.

g. The researcher will use an even voice when using the standard phrases and watch the patient closely without getting distracted. Each time the participant returns to the starting point, the researcher will mark the lap on the worksheet and let the participant see it. The researcher will give the participant **only** the following standard encouragements.
   - After the 1st minute: **You are doing well. You have 5 minutes to go.**
   - 4 min remaining: **Keep up the good work. You have 4 minutes to go.**
   - 3 min: **You are doing well. You are halfway done.**
   - 2 min: **Keep up the good work. You have only 2 minutes left.**
   - 1 min: **You are doing well. You have only 1 minute to go.**
   - 15sec: **In a moment I am going to tell you to stop. When I do just stop right where you are and I will come to you.**
   - Timer rings: **Stop**. The researcher will walk to the participant. The researcher will take the chair to the participant if they look exhausted. The researcher will mark the spot where the participant stopped by placing a bean bag on the floor.
   - If the participant stops and needs to rest: **You can lean against the wall if you would like, then continue walking whenever you feel able**. The researcher will not stop the timer. If the participant stops before the 6 minutes are over and cannot continue, the researcher will take the chair over for the participant to sit on and note the distance, time stopped and reason for stopping on the worksheet.

h. The researcher will assess and record the Borg dyspnoea and fatigue levels again and ask: **What if anything kept you from walking farther?**

i. The researchers will complete the worksheet.

j. The researcher will then congratulate the participant on a good effort and offer a drink of water.

FREE

PHYSIOTHERAPY

In preparation for your ABDOMINAL SURGERY

ARE YOU:

- 60 years or older
- Scheduled for abdominal surgery

YOU QUALIFY!

ASK YOUR SURGEON ABOUT THIS RESEARCH STUDY!

Come and see me directly following your appointment with your surgeon and get R50 for your time and trouble.

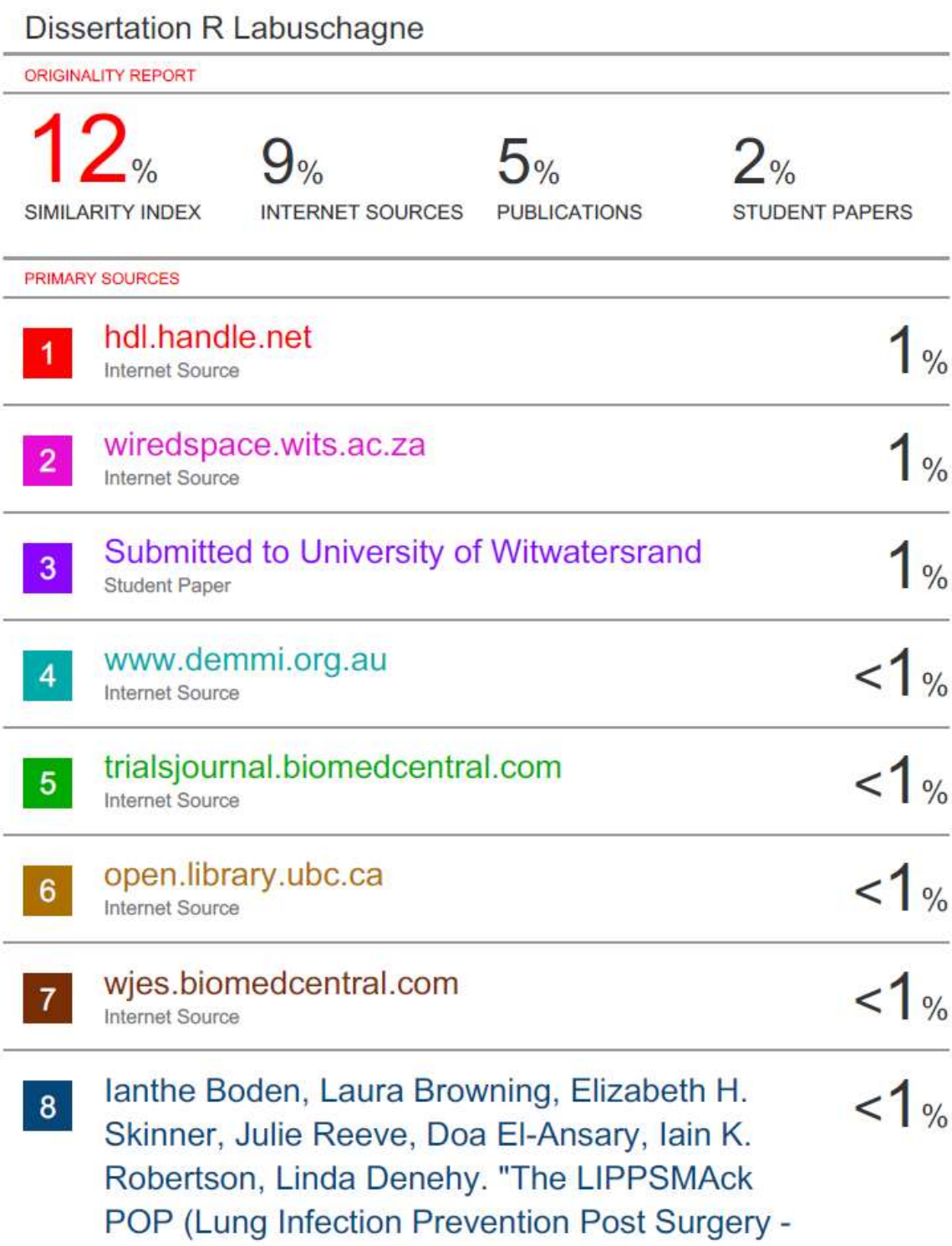
Suite 114, Midstream Hill Medical Park

(Just follow the corridor to the building next door, no need to drive)

Rozelle Labuschagne

072 474 2248

APPENDIX AA TURNITIN REPORT



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