

INVESTIGATING THE PHYSIOTHERAPY MANAGEMENT OF PATIENTS WITH POLYTRAUMA ADMITTED TO ACUTE CARE SETTINGS AND FACTORS THAT INFLUENCE SERVICE DELIVERY AFTER DISCHARGE: A NAMIBIAN SURVEY

Hannah E Chirombo

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfillment of the requirements for the degree of Masters of Science in Physiotherapy.

Windhoek, Namibia 7 June 2024

DECLARATION

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

A handwritten signature in black ink, appearing to read 'H. Chirombo', with a horizontal line underneath.

7 June 2024

ABSTRACT

Introduction: Globally 5.8 million deaths per year are because of multiple traumatic injuries with as much as 16,000 deaths a day. Traumatic physical injuries thus pose a notable risk worldwide resulting in morbidity and mortality. Most commonly road traffic collisions are the largest contributing factor to traumatic physical injuries. Namibia ranks highly in Africa in the proportion of cases of motor vehicle crashes (MVC) per population and are the fifth leading cause of death. With Namibia also ranking highly on violence, many people often require rehabilitation following physical trauma. Delivery and accessibility of rehabilitation services in Namibia is hindered by a critical shortage of rehabilitation service providers employed by the state as most are attracted by the private sector. In the existing literature, auditing of usual care physiotherapy practice following polytrauma is not frequently documented. For a country with a high incidence of MVCs, it is imperative to look at usual care in physiotherapy for patients with polytrauma.

Aim: To describe the physiotherapy management of patients with polytrauma in acute care settings in Namibia and the factors that influence service delivery to these patients after discharge.

Methodology: A cross-sectional survey was conducted using an electronic survey tool. A study-specific questionnaire was developed, and content validation of the questionnaire was conducted by two physiotherapy experts in the field of traumatology. Convenience sampling was used to invite all registered physiotherapists practicing in Namibia's state and/or private acute care facilities to participate (n=133). Descriptive statistics were used to summarise the data. Categorical data was summarized as frequencies and percentages and presented in tables, pie charts, and graphs. Continuous data were summarised as medians and interquartile ranges. Qualitative content analysis was done on data obtained from patients' answers to open-ended questions.

Results: Fifty-five questionnaire links were opened by the respondents; 52 responses were considered in this study yielding a 39% response rate (n=52/133). Female physiotherapists made up most of the respondents (n= 33; 64%). Most respondents were young with a median age of 30 years (IQR= 28-31) and an average of six years (IQR= 3.3-7) of clinical practice. Respondents worked in private institutions (n=18; 35%), public sector (n=16; 31%) and both public and private sector (n=18; 35%). The majority of the respondents encountered patients with polytrauma in the ICU setting and hospital ward. Most participants (n=47, 93%) reported that majority of the patients with polytrauma that they see in their places of work are males. The most frequent mechanism of injury resulting in polytrauma was motor vehicle crashes (n= 47; 93%), whilst stab wounds and gunshot wounds were rare causes of polytrauma. Frequently injured body regions were the lower limb (n=40; 77%) and head and neck (n=37; 71%). Physiotherapists commonly used breathing exercises (n=44; 85%), suctioning (n=42; 81%), manual chest therapy (n=39; 75%), body positioning to optimize oxygenation (n=38; 73%), respiratory muscle strengthening (n=35; 67%), active cycle of breathing techniques (n=34; 65%), incentive spirometry

(n=34; 65%), positive expiratory pressure therapy (n=31; 60%), body positioning to aid postural drainage (n=28; 54%) and nebulisation therapy (n=25; 48%) to optimize/restore their polytrauma patients' respiratory function. Whilst manual hyperinflation (n=32; 62%), ventilator hyperinflation (n=29; 56%) and intermittent positive pressure breathing (n=27; 52%), were 'rarely used'.

Physiotherapists frequently used early mobilisation out of bed (n=49; 94%), active range of motion (n=48; 92%), passive ROM (n=48; 92%), in bed mobilisation (n=46; 89%), and functional exercises (n=42; 81%) to restore/maintain optimal neuromusculoskeletal system function in patients with polytrauma. These techniques were immensely popular among respondents such that no one reported not using them in patient care.

In the evaluation of treatment of the neuromuscular system the de Morton mobility index (n= 41; 78%), physical function in intensive care unit test (n=35; 67%) and Chelsea critical care physical assessment tool (n=34; 67%) were validated outcome measures 'rarely used' by most of the respondents, whilst the evaluation of muscle power (n=43; 83%), and medical research council sum score (n=43; 83%) were frequently used.

Patients with polytrauma stayed between eight to 15 days and were then discharged into step-down facilities (n= 25; 48%), and subacute facilities of the same institution (n= 19; 37%) for extended care whilst some were discharged home (n= 21; 40%). Functional outcomes and hospital length of stay were factors reported to influence patients' discharge. Respondents reported that they routinely provided home exercise programs focused on respiratory rehabilitation, cardiopulmonary endurance training, and patient and caregiver education to their patients.

The lack of adequate human resources in the physiotherapy profession and insufficient knowledge by team members in Namibia about the role of physiotherapy in the care of patients with polytrauma injury were factors reported to affect in-hospital physiotherapy service delivery. Inadequate support systems for patients by their family/caregivers and the long distances that patients need to travel to access rehabilitation services after hospital discharge were factors reported to affect the continuity of physiotherapy service provision after discharge from an acute care facility. Good family support (n=11; 21%) as well as patient's self-motivation and compliance to their treatment (n=10; 19%) were factors reported as enablers to physiotherapy service provision post-discharge.

Conclusion: In Namibian acute care settings, patients with polytrauma are mostly male, sustained injury through motor vehicle crashes, and had an extended hospital stay before discharge to step-down facilities. Physiotherapy management is focused on prevention of respiratory system dysfunction and all physiotherapists prioritized active exercises and mobilisation out of bed in their patient management. Findings contribute to the limited existing body of knowledge regarding the physiotherapy management of Namibian patients who sustained polytrauma injury. The limited use of physiotherapy techniques that require adjustment of mechanical ventilator settings and the limited use of validated outcome measures

by physiotherapists in their patient management are highlighted. The lack of human and financial resources are factors reported to impact physiotherapy service delivery in Namibia.

Implications for clinical practice: Findings from this study provide a platform from which intervention-based studies can be conducted to better understand the effect of physiotherapy management on patient outcomes after polytrauma.

KEY WORDS: Polytrauma, Acute Care, Mobilisation, Exercise, Service Delivery

ACKNOWLEDGEMENTS

I would like to express my gratitude to the following:

- My family and friends for their continual support and encouragement throughout this journey.
- The participants for taking part in this study.
- My research supervisor Professor Helena Van Aswegen for the guidance and sincere dedication to this undertaking.

TABLE OF CONTENTS

Declaration.....	i
Abstract.....	ii
Acknowledgements	v
Table of Contents	vi
List of Tables	xi
List of Figures	xii
List of Abbreviations	xiii

1.	Chapter 1: Introduction.....	1
1.1	Introduction.....	1
1.2	Problem Statement.....	3
1.3	Aim of the Study.....	3
	Objectives of Study.....	3
1.5	Significance of Study.....	4
1.6	Type of Study.....	4
1.7	Working Definitions.....	4
2.	Chapter 2: Literature Review.....	6
2.1	Introduction.....	6
2.1.1	Polytrauma Definition.....	6
2.1.2	Epidemiology of Polytrauma.....	7
2.2	Commonly Injured Regions	8
2.3	Complications Associated with Polytrauma.....	10
2.3.1	Inflammatory Mediated Responses.....	10
2.3.2	Pain as a Consequence of Polytrauma.....	11
2.4	Pulmonary Complications Following Polytrauma.....	13
2.4.1	Ventilator Induced Diaphragmatic Dysfunction.....	13
2.4.2	Ventilator-Associated Pneumonia.....	14
2.4.3	Lung Volume Loss.....	14
2.5	Intensive Care Unit-Acquired Weakness.....	15
2.6	Post-Intensive Care Syndrome.....	16

2.7	Physiotherapy Outcome Measures in the Acute Care Settings.....	17
2.8	Physiotherapy Management Of Patients With Polytrauma.....	20
2.8.1	Respiratory Physiotherapy For The Patient With Polytrauma.....	20
2.8.1.1	Techniques To Mobilise And Remove Retained Secretions.....	20
2.8.1.1.1	Nebulisation.....	20

	Page
2.8.1.1.2 Postural Drainage.....	20
2.8.1.1.3 Manual Chest Clearance Techniques.....	21
2.8.1.1.4 Airway Suctioning and Active Coughing.....	21
2.8.1.1.5 Active Cycle of Breathing Techniques.....	22
2.8.1.2 Techniques that Improve Lung Volumes.....	23
2.8.1.2.1 Positioning.....	23
2.8.1.2.2 Manual Hyperinflation.....	23
2.8.1.2.3 Positive Expiratory Pressure Therapy.....	24
2.8.1.2.3.1 Flutter Device.....	24
2.8.1.2.3.2 Positive Expiratory Pressure Bottle.....	25
2.8.1.1.4 Incentive Spirometry.....	25
2.8.1.1.5 Intermittent Positive Pressure Breathing.....	26
2.8.1.3 Techniques that Improve Respiratory Muscle Strength.....	26
2.8.3.1.1 Inspiratory Muscle Strengthening.....	26
2.8.1.4 Early Exercise and Mobilisation.....	28
2.8.1.4.1 Early Mobilisation.....	28
2.8.1.5 Early Exercise.....	30
2.8.1.6 Functional Exercises.....	31
2.8.1.7 The Maintenance of Range of Motion In Polytrauma.....	32
2.8.2 Pain Management for Chest Trauma.....	32
2.9 Barriers to Physiotherapy Management of Patients with Polytrauma.....	33
2.10 Discharge Destinations Following Acute Care Discharge.....	34
2.11 Conclusion.....	35
 3. Chapter 3: Methodology	 36
3.1 Study Design.....	36
3.2 Participants.....	36
3.2.1 Study Sample Selection.....	36
3.2.2 Inclusion Criteria.....	36
3.2.3 Exclusion Criteria.....	36
3.2.4 Sample Size.....	36
3.3 Study Procedures.....	37

	Page
3.3.1 Instrumentation.....	37
3.3.2 Data Collection Procedure.....	38
3.4 Ethical Considerations.....	39
3.5 Data Analysis.....	39
4. Chapter 4: Results	40
4.1 Socio-Demographic Data of Physiotherapists.....	40
4.2 Profile of Patients Presenting with Polytrauma.....	43
4.3 Physiotherapy Treatment Strategies.....	45
4.4 Outcome Measures.....	47
4.5 Length of Hospital Stay.....	49
4.6 Discharge Destinations.....	50
4.7 Rehabilitation Programs.....	51
4.8 Barriers to Physiotherapy Service Delivery.....	51
4.9 Enablers to Physiotherapy Service Delivery.....	54
4.9.1 Enablers During Hospital Stay.....	54
4.9.2 Enablers Post-Discharge.....	54
5. Chapter 5: Discussion	55
5.1 Response Rate of the Current Survey.....	55
5.2 Socio-Demographics.....	55
5.3 Profile of Patients Presenting with Polytrauma.....	57
5.4 Treatment Strategies to Optimise Respiratory Function.....	57
5.5 Treatment Strategies to Optimise Neuromuscular System.....	59
5.6 Outcome Measures for the Respiratory and Neuromusculoskeletal System....	60
5.7 Factors Affecting Discharge.....	62
5.8 Rehabilitation Programs.....	63
5.9 Barriers and Enablers to Physiotherapy Service Provision.....	64
5.10 Limitations.....	65

LIST OF TABLES

	Page
Table 3.1 : Outcome measures used to influence physiotherapy treatment progression for patients with polytrauma.....	38
Table 4.1 : Physiotherapy Techniques used by Respondents for Optimizing Respiratory System Function for Patients with Polytrauma.....	45
Table 4.2 : Physiotherapy Techniques used by Respondents to Maintain/Restore Optimal Function of the Neuromusculoskeletal System for Patients with Polytrauma.....	46
Table 4.3 : Physiotherapy Outcome Measure used to Evaluate Patients with Polytrauma's Response to Treatment of their Neuromusculoskeletal System.	48
Table 4.4 : Barriers to Physiotherapy Service Delivery to Patients with Polytrauma during their Hospital Stay.....	52
Table 4.5 : Barriers to Physiotherapy Service Delivery to Patients with Polytrauma after Hospital Discharge.....	53

LIST OF FIGURES

	Page
Figure 4.1 : Survey Distribution Process.....	40
Figure 4.2 : Qualification of Physiotherapy Respondents (n=52).....	41
Figure 4.3 : Postgraduate Qualification held in Specific Fields of Physiotherapy (n=52)...	42
Figure 4.4 : Hospital Settings where Patients with Polytrauma were Managed by Respondents (n=52).....	43
Figure 4.5 : Mechanism of Injury of Patient Admitted with Polytrauma.....	43
Figure 4.6 : Body Regions often Injured in Polytrauma Patients in Namibia.....	44
Figure 4.7 : Outcome Measures used by Respondents to Evaluate Patients with Polytrauma's Response to Treatment of their Respiratory System (n= 52)....	47
Figure 4.8 : Outcomes that Influence Progression in Physiotherapy Management of Patients with Polytrauma (n= 52).....	49
Figure 4.9 : Patient Length of Stay (days and weeks) in Acute Care Facilities after Polytrauma as Reported by Namibian Physiotherapists (n=52).....	50

LIST OF ABBREVIATIONS

ABGs	- Arterial Blood Gases
ACBT	- Active Cycle of Breathing Techniques
ADLs	- Activities of Daily Living
AIS	- Abbreviated Injury Score
CBR	- Community-Based Rehabilitation
CPAP	- Continuous Positive Airway Pressure
CPAx	- Chelsea Critical Care Physical Assessment Tool
DEMMI	- de Morton Mobility Index
FET	- Forced Expiratory Technique
FIM	- Functional Independence Measure
FiO ₂	- Fraction of Inspired Oxygen
FSS-ICU	- Functional Status Score Intensive Care Unit
GCS	- Glasgow Coma Scale
HPCNA	- Health Professions Council of Namibia
ICF	- International Classification of Function, Disability and Health
ICU	- Intensive Care Unit
ICUAW	- Intensive Care Acquired Weakness
IPPB	- Intermittent positive pressure breathing
IQR	- Interquartile Range
MHI	- Manual Hyperinflation
MRC-SS	- Medical Research Council Sum Score
MV	- Mechanical Ventilation
MVAF	- Motor Vehicle Accident Fund
MVC	- Motor Vehicle Crash
NSAIDs	- Non-Steroidal Anti-inflammatory Drugs
NSP	- Namibia Society of Physiotherapy
PD	- Postural Drainage
PICS	- Post Intensive Care Syndrome

QoL	- Quality of Life
ROM	- Range of Motion
SpO ₂	- Peripheral Oxygen Saturation
TENS	-Transcutaneous Electrical Nerve Stimulation
VAP	- Ventilator-Associated Pneumonia

CHAPTER 1

1.1 INTRODUCTION

Despite ongoing advances in the medical field, the global death rate due to polytrauma averages 15%, reaching as high as 63% when it is complicated by traumatic brain injuries and as much as 35% when associated with pelvic fractures (Thippeswamy and Rajasekaran, 2020). Globally 5.8 million deaths per year occur because of multiple traumatic injuries with as much as 16,000 deaths a day (Lenjani et al., 2019). Traumatic physical injuries thus pose a notable risk for morbidity and mortality worldwide (WHO, 2018).

Since traumatic physical injury to the human body occurs often and is linked to considerable suffering and loss of life, it has been accepted as a global health problem (Duckworth and Iezzi, 2010). It has been seen as a health burden that significantly affects low and middle-income countries, as they often struggle to implement injury prevention measures in their public healthcare systems (Due et al., 2016). Most commonly road traffic collisions are the largest contributing factor to traumatic physical injuries (Lenjani et al., 2019). Namibia ranks highly in Africa in the proportion of cases of motor vehicle crashes (MVC) per population (Amweelo, 2016; Chatukuta et al., 2021) and are the fifth leading cause of death (World Health Organisations, 2018). Since Namibia also ranks highly on violence, many people require rehabilitation following physical trauma (Martin, 2019).

Delivery and accessibility of rehabilitation services in Namibia is less than optimal. Often, it is hindered by a critical shortage of rehabilitation service providers employed by the state as most are attracted by the private sector (Shumba et al., 2018). Due to an overall shortage of rehabilitation personnel who can manage orthopaedic conditions, orthopaedic technical service departments have endeavoured to mitigate this challenge by sending their staff for qualifying and postgraduate courses in other African countries (Shumba et al., 2018).

Polytrauma is defined as physical trauma to not less than two regions of the human body with an Abbreviated Injury Scale (AIS) score of greater or equal to three as well as the presence of systematic inflammatory response syndrome for at least the initial 72 hours. It is suggested an “all or nothing diagnosis” unaccompanied by additional grading (Butcher and Balogh, 2009). Patients who are significantly injured following polytrauma often have good outcomes with the Injury Severity Score (ISS) being an accepted tool in evaluating severity and prospects of recovery following trauma, however, clinical outcomes cannot be deduced from this score (von Rden et

al., 2013). Whilst severe physical injury is associated with mortality, injuries that do not result in death result in considerable financial costs to the persons and society (Duckworth and Iezzi, 2010; Andrzejowski, Holch and Giannoudis, 2021). Thus, it presents a negative economic impact specifically on developing economies due to significantly high treatment costs (González Robledo et al., 2017; Balke et al., 2022).

Patients with polytrauma present a paramount test to trauma care. Ensuring their care is of a high standard remains a centre of attention in clinical practice and medical research. Clinical outcomes in patients with polytrauma have often been influenced by patient demographics (age, sex, injury severity, and site) as well as social class and socioeconomic status (Larsen et al., 2016). These patients can be successfully managed with dedicated protocols in assigned institutions (Butcher and Balogh, 2009; Kelly et al., 2017). A multidisciplinary rehabilitation method provides the best means to improve outcomes following trauma (Al Hanna et al., 2020).

In patients with orthopaedic trauma, the key results lie in the re-establishment of physical functionality so that patients can return to their previous activities (Allemann et al., 2019; Gessner, Horn and Lowenberg, 2020). Observational studies propose that even though multiple trauma survivors demonstrate significant functional and cognitive impairments, their functional capabilities and quality of life improved after physiotherapy (Khan et al., 2012; Nauth et al., 2021). Physiotherapy is efficient in restoring the ability to perform activities of daily living (ADLs), although patients are often unequipped to return to their pre-trauma functional capacity (Khan et al., 2012; Padovani, Silva, and Tanaka, 2017).

In comparison to patients without polytrauma, patients with polytrauma make up a higher proportion of patients admitted to the intensive care unit (ICU) and usually have a longer ICU stay (Rau et al., 2017). There are still many intensive care multidisciplinary team members who are reluctant to mobilize patients with polytrauma because of safety concerns, the feasibility of therapy, and a lack of scientific evidence about the physiotherapist's performance in these cases (Jacob et al., 2021). Such patients often have multiple lesions, and their proper treatment incorporates knowledge of several different surgical specialties. This makes it more difficult to understand the consequences of early physiotherapeutic interventions in each type of injury and decision-making by a single intensivist, and a joint evaluation of different specialties is necessary (Padovani et al., 2017).

In an investigation that evaluated the significance of early mobilization of acute care patients who were receiving vasoactive drugs, it was suggested that a model of physical therapy intervention for patients with severe polytrauma in the ICU is needed (Jacob et al. (2021). This is of great clinical relevance, considering the scarcity of literature regarding the particularities of early physiotherapeutic intervention to this specific population of patients on a global level (Jacob et al., 2021) and in Namibia. The aim of this study is thus to investigate the physiotherapy management of patients with polytrauma in acute care settings in Namibia.

1.2 **PROBLEM STATEMENT**

It must be conceded that most people who sustain significant physical injury survive it. Injuries that do not result in death result in considerable financial costs to the persons and society (Duckworth and Iezzi, 2010). The impact of physical trauma can also negatively influence a person's productivity at work, and persons impacted by polytrauma often need compensation due to resulting physical and psychological impairments (Dogrul et al., 2020). Namibia ranks highly in Africa in the proportion of cases of motor vehicle crashes (MVC) per population (e.g. 33.4 per 100 000 population) (Amweelo, 2016; Chatukuta et al., 2021). Anecdotal evidence obtained from the Namibian Motor Vehicle Accident Fund shows that economically active persons who sustained physical trauma claim largely into the Disability Grant. In Namibia, most claimants are individuals within the 16-59 years age group with permanent and semi-permanent disabilities (Gibson et al., 2022). Insufficient, late, or lack of rehabilitation service provision may fail in such persons to achieve functional levels allowing for a return to work only when the physical impairment is manageable.

Auditing of usual care physiotherapy for patients in intensive care following polytrauma is not frequently documented in rehabilitation literature. Nevertheless, countless benefits to recording usual or standard care practices have been shown (Skinner et al., 2015). There is limited research on rehabilitation interventions for patients with polytrauma in acute care settings. By the year 2017, no randomized controlled trials or clinical trials had described rehabilitation interventions for patients with polytrauma in acute care settings internationally (Padovani, Silva and Tanaka, 2017). It is therefore important to carry out a primary study in this area in a country such as Namibia, with a high incidence of MVCs and physical assault, to look at usual care physiotherapy management for patients with polytrauma injury.

1.3 **RESEARCH QUESTION**

What is the physiotherapy management of patients with polytrauma admitted to acute care settings in Namibia? What factors influence service delivery provided to these patients after discharge from acute care?

1.4 **AIM OF THE STUDY**

To describe the physiotherapy management of patients with polytrauma in acute care settings in Namibia and the factors that influence service delivery to these patients after discharge.

1.5 **OBJECTIVES OF STUDY**

- To describe the profile of physiotherapists who manage patients with polytrauma injuries in acute care settings in Namibia.
- To report on the profile of patients with polytrauma that are managed by physiotherapists in acute care settings in Namibia.
- To identify current physiotherapy treatment strategies used in the management of patients with polytrauma injuries in acute care settings in Namibia.
- To identify outcome measures used by physiotherapists to guide their progression of patient management in acute care settings in Namibia.
- To identify the type of rehabilitation programs offered to these patients following hospital discharge.
- To identify barriers and enablers to physiotherapy service delivery for patients with polytrauma in acute care settings and after discharge from acute care settings in Namibia.

1.6 **SIGNIFICANCE OF STUDY**

Globally, there is a scarcity of documented usual care physiotherapy practices in managing patients with polytrauma injuries in acute care settings (Skinner et al., 2015; Doiron and Hoffmann, 2018; Al Hanna et al., 2020). In Namibia, there are limitations in accessing rehabilitation services (Shumba and Moodley, 2021). It is of importance to establish barriers and enablers to the provision of physiotherapy services to patients with polytrauma in Namibia as it may influence policy and improve access to these services. Whilst physiotherapists play a known and essential role in the delivery of multidisciplinary team-based care in acute care settings, it is imperative to establish strategies used in the usual care of these patients (Skinner et al., 2015). Whilst management of patients with polytrauma is often not fully experienced in detail during undergraduate training for most physiotherapists in Namibia, due to lack of human resources

relating to availability of rehabilitation personnel in clinical settings, it is important to establish and report on treatment strategies employed by practicing physiotherapists as this may inform curriculum review processes at Namibian universities in future. It also becomes essential to understand physiotherapy treatment strategies and interventions within a population that has high MVCs, as well as high incidences of physical assault which are known contributors to physical injuries. Findings from this study may aid the development of clinical practice guidelines and create a platform from which intervention-based studies can be conducted to improve rehabilitation outcomes and better understand the effect of physiotherapy management on patient outcomes after polytrauma.

1.7 **TYPE OF STUDY**

A cross-sectional study using a survey was undertaken. The checklist for reporting survey studies (CROSS) was used in sharing information and results of this study.

1.8 **WORKING DEFINITIONS**

- Polytrauma is defined as two or more orthopaedic injuries with or without injury to organ systems, one of which may be life-threatening, resulting in physical, cognitive, psychological, or psychosocial impairments and functional disability (Tosounidis and Giannoudis, 2016; Turculea et al., 2021). For a person to be considered to have suffered polytrauma they should have an (Abbreviated Injury Scale) AIS greater or equal to three in at least two body regions (Rau et al., 2017; Driessen et al., 202). This working definition of polytrauma, traumatic injuries to the brain or spinal cord and injuries sustained from burns were not included in this study. The focus of this study was to examine the management of multiple orthopaedic injuries to the extremities and thorax which result in critical illness and the management of such patients by physiotherapists in acute care facilities in the state and private sector in Namibia.
- Abbreviated Injury Scale (AIS) is an anatomical prognostic scoring system that assigns a severity score to injuries of the head, neck, thorax, abdomen, spine, extremities, and other trauma. High-ranking scores are correlated with a lower likelihood of survival (Hietbrink and Leenen, 2016; Rau et al., 2017).
- An acute care setting is any setting in a public or private hospital in Namibia at which patients with polytrauma (multiple orthopaedic injuries) are admitted for management. The Intensive Care Unit (ICU), high care unit and hospital wards all make up acute care settings.
- Intensive care unit-acquired weakness (ICUAW) is defined as clinically detectable muscle weakness in critically ill patients.

- Rehabilitation is defined as a set of interventions that are carried out in order to optimise physical function in individuals with health conditions. In the acute care setting, rehabilitation focuses on achieving early functional independence in activities of daily living, minimising length of stay in hospital as well as preventing complications associated with critical illness.

CHAPTER 2

2 LITERATURE REVIEW

Information sources used in this study were from the year 2003 to 2024. These sources included PubMed, Scopus, The Cochrane Library, Google Scholar, WebMD, ClinicalKey, Access-Physiotherapy, Science Direct, and PEDro. The search was conducted using keywords such as 'polytrauma physiotherapy', 'physical therapy in acute care', 'polytrauma classification', 'incidence of polytrauma', 'MVC in Namibia', 'rehabilitation in Namibia', 'polytrauma physiotherapy management', 'acute-care physiotherapy', 'multiple trauma physiotherapy', 'polytrauma rehabilitation', 'physiotherapy in ICU', 'role of physiotherapy in critical illness', 'critical care rehabilitation', 'acute-care physiotherapy outcome measures', and 'ICU physiotherapy barriers'. The key concepts that are focused on in this literature review include the definition of polytrauma, epidemiology of polytrauma, complications associated with polytrauma, outcome measures used in physiotherapy management of patients with polytrauma, physiotherapy management of polytrauma, and lastly, barriers to effective rehabilitation.

2.1 INTRODUCTION

2.1.1 Polytrauma Definition

The Berlin definition of polytrauma states that for a person to be considered to have suffered polytrauma they should have an (Abbreviated Injury Scale) AIS greater or equal to three in at least two body regions in addition to one or more additional factors (Tosounidis and Giannoudis, 2016; Rau et al., 2017; Driessen et al., 2021). These additional factors can be a Glasgow Coma Scale (GCS) score less than or equal to eight out of 15, systolic blood pressure less than 90mmHg, and an activated thromboplastin time less than or equal to 40 seconds in a person less than 70 years of age (Hietbrink and Leenen, 2016; Rau et al., 2017; Andrzejowski, Holch and Giannoudis, 2021; Turculeã et al., 2021). Hypotension, acidosis and an elevated base excess are other additional factors that are at times added to the polytrauma definition (Driessen et al., 2021).

The AIS is an anatomical prognostic scoring system that assigns a severity score to injuries of the head, neck, thorax, abdomen, spine, extremities, and other trauma. High-ranking scores are correlated with a lower likelihood of survival (Hietbrink and Leenen, 2016; Rau et al., 2017). The Berlin polytrauma definition is effective in identifying patients who are critically ill, have high AIS scores and require multidisciplinary care by specialists. These patients have poor clinical outcomes and high utilisation of medical resources (Driessen et al., 2021). This polytrauma

definition is useful in capturing a population of patients that is resource-intensive and has a high mortality rate, whilst excluding patients that have severe single-system injuries (Butcher, D'Este and Balogh, 2014; Hietbrink and Leenen, 2016). Borderline patients with polytrauma are those patients who may then be successfully stabilized but remain at a high risk of deterioration (Hietbrink and Leenen, 2016; Driessen et al., 2021).

In this study, polytrauma is defined as two or more orthopaedic injuries with or without injury to organ systems, one of which may be life-threatening, resulting in physical, cognitive, psychological, or psychosocial impairments and functional disability. In this definition of polytrauma, traumatic injuries to the brain or spinal cord and injuries sustained from burns are not included in this study (Chapter 1, section 1.7). The exclusion of patients with isolated head injuries who have a known innately higher morbidity and mortality rate is important as they do not represent true polytrauma (Butcher, D'Este and Balogh, 2014). As the polytrauma definition is broad, the focus of this study looks at the management of multiple orthopaedic injuries to the extremities and the thorax resulting in critical illness and the patient being managed in an acute care facility in the public or private sector in Namibia (Chapter 1, section 1.7).

2.1.2 Epidemiology of Polytrauma

In industrialized societies, physical trauma is a significant factor associated with death (Turculea et al., 2021). In the USA, polytrauma-related injuries make up 10% of acute care admissions (Plani, Van Aswegen and Morrow, 2015, p. 310). In developing nations, physical trauma represents a significant contribution to morbidity in children and young adults (Haider et al., 2017). Despite enduring efforts to improve outcomes, polytraumatized patients experience mortality rates of approximately 20% (Haider et al., 2017).

In young adults, high-energy injuries may result in chest wall and lower extremity injuries (Plani, Van Aswegen and Morrow, 2015, p.321; Tosounidis and Giannoudis, 2016). In this population, the most common mechanisms of injury leading to polytrauma are road traffic collisions followed by falls from a height (Dogrul et al., 2020; Weinberg, Roos and Van Aswegen, 2022). Of these mechanisms, road traffic collisions contribute 24% and falls from heights 14% of the associated morbidity (Haider et al., 2017).

In Africa, MVCs are linked to poor compliance with road traffic rules and poor infrastructure development (Zimmerman et al., 2020). In Africa south of the equator, the incidence of traumatic injuries is 156 per 100,000 which is much higher than the global incidence of 106 per 100,000;

this patient demographic largely presents with associated polytrauma (Zimmerman et al., 2020). In Tanzania, the incidence of traumatic injuries is higher in rural areas. A notable difference exists between the quality of roads and hospital infrastructure between rural and urban areas (Njelesani, Couto and Cameron, 2011; Zimmerman et al., 2020). The World Economic Forum's (WEF) global competitive report index of 2020 ranked Namibia's road network infrastructure to be the best quality in Africa (World Economic Forum, 2020). In 2018, Namibia ranked high in Africa on the number of motor vehicle crashes (MVC) according to Motor Vehicle Fund statistics and are the fifth leading cause of death (World Health Organisations, 2018).

In South Africa, the main causes of multiple injuries are MVCs, pedestrian-vehicle accidents and physical assault in adults; with most of these patients often requiring ICU admission (Plani, Van Aswegen and Morrow 2015, p.310). The incidence of polytrauma is associated with a 15% chance of blunt chest trauma, resulting in associated rib fractures in an average of about 70% of the patients (Dogrul et al., 2020). In the elderly population, each additional rib fracture which occurs as a result of chest trauma increases the odds of mortality by 19% and of developing pneumonia by 27% (Unsworth, Curtis and Asha, 2015).

Low-impact mechanisms of injury such as low falls result in fractures in older patients. Elderly patients often sustain multiple injuries from falls (Unsworth, Curtis and Asha, 2015). In Namibia, falls are a serious health risk for older adults and children. Falls are a leading cause of disability and constitute about 10% of emergency cases and more than 50% of injury-related hospitalisations in Namibia (Tomas, Ashipala and Tomas, 2021).

Butcher et al. (2014) from Australia conducted a pilot study to validate the definition of polytrauma. It was noted that patients with an AIS score greater than two in at least two body regions with a high ISS ($2 \times \text{AIS score} > 2$) were significantly younger male patients (mean age of 46.5 years), in comparison to other patients with multiple orthopaedic trauma which did not meet the definition of polytrauma (Butcher, D'Este and Balogh, 2014). Similarly, Larsen et al. (2016) in a one-year cohort follow-up study in Denmark that evaluated the quality of life (QoL) following polytrauma, reported that the average age of patients with polytrauma was 39.6 years for males and 47.4 years for females also a significantly younger population than the control group without polytrauma. In Namibia, 76.2% of road traffic accident victims are male, often below the age of 35 years (Amweelo, 2016). This shows that most patients who present with polytrauma in acute care settings are likely to be young males.

There is a paucity of information on Namibian research studies that highlight the occurrence of true polytrauma or the rate of admission of patients with polytrauma into acute care settings.

2.2 COMMONLY INJURED REGIONS

The face, head and neck regions are the most frequently injured in polytrauma (Mejaddam and Velmahos, 2012; Padovani, Silva and Tanaka, 2017; Rau et al., 2017). As a consequence, more polytrauma patients are seen to have a GCS of less than eight due to a higher risk of head trauma, in comparison to other patients with other trauma. Following the face, head and neck region, blunt trauma causing thoracic trauma occurs more frequently in males than females. In a study by Beshay et al. (2020) which looked at risk factors for thoracic trauma at a trauma centre, in a group of 285 patients, 70% were male and younger than 46 years of age. In the same study, the extra-thoracic trauma group (affecting the upper and lower limbs and pelvis) was also made up of mostly male patients (73%) (Beshay et al., 2020).

The thoracic region is the third most frequently injured region in polytrauma (Padovani, Silva and Tanaka, 2017; Rau et al., 2017). Thoracic trauma occurs as frequently as abdominal trauma in some studies as both are regions that are likely to suffer jointly from blunt trauma, especially in MVCs, automobile accidents as well as pedestrian-vehicle accidents (Butcher and Balogh, 2009; Andrzejowski, Holch and Giannoudis, 2021). Injuries associated with blunt thoracic trauma include diaphragmatic injuries, hemothorax, pneumothorax, esophageal injuries, great vessel injuries, and injury to the thoracic ducts and veins (Hietbrink and Leenen, 2016).

Abdominal injuries constitute 20% of all polytrauma injuries (Beshay et al., 2020). In patients with polytrauma involving the abdominal region, abdominal trauma is a leading cause of death especially in penetrating abdominal trauma involving damage to major blood vessels (Chrysou et al., 2017; Van Aswegen, 2020). When fractures of lower ribs such as ribs eight to twelve occur, associated intra-abdominal and diaphragmatic injuries should be considered (Hietbrink and Leenen, 2016).

Pelvic fractures are often related to substantial internal blood loss as the pelvic region has a rich blood supply. When pelvic fractures occur as a result of blunt trauma, blood loss is severe and the mortality rate ranges between 20% to 60% (Mejaddam and Velmahos, 2012). In the geriatric population pelvic fractures can occur due to low-energy trauma mechanisms such as falls from own height (Plani, Van Aswegen and Morrow, 2015, p.311).

In patients with polytrauma involving lower extremity injuries and who have high ISS scores, automobile accidents are seen to be the major cause of the injuries (von Rüden et al., 2013). High-energy trauma resulting in closed femoral fractures in adults may result in blood loss of up to two litres, which may double in open femoral fractures (Stahel, Heyde and Ertel, 2005). Long bone fractures such as femoral fractures requiring surgical management are seen to result in higher rates of pulmonary complications such as pulmonary embolism in cases of late stabilisation; in patients with polytrauma, early fracture fixation is recommended whenever adequate ventilatory support and proper fluid management have been provided (Lee et al., 2021; Nauth et al., 2021). Fragility fractures can occur from low falls and can result in neck or femur fractures. These are directly associated with an increase in age and avascular necrosis of the femoral head is a common complication (Plani, Van Aswegen and Morrow, 2015, p.312).

Violent blows to the lateral aspect of the knee joint during weight bearing can result in high impact injuries such as tibial plateau fractures and associated soft tissue injuries to the medial and lateral collateral ligaments, anterior and posterior cruciate ligament, and lateral meniscus tears (Plani, Van Aswegen and Morrow, 2015, p.323). Pedestrian vehicle accidents and motor vehicle crashes are common causes of tibial plateau fractures in the younger population whilst simple falls are a common mechanism of injury in the elderly (Spurrier and Stapley, 2016). Lateral blows to the knee can result in fibula fractures alone, which are commonly associated with common peroneal nerve entrapment (Saranteas et al., 2019; Murphy et al., 2020). In proximal and middle-third lower limb crush injuries resulting in closed tibial and/or fibula fractures, compartment syndrome is a common complication (Dobscha et al., 2008; Saranteas et al., 2019). There is a paucity of information on studies published in Namibia on the type of commonly injured body regions, commonly occurring fractures and mechanisms of injuries associated with polytrauma.

2.3 COMPLICATIONS ASSOCIATED WITH POLYTRAUMA

2.3.1 Inflammatory Mediated Responses

The pathogenesis of inflammatory-mediated responses after major trauma is multifaceted and the severity is related to the magnitude of the initial tissue injury (Tosounidis and Giannoudis, 2016; Vicente et al., 2022). About 92% of the fatalities in patients with polytrauma are triggered by the initial trauma, while secondary mortality may be a result of the development of acute respiratory distress syndrome, which is the most common complication during acute care hospitalisation, followed by multiple organ failure, as a result of systematic inflammation (Tosounidis and Giannoudis, 2016; Haider et al., 2017). In polytrauma involving fractures in long

bones, the development of deep vein thrombosis and pulmonary embolism is a postoperative complication worsened by the associated immobility in critical illness (Main and Denehy, 2016 p.106).

Numerous biomarkers have been identified and linked with systemic inflammation following polytrauma. Interleukin-6 and monocyte chemoattractant proteins are biomarkers associated with initial tissue damage and paradoxical cellular dysfunction; over-activation of these can result in death (Vicente et al., 2022). Interleukin-1, interleukin-6 and tumour necrosis alpha (TNF- α) are pro-inflammatory cytokines associated with systemic immunomodulation in response to trauma or infection (Van Aswegen, 2015 p.4). Significant polytrauma results in a dysregulated multisystem inflammatory response as well as associated immunosuppression, organ failure and possible death. This decrease in immunity increases the occurrence of local infections, early sepsis, organ dysfunction as well as a persistent inflammatory state resulting in immunosuppression catabolic syndrome (Spurrier and Stapley, 2016; Tosounidis and Giannoudis, 2016; Vicente et al., 2022). This catabolic state is a contributor to associated muscle wasting and weakness in critically ill patients (Hermans and Van den Berghe, 2015; Vicente et al., 2022).

When sepsis is present the development of myopathy is noted in respiratory and peripheral muscles (Hermans and Van den Berghe, 2015; Balke et al., 2022). The surge in proinflammatory cytokines such as interleukin-1 and tumour necrosis factor-alpha (TNF- α) results in the development of pyrexia, malaise and a decrease in appetite leading to capillary leak. This results in muscle proteolysis, cytolysis and loss of muscle mass (Akar et al., 2017; Vicente et al., 2022). As a consequence of immobility and bed rest, a surge in reactive oxygen species is also noted. Physical efforts in the form of early mobilisation when employed can directly minimize protein breakdown as early exercise is seen to decrease the inflammatory load (Kayambu, Boots and Paratz, 2013).

2.3.2 Pain as a Consequence of Polytrauma

The activation and persistence of the pain stimuli, the local and systematic release of proinflammatory cytokines, the age of the patient, their sex as well as their genetics determine the extent of the immune system-mediated inflammatory response (Wessem, 2013; Tosounidis and Giannoudis, 2016). Patients with high injury severity such as those with polytrauma also suffer from associated internal injuries to large blood vessels, lungs, diaphragm, intestines, kidneys and spleen which can also contribute to increased mortality and hospital length of stay

(Spurrier and Stapley, 2016; Giles et al., 2022). Therefore, patients with polytrauma experience significant pain from the time of injury which may persist, in a less acute form, for several months or years after discharge from the hospital (Duckworth and Iezzi, 2010; Dalton et al., 2019; Dogrul et al., 2020; Zimmerman et al., 2020).

Thoracic wall pain is a leading complaint in patients following chest trauma (Beshay et al., 2020). Most commonly blunt trauma causes rib fractures which frequently occur in the posterior aspect of the thoracic wall which is the weakest anatomical point (Kim and Moore, 2020). Innervation of the thoracic wall is by two intercostal nerves for each rib segment resulting in significant pain when a patient suffers from rib fractures, has an intercostal drain placed for the management of pleural space infiltrates, or undergoes thoracic surgery. Mobility of the thoracic wall increases pain in these patients and splinting of the thoracic wall is a normal response to pain. Thoracic wall splinting decreases the patient's ability to cough or take a deep breath or actively participate in chest physiotherapy (Kim and Moore, 2020; Weinberg, Roos and Van Aswegen, 2022). Due to thoracic wall pain, there is a decrease in overall physical function and perpetuation of pain avoidance behaviors (Dogrul et al., 2020). The associated pulmonary complications increase hospital length of stay and medical costs (Slinger and Naidu, 2019; Weinberg, Roos and Van Aswegen, 2022).

In patients with polytrauma, the presentation of pain varies from patient to patient. Patient outcomes and the effectiveness of rehabilitation interventions are related to the site of injury and number of fractures, involvement of joints, age, premorbid conditions and patient perception of their condition (Swinkels et al., 2011; Tosounidis and Giannoudis, 2016). The surgical management of unstable fractures to the pelvis and acetabulum has been historically delayed, yet the early patient-related effects of these injuries include severe pain and immobility which does not fully improve even after surgical reduction (Nauth et al., 2021). In patients with multiple long bone fractures a frequent cause of severe pain and limited joint range of motion (ROM) is myositis ossificans (the formation of bone outside the bony skeleton) (Plani, Van Aswegen and Morrow, 2015, p.329). In addition, multiple lower extremity fractures that are managed surgically or conservatively can present with swelling which contributes largely to the patient's pain experience (Plani, Van Aswegen and Morrow, 2015, p.351).

Improperly managed initial pain from the trauma or surgery has been shown to contribute to chronic pain syndromes (Duckworth and Iezzi, 2010; Dogrul et al., 2020; Weinberg, Roos and Van Aswegen, 2022). Thus, the cornerstone of the management of patients with polytrauma and thoracic injury includes the effective management of chest wall pain (Kim and Moore, 2020).

Chronic pain syndromes and depression are common in patients with traumatic injuries during their recovery (Due et al., 2016; Rawal, Yadav and Kumar, 2017). Chronic pain syndromes can persist for six years post discharge with 50% of patients who suffered blunt thoracic trauma suffering immensely of pain in the first three months following injury (Zimmerman et al., 2020).

The pharmacological management of pain includes a) patient-controlled intravenous opioids and controlled analgesia pumps which are rapidly reduced to oral medications; b) non-opioid analgesia such as nonsteroidal anti-inflammatory drugs (NSAIDs); c) systemic or local analgesia methods such as epidural analgesia, intrapleural analgesia, intercostal nerve block, and thoracic paravertebral block; and eventually d) topical patches (Dalton et al., 2019; Slinger and Naidu, 2019; Dogrul et al., 2020). A recent systematic review found that non-pharmacological therapeutic interventions (e.g., transcutaneous nerve stimulation and physiotherapy), used in combination with pharmacological management, are effective in managing pain and improving pulmonary function in patients with thoracic trauma (Weinberg, Roos and Van Aswegen, 2022). Other important elements in the management of pain in acute care include the administration of analgesia based on individual patient needs, using unit-specific clinical practice guidelines, and patient education by all members of the multidisciplinary team (Chou et al., 2016).

Early effective pain management is essential to reduce complications. It also aids patient compliance with treatment, thus increasing the ability of these patients to tolerate therapeutic interventions (Weinberg, Roos and Van Aswegen, 2022). Aggressive pain management interventions such as the provision of early pain medication are effective for most persons with multiple trauma as they frequently experience persistent pain which impacts their physical and social well-being (Duckworth and Iezzi, 2010; Dalton et al., 2019; Dogrul et al., 2020). In the management of pain, a treatment that is consistent with a pain relief model is less effective than a treatment centred on a pain coping model (Duckworth and Iezzi, 2010; von Rüden et al., 2013). Pain coping models emphasize pain acceptance aiding patients to live as normal a life as possible in the presence of pain; therefore early communication with patients to manage expectations and help them understand their pain is important (Duckworth and Iezzi, 2010; Dalton et al., 2019).

2.4 PULMONARY COMPLICATIONS FOLLOWING POLYTRAUMA

2.4.1 Ventilator Induced Diaphragmatic Dysfunction

The replacement or support of spontaneous breathing by mechanical ventilation (MV) that occurs in patients who suffered trauma as they are managed in the ICU, results in rapid wasting of and

alterations in myofiber length of the respiratory muscles (Zein et al., 2016; Elkins and Dentice, 2022). A reduction in diaphragm thickness indicative of diaphragmatic atrophy, a decrease in diaphragmatic excursion as well as a decrease in diaphragmatic thickening fraction (a dynamic measure of diaphragm thickness which is measured at the end of inspiration and expiration) are factors known to occur as a consequence of MV (Dong et al., 2021). The crosssectional areas of slow-twitch and fast-twitch muscle fibres reduce, resulting in diaphragmatic weakness (Worraphan et al., 2022).

The loss of the ability of the diaphragm to effectively generate adequate force of contraction in patients on MV is termed ventilator-induced diaphragm dysfunction (Zein et al., 2016; Supinski et al., 2018; Dong et al., 2021). On electromyography, complete diaphragm inactivity can be noted in patients on sedation and MV as a result of progressive atrophy to the diaphragm (Supinski et al., 2018). Even when lighter sedation strategies are employed, mechanical ventilation unloads the diaphragm to a great extent, resulting in diaphragmatic dysfunction, and reduced or absent respiratory drive (Dong et al., 2021).

Existing evidence suggests that infection can be a significant risk factor in the development of severe diaphragmatic weakness in critically ill patients on MV (Supinski et al., 2018). Patients with polytrauma remain at risk of infections and sepsis due to penetrating injuries, and multiple surgical procedures as a consequence of the natural systemic inflammatory response to trauma. In theory, any critically ill patient who needs MV should be considered to be at risk of developing diaphragmatic weakness (Martin et al., 2011; Viviani, 2011).

Diaphragmatic dysfunction negatively affects weaning outcomes resulting in longer MV dependency, longer ICU length of stay and other complications such as intensive care unit-acquired weakness (ICUAW) (Martin et al., 2011; Dong et al., 2021). Due to diaphragmatic weakness and atrophy, the weaning process is often initiated late, and the significant loss of diaphragmatic strength means that between 5% and 15% of critically ill patients on controlled MV, being weaned repeatedly, fail to regain respiratory autonomy in expected time frames (Marques et al., 2017). This results in patients having an extended period of MV, increasing hospital costs and the risk of mortality and morbidity (Dong et al., 2021).

2.4.2 Ventilator-Associated Pneumonia

Ventilator-associated pneumonia is a form of pneumonia occurring 48 hours after endotracheal tube intubation, often presenting with risk factors such as multidrug-resistant bacteria; both

factors contributing to its pathology (Castro et al., 2013). In addition, it is characterized by a worsening chest radiological picture as well as an increased white cell count (Main and Denehy, 2016, p.430). It is a common and severe complication of MV that critically ill patients such as those with polytrauma, who require assistance with breathing, often suffer from (Wang, Pan and Hu, 2019). In patients who present with rib fractures, 30% develop pneumonia whilst on MV, however, the incidence is higher in older patients (Hietbrink and Leenen, 2016). Ventilator-associated pneumonia is a known contributor to prolonged ICU length of stay (Castro et al., 2013; Stiller, 2013).

2.4.3 Lung Volume Loss

Patients who receive supplemental oxygen via invasive ventilation through the use of an artificial airway are at risk of lung volume loss (Lottering and Van Aswegen, 2016). Patients who have undergone corrective surgery to the thoracic and upper abdominal region are also at risk of respiratory complications such as lung volume loss (Pieczkoski, Margarites and Sbruzzi, 2017). Lung volume loss occurs in patients with polytrauma due to multifactorial processes. Prolonged MV, prolonged bedrest, pain and poorly controlled pain in the thoracic and abdominal region (which may be due to rib fractures, postoperative pain, presence of intercostal drains causing a decrease in thoracic expansion) all reduce functional residual capacity contributing to lung volume loss (Restrepo et al., 2011; Pieczkoski, Margarites and Sbruzzi, 2017).

Altered respiratory mechanics cause a decrease in lung volumes such as residual volume, total lung capacity, vital capacity and functional residual capacity, leading to atelectasis causing impaired gaseous exchange and reduced alveolus and arterial oxygenation (Romanini et al., 2007). In patients with trunk trauma, sternotomy, upper abdominal trauma/surgery, and in the existence of intercostal drains, the alteration in respiratory biomechanics has particular negative changes in thoracic expansion, and decreased diaphragmatic excursion that leads to lung volume loss (Romanini et al., 2007; Dafoe, Leigh and Stiller, 2020).

2.5 INTENSIVE CARE UNIT-ACQUIRED WEAKNESS

Prolonged bed rest in patients with critical illness, specifically those with traumatic injury who undergo periods of immobility before fracture management, results in short-term as well as long-term neuromuscular complications, significant loss of muscle mass and strength at a rate of about 1% to 5% per day (Hermans and Van den Berghe, 2015; Samosawala, Vaishali and Chakravarthy Kalyana, 2016). In the ICU, muscle wasting is early onset and progressive (Parry et al., 2015). Intensive care unit-acquired weakness (ICUAW) is defined as clinically detectable

muscle weakness in critically ill patients in whom there is no probable aetiology other than the critical illness (Denehy et al., 2013; Samosawala, Vaishali and Chakravarthy Kalyana, 2016; Hodgson and Tipping, 2017). The pathophysiology of ICUAW involves axonal neuropathy and/or myopathy. There is an interconnection between microvascular, metabolic, and electrical energy changes, which combine resulting in loss of muscle strength and muscle atrophy (Hermans and Van den Berghe, 2015; Hodgson and Tipping, 2017; Anekwe et al., 2020).

Intensive care unit-acquired weakness is a short-term, early onset complication of sedation, immobilisation, vasoactive medication as well as systemic inflammatory responses which are marked with muscle wasting that increases hospital length of stay and reduces the quality of life (QoL) (Hermans and Van den Berghe, 2015; Samosawala, Vaishali and Chakravarthy Kalyana, 2016; Jacob et al., 2021). The associated decrease in physical function and QoL is seen to result in impairment for as long as five years post-ICU discharge (Hermans and Van den Berghe, 2015). Conditions that have a high illness severity such as polytrauma which may be coupled with sepsis, prolonged immobilisation, hyperglycaemia, and acute kidney injury result in increased risk for the development of ICUAW. When ICUAW is present, respiratory muscles are often affected, which contributes to delayed weaning from MV and deferred restoration of spontaneous breathing (Hermans and Van den Berghe, 2015).

Long-term complications associated with ICUAW include neuro-muscular dysfunction, reduced functional capacity, restrictions in participation in ADLs, reduced QoL, possible hospital readmission, and at times death (Sumann et al., 2020). Intensive care unit- acquired weakness is thus associated with substantial impairments in body structure and function, activity limitations, and participation restrictions which may persist post-discharge from an acute care facility (Anekwe et al., 2020).

2.6 POST-INTENSIVE CARE SYNDROME

Multiple traumatic injury poses a significant challenge to patients' perception of their ability to control their environment. The multiple stressors presented by the initial traumatic episode itself and from the sequelae of events following the accident such as admission into an acute care facility, multiple surgeries and diagnostic tests for example, diminish a patient's perception of control over their self and their environment (Yach, 2008; Larsen et al., 2016). In patients who suffer orthopaedic polytrauma, the mental disability they experience in the first few months and years following trauma is primarily related to an initial psychological reaction following the major trauma and from the ICU admission (Larsen et al., 2016). In addition, although mostly subjective,

activation and maintenance of the stress response varies across patients' socio-demographics (Yach, 2008).

Post-intensive care syndrome (PICS) describes new or worsening cognitive, psychological and physical status decline following critical illness continuing past discharge from the acute care setting (Rawal, Yadav and Kumar, 2017). This consequence of ICU admission has lasting implications for both the family and the patient. Post-intensive care syndrome-family (PICS-F) refers to the new onset or prolonged psychological effects of critical illness and ICU admission on the patient's family and/or caregivers. This includes the experiences of the family during a patient's critical illness as well as those that occur following the death or discharge of a loved one from the ICU (Rawal, Yadav and Kumar, 2017).

As many as 33% of patients with PICS have their employment prospects greatly affected such that they may fail to return to work or fail to return to their previous job position before ICU admission (Colbenson, Johnson and Wilson, 2019). This has lasting implications for the patient's and their family's financial situation. In the long run, about 25% of these patients require support carrying out ADLs after ICU admission and this can have a tremendous effect on family members (Rawal, Yadav and Kumar, 2017).

Common manifestations of PICS include global muscle weakness, lethargy, impaired mobility, anxiety or depressive mood disorders, sexual dysfunction, and insomnia. Associated cognitive issues may include amnesia, slow mental processing and short concentration span (Rawal, Yadav and Kumar, 2017). All critically ill patients should be evaluated for PICS before ICU and hospital discharge and given suitable management including follow-up appointments after hospital discharge. These patients should thus be managed in a multifactorial approach which includes psychological treatment options (Dogrul et al., 2020). Physiotherapists play a notable role in providing emotional support and aid in improving the overall well-being of critically ill patients (Gosselink et al., 2008).

2.7 PHYSIOTHERAPY OUTCOME MEASURES IN THE ACUTE CARE SETTINGS

In the physiotherapy management of patients in acute care settings, assessment and treatment of patients is dependent on the medical diagnosis but also focus more on the physiological and functional deficiencies the patient may present with. The acute care hospital setting is challenging and ever-changing which makes the development of a core set of outcome measures difficult to establish and implement (Parry et al., 2015). Despite these challenges, the

need for physiotherapists to use consistent measures is well-known and recommended in clinical practice guidelines (Swinkels et al., 2011; Parry et al., 2015). Research has shown a lack of clinical application of clinometric measurement instruments in daily physiotherapy practice which hinders implementation of these guidelines (Swinkels et al., 2011; Sommers et al., 2015).

Muscle mass, strength and function are interconnected factors. Muscle mass is a passive nonvolitional outcome, whereas muscle strength is an active dynamic measure that provides information on the level of physical impairment. In patients with polytrauma, due to periods of immobility, pain and critical illness whilst in acute care settings, disuse atrophy of muscle as well as inflammation results in loss of muscle mass and strength (Hermans and Van den Berghe, 2015; Hodgson, 2017). Physical function and muscle strength assessment is complex in the ICU as it requires adequate cognitive capacity for tasks to be completed by the patient (Parry et al., 2015). This is often an unmet requirement in the ICU due to sedation, delirium, and reduced level of consciousness.

The Medical Research Council sum score (MRC-SS) is the most common muscle strength outcome measure used in the ICU setting (Denehy et al., 2013; Parry et al., 2015; Sommers et al., 2015). It has good inter-rater reliability for all muscle groups measured. The diagnosis of ICU-AW (<48 out of 60 on MRC-SS) is however at times inconsistent among raters in the acute care setting (Denehy et al., 2013; Parry et al., 2015). Evidence is scarce on the use of this outcome measure in patients with orthopaedic injuries in the acute care setting.

In patients with critical illness, the handgrip dynamometer is used to assess grip strength whilst the hand-held dynamometer is also used in the assessment of all other muscle groups (Parry et al., 2015). In a systematic review that aimed to identify outcome measures used in the evaluation of functional impairment and activity limitations in patients with critical illness, it was established that there is excellent intra-rater and inter-rater reliability for the handgrip dynamometer (0.92–0.97) and hand-held dynamometry (0.76–0.96) (Parry et al., 2015). The goniometer is the most commonly used measurement instrument in the assessment of active or passive ROM and it has been validated for use in patients with orthopaedic injuries (Swinkels et al., 2011; Sommers et al., 2015). The reliability of goniometric measurements of passive range of motion in lower extremities is considered to be good to excellent (0.75-1), although a mean standard deviation of around 5° has been reported for repeated measures in inter-observer studies (Ore et al., 2020).

Physical function is assessed by measuring the ability of a patient to perform normal activities such as basic ADLs and is graded using a validated scale (e.g. Barthel index, functional independence measure (FIM)) or physical performance tasks (e.g. the Physical Function ICU Test (PFIT), Short Physical Performance Battery) and walking tests (Doiron and Hoffmann, 2018). The Barthel index and the FIM are valid and reliable measures used in a variety of patient populations, however, several items are not applicable for use in critically ill patients with reduced function (Sommers et al., 2015). The PFIT is an excellent and inexpensive measure of physical function with superior clinical utility. It is effective, responsive to change, and predictive of key physical outcomes in acute care settings and has also proven useful in patients with orthopaedic injuries (Denehy et al., 2013; Parry et al., 2015; Doiron and Hoffmann, 2018). The FIM is validated for use on patients with orthopaedic injuries, however, it does not fully outline the impact of major trauma on function, disability and health (Bouman et al., 2017).

Common physical function assessment tools that have been established to have excellent reliability in acute care settings include the Chelsea Critical Care Physical Assessment Tool (CPAx) and ICU mobility scale (Parry et al., 2015; Gandotra et al., 2021). Functional performance outcome measures are heavily dependent on the patient's physical capacity to perform a set of tested activities. The FIM and the Berg balance scale may not be appropriate for acutely ill persons; yet, these are effective in managing subacute patients in long-term weaning facilities (Gosselink et al., 2008; Parry et al., 2015).

The FSS-ICU and FIM tools rate the ability of a patient to progressively mobilize by providing a score from one (total dependence) to seven (full independence), rating the patient's ability to perform functional activities such as bed mobility, transfers, and gait. In these measures, numerous items are not appropriate to administer in this patient population resulting in floor effects and low responsiveness, however, they remain useful in the ICU (Schober and Thornton, 2013; Sommers et al., 2015). In ICU intervention groups in which patients receive early active physiotherapy, mobility milestones measured by these outcome measures are achieved at a faster rate (Schober and Thornton, 2013; Sommers et al., 2015; Bouman et al., 2017).

In the assessment of muscle strength, functional activities and cardiopulmonary endurance, Schober and Thornton (2013) concluded that a key outcome is the time taken to achieve milestones and the distance ambulated by the patient (Schober and Thornton, 2013). The 6-min walk test assesses ambulatory distance, exercise capacity and endurance; it is frequently used on patients with orthopaedic trauma such as rib, upper and lower extremity fractures as it is

inexpensive to administer (Swinkels et al., 2011; Van Aswegen, 2020). The 6-minute walk test can be broken down into two-minute walking intervals in the ICU setting, and in patients with lower limb orthopaedic injuries to assess cardiovascular fitness over shorter achievable distances (Reid et al., 2015; Oliveros et al., 2022).

Physiotherapy outcome measures that are well-established for respiratory care and cardiopulmonary management may also not be fully applicable in the ICU (Zhao et al., 2020). The ability of patients to perform breathing exercises, effectively cough and do aerobic exercises may be limited by sedation, reduced level of consciousness, or delirium which affects active participation. In daily management of the patient with thoracic trauma or chest wall pain on MV, pulse oximetry, assessment of thoracic expansion and assessment of breathing to identify respiratory comfort/discomfort is frequently done (Sumann et al., 2020). There is 100% expert consensus that respiratory physiotherapy assessment should also include a careful look at arterial blood gases (ABGs), a fraction of inspired oxygen (FiO_2) as well as oxygen saturation (SpO_2) to assess for signs of impaired gaseous exchange (van der Lee, Hill and Patman, 2019). There is 97% expert consensus that outcome measures that assess increased work of breathing such as minute ventilation, rate of breathing, respiratory pattern, and ventilator-patientsynchrony are essential in routine ICU physiotherapy care (Curtis et al., 2017; van der Lee, Hill and Patman, 2019).

There is no documented use of outcome measures in the physiotherapy management of patients in acute care settings in Namibia; neither does evidence exist on injury-specific outcome measures used in the physiotherapy management of patients with polytrauma.

2.8 PHYSIOTHERAPY MANAGEMENT OF PATIENTS WITH POLYTRAUMA

2.8.1 Respiratory Physiotherapy for the Patient with Polytrauma

The physiotherapist's role in the management of patients in an acute care setting varies widely across countries and hospital units (Sommers et al., 2015). Physiotherapists manage associated deconditioning and related complications for patients with critical illness. Their role includes the management of respiratory complications such as retained secretions, lung collapse, and pulmonary infections, in patients with acute lung injury, thoracic trauma, abdominal trauma and in those who have had thoracic and abdominal injuries (Zhao et al., 2020). Due to the detrimental effects associated with sequelae of critical illness and immobility, physiotherapy is needed throughout the length of illness and ICU admission (Jacob et al., 2021; Faizan et al., 2022).

2.8.1.1 Techniques to Mobilise and Remove Retained Secretions

2.8.1.1.1 Nebulisation

Nebulisation therapy delivers medication in aerosol form directly to the respiratory system of intubated and non-intubated patients. A nebulizer device is used to convert a solution into an aerosol form which can be delivered directly to the respiratory tract. In physiotherapy practice, bronchodilators, mucolytics, and decongestants are administered through nebulisation therapy (Skinner et al., 2015; Main and Denehy, 2016). Weaning time frames are seen to be shorter in ICU patients with a tracheostomy who receive daily nebulisation therapy in combination with other usual care physiotherapy techniques (Marques et al., 2017). Patients should be nebulized at least 15 minutes before other physiotherapy interventions that are used to optimize respiratory function (Stiller, 2013).

2.8.1.1.2 Postural drainage

Modified postural drainage (PD) is a secretion clearance technique that is effective when used in combination with other airway clearance techniques to drain and mobilize peripheral secretions (Skinner et al., 2015; Van Aswegen, Morrow and van Aswegen, 2015, p. 197). Multiple body positions, specified according to the anatomy of the tracheobronchial tree can be used to facilitate secretion mobilisation from affected lung segments by gravity. Modified PD used in combination with chest wall vibrations, shakings and percussions, applied to the affected lung segments for several minutes in a treatment session optimize drainage of retained secretions from the tracheobronchial tree (Parry et al., 2015). Classical head down tilt positions may not be tolerated by critically ill patients in the ICU for risk of aspiration, cardiovascular dysregulation, shortness of breath, hypoxemia and vomiting (Parry et al., 2015; Skinner et al., 2015). In the acute care facility the patient's face should always be in the frontal view, or visible if the patient is in side lying, so that any signs or facial expressions of position intolerance or pain can be monitored (Ahmad, 2018).

2.8.1.1.3 Manual chest clearance techniques

Intubated patients with high sputum volumes may benefit from manual chest clearance techniques. Techniques such as percussions, shakings, chest wall vibrations, and/or expiratory rib cage compressions are performed routinely in the management of ICU patients to assist in secretion clearance (van der Lee, Hill and Patman, 2019). These techniques decrease airflow resistance and reduce the risk of bronchopulmonary infections (Morrow and Van Aswegen, 2015, p. 110). Numerous combinations to manual chest clearance techniques can be used to achieve secretion clearance (Wang, Pan and Hu, 2019). Nebulisation and humidification can be used in combination with manual chest clearance techniques to aid

secretion mobilisation for expectoration or suctioning (Main and Denehy, 2016; Tadyanemhandu and Manie, 2016). Manual chest clearance techniques to improve bronchial hygiene and aid pulmonary re-expansion should be avoided in the patient with polytrauma who has fractured rib or sternum segments, acute thoracic pain, cardiovascular instability, bronchospasm, pulmonary embolism, undrained pneumothorax or hemothorax, and frank hemoptysis (Padovani, Silva and Tanaka, 2017). However, in a global study on the physiotherapy management of trunk trauma, manual chest clearance techniques were reported to be less commonly used by physiotherapists (Van Aswegen et al., 2020).

2.8.1.1.4 Airway suctioning and active coughing

The most commonly performed respiratory physiotherapy technique by physiotherapists for patients who are intubated and on MV is suctioning for secretion clearance (Stiller, 2013; Skinner et al., 2015). There is expert consensus that in performing routine bronchial hygiene therapy, normal saline (not more than 2ml) should be instilled in the airway during endotracheal suctioning only when the secretions appear very tenacious, dry and difficult to clear with suctioning and other techniques (van der Lee, Hill and Patman, 2019). Although MV use, sedation and the presence of an artificial airway increases the production of secretions, neither suctioning nor instillation of normal saline should be performed routinely unless indicated by assessment findings (Gosselink et al., 2008; van der Lee, Hill and Patman, 2019).

It is important that the physiotherapist encourages their patients to attempt active coughing during suctioning to enhance the patient's ability to effectively clear retained secretions from their airways, in preparation for extubation (van Aswegen, Morrow and Van Aswegen, 2015, p.182). In patients with rib fractures or who had abdominal surgery, it is important to provide support to the chest wall or surgical site during coughing to enhance the effectiveness of the patient's cough effort (Kayambu, Boots and Paratz, 2013; Van Aswegen, Morrow and Van Aswegen, 2015, p.213).

2.8.1.1.5 Active cycle of breathing techniques

The active cycle of breathing technique (ACBT) is a cycle of breathing control, thoracic expansion exercises (TEE) and forced expiratory techniques (FET) used to clear bronchial secretions (Main and Denehy, 2016; Ahmad, 2018). It is a frequently used technique by physiotherapists (>80%) to optimize respiratory function in patients with compromised cardiorespiratory function (Van Aswegen et al., 2020). Breathing control is followed by TEE

for three to four breaths. Thoracic expansion exercises are important in increasing lung volumes as well as clearing excess bronchial secretions. An inspiratory hold of three seconds during TEE allows air to flow through collateral ventilation channels and help dislodge secretions in peripheral airways and mobilize them towards the larger airways (Main and Denehy, 2016). Breathing control is restarted again (20–30 seconds or six breaths) followed finally by FET. Depending on the proximity of the secretions (distal or proximal) a medium sized breath with a longer huff or large sized breath with a shorter huff are encouraged to expectorate the secretions. The whole cycle should be repeated five times every waking hour (Ahmad, 2018; Derakhtanjani et al., 2019).

The ACBT creates dynamic compression of the airways downstream, producing increased turbulent airflow which aids secretion mobilisation. This airway clearance technique can be practiced in the highest functional position for the acute care patient, for example in sitting as well in a gravity aided positions. Active cycle of breathing techniques is an important nonpharmacological physiotherapy intervention which also aids the reduction of pain from rib fractures (Weinberg, Roos and Van Aswegen, 2022). In the patient with polytrauma in an acute care setting who is sedated or critically ill, ACBT may be difficult to carry out effectively as it depends largely on active participation of the patient. It is thus a strategy reserved for use in patients who are more alert and able to carry out instructions correctly.

2.8.1.2 Techniques that Improve Lung Volumes

2.8.1.2.1 Positioning

Positioning is a usual care physiotherapy technique and is commonly performed by physiotherapists (Skinner et al., 2015; Van Aswegen, 2020). After thoracic trauma, early upright positioning increases functional residual capacity and prevents lung collapse (Ahmad, 2018). Positioning patients after trauma utilizes gravitational pull to enhance ventilation, perfusion, and gas exchange. The upright position also improves chest expansion and increases autonomic activity which can reduce cardiac stress from compression by other systems in the supine position (Gosselink et al., 2008; Wang, 2018). Consistent two hourly body position changes out of the usual supine position which might allow for easier nursing care are vital in maintaining skin integrity and optimizing oxygenation through matching lung ventilation and perfusion (Main and Denehy, 2016, p.706).

In patients with thoracic trauma, effective diaphragmatic breathing is minimized by pain from thoracic or abdominal injury or because of surgery. When a patient is put into the sitting position, which puts the pelvis in posterior pelvic tilt, the diaphragm length tension relationship

is optimized facilitating effective diaphragmatic breathing (Ahmad, 2018). Putting patients with low oxygen saturation and increased work of breathing into prone position is shown to improve respiratory function and reduce energy expenditure (Gosselink et al., 2008; Hermans et al., 2014). However, patients with polytrauma who might present with open injuries, multiple fractures, and splints or casts may be challenging to position in prone.

The upright standing position allows for increased alveoli recruitment in comparison to sitting (Wang, 2018). The upright position also improves lung volumes and oxygenation, stimulates autonomic activity, and can lessen cardiac stress from compression from abdominal contents (Gosselink et al., 2008). When ventilation improves an improvement in physical comfort can be noted (Weinberg, Roos and Van Aswegen, 2022). However, the semi-fowler position is frequently used in ICU for cardiorespiratory rehabilitation as it is more functional in the management of patients that are critically ill and have poor cardiopulmonary endurance.

2.8.1.2.2 Manual hyperinflation

Manual hyperinflation (MHI) is a respiratory manoeuvre frequently used by physiotherapists in the management of critically ill intubated and mechanically ventilated patients (Lockstone et al., 2023). It is carried out by the use of a manual resuscitator bag in order to trigger a slow deep inspiration (a larger than normal tidal volume breath) followed by an inspiratory hold of two to three seconds, and then a quick release of the bag to augment forced expiration (Choi and Jones, 2005). The usefulness of MHI and its effect on improving lung volumes is evaluated by its capacity to generate an expiratory flow imbalance which is a peak expiratory flow higher than the peak inspiratory flow which can aid secretion mobilisation towards the proximal airways by mimicking a cough (Tucci et al., 2019; Lockstone et al., 2023). In addition, MHI reduces airway resistance and increases lung compliance (Choi and Jones, 2005; Khodayari et al., 2022).

There is expert consensus that patients on MV who have high sputum viscosity and low alveoli recruitment are able to benefit from MHI (Van der Lee, Hill and Patman, 2019). In addition MHI can prevent pulmonary atelectasis, improve alveoli recruitment and improve arterial oxygenation (Gosselink et al., 2008; Lockstone et al., 2023). Manual hyperinflation is an intervention less commonly used by physiotherapists (<35%) in the management of patients with trunk trauma (Van Aswegen et al., 2020). It should not be performed in patients with undrained pneumothorax, emphysema bullae, severe bronchospasm, head injury with intracranial pressure above 25mmHg, patients on high positive end-expiratory pressure

(greater than 10cmH₂O), fraction of inspired oxygen greater than 70%, or severe arterial hypotension (Choi and Jones, 2005; Khodayari et al., 2022).

2.8.1.2.3 Positive expiratory pressure therapy

Positive expiratory pressure (PEP) therapy improves lung volumes by imposing an expiratory flow resistance thereby increasing airway diameter, and increasing alveoli capacity for gaseous exchange (Demchuk and Chatburn, 2021). Positive expiratory pressure therapy also enhances mucus clearance; the increased expiratory flow behind mucus plugs increases mucus mobilisation from the peripheral airways into main airways where they can be expectorated or suctioned (Myers, 2007; Demchuk and Chatburn, 2021). Caution should be taken during use in patients with polytrauma who present with unmanaged pneumothorax, high intracranial pressure, frank hemoptysis and recent head/facial fractures.

2.8.1.2.3.1 Flutter device

Oscillatory PEP devices generate repetitive occlusions that are known to reduce mucus viscosity (Fagevik Olsén, Lannefors and Westerdahl, 2015). The flutter device is a small, handheld device with a mouthpiece and a small cover which encompasses a steel ball. During exhalation, the ball vibrates within the device, resulting in disruptions in expiratory airway flow and generating positive expiratory pressure (Main and Denehy, 2016. p.277). This oscillatory vibration of air in the device is similar to what occurs to the air within the airways, generating forces which cause deformation to secretions reducing its viscoelasticity (Demchuk and Chatburn, 2021). The frequency of oscillations produced by the device may imitate how cilia beat further increasing the upward mobilisation of secretions towards main airways where they can be expectorated (Myers, 2007).

2.8.1.2.3.2 Positive expiratory pressure bottle

Oscillatory PEP can also be generated by the use of a blow bottle called the bubble-PEP. This is a popular treatment strategy for physiotherapists in South Africa in the ICU setting for spontaneously breathing patients (Lottering and Van Aswegen, 2016). The patient expires via a tube inserted into a bottle of water. This decreases expiratory flow and increases expiratory time, leading to a smaller volume of expired air. This has an effect of improving airway wall stability and increasing the volume of air available for gaseous exchange (Fagevik Olsén, Lannefors and Westerdahl, 2015).

The patient is instructed to take a slightly larger than normal breath resulting in a higher tidal volume but not to fully fill the lungs. This is followed by maintaining a steady expiration for at least three to four seconds whilst trying not to exhale all the way down towards functional residual capacity (Volsko, DiFiore and Chatburn, 2003). The height of the water column, the diameter of the tube, the length of the tube, the breathing pattern and the force of expiration are all considerations that influence the impact of the patient's respiratory condition and the expiratory pressure achieved (Fagevik Olsén, Lannefors and Westerdahl, 2015). Blowing through the tube generates bubbles in the bottle. The water level in the bottle is usually approximately 10 cm which provides the threshold resistance to expiration and the oscillatory effect in the airway which helps in maintaining lung volumes and aid secretion clearance (Volsko, DiFiore and Chatburn, 2003; Myers, 2007).

2.8.1.2.4 Incentive spirometry

Incentive spirometry is a respiratory rehabilitation technique which uses a biofeedback system to motivate patients with respiratory complications to carry out diaphragmatic breathing and regain lung function (Ahmad, 2018). There are two main types of incentive spirometry devices, namely flow-incentive spirometry, and volume-incentive spirometry. In the flow-incentive spirometry, the degree of air flow achieved by the patient during inspiration is represented by the level to which balls in the device rise as a result of the patient's respiratory effort. In volume-incentive spirometry, the volume of the air displaced during inspiration is depicted on the device (Unsworth, Curtis and Asha, 2015; Ahmad, 2018; Faizan et al., 2022).

Incentive spirometry helps to generate large and sustained transpulmonary pressures which result in the expansion of collapsed alveoli preventing and treating pulmonary complications (Carvalho, Paisani and Lunardi, 2011). Incentive spirometry is effective in improving postoperative pulmonary complications in patients with thoracic trauma, and evidence from clinical trials and surveys exists to support its use in patients with trunk trauma (Van Aswegen, 2020). In the acute care setting, patients who are sedated and cannot follow instruction or patients in whom co-operation is reduced or those unable to understand instruction or demonstrate proper use of the device may not benefit from its use (Restrepo et al., 2011).

2.8.1.2.5 Intermittent positive pressure breathing

Intermittent positive pressure breathing (IPPB) is a thoracic expansion technique that maintains a positive airway pressure throughout inspiration, with the airway pressure returning to normal atmospheric pressure during expiration (Romanini et al., 2007). This technique has

been shown to enhance the tidal volume and can decrease the work of breathing when used in a fully relaxed patient as the work of breathing during inspiration approaches zero (Main and Denehy, 2016, p. 292). It is also indicated in the prevention or treatment of atelectasis that is unresponsive to other therapies, and in secretion clearance (Bourdin et al., 2012).

More than 50% of physiotherapists who practice in South African ICUs reported that they use IPPB and incentive spirometry as part of patient treatment in acute care settings (Lottering and Van Aswegen, 2016). Intermittent positive pressure ventilation is seen to improve arterial oxygen concentration more efficiently than incentive spirometry (Romanini et al., 2007). Intermittent positive pressure breathing also offers an efficient means of delivering humidification agents, bronchodilators, decongestants and mucolytic agents to the airways (Khan, Zaman and Doza, 2015). After an IPPB treatment session the local ventilation significantly increases past baseline levels before treatment initiation, and these effects are sustained for three hours in patients with reduced lung volumes (Guérin et al., 2010). Various IPPB devices are available, however its use is limited to spontaneously breathing patients and not intubated patients on MV.

2.8.1.3 Techniques that Improve Respiratory Muscle Strength

2.8.1.3.1 Inspiratory muscle strengthening

Inspiratory muscles, like other skeletal muscles, undergo physiological changes in response to being unloaded by MV use, and undergo adaptations in response to training (Main and Denehy, 2016, p. 349). The diaphragm, which is the chief inspiratory muscle, responds to MV with rapid atrophy and negative alterations in myofiber length. This progressive weakness and deconditioning present complications that result in MV weaning difficulties (Elkins and Dentice, 2015). Inspiratory muscle training seeks to arrest this deconditioning by applying a targeted load to the diaphragm and accessory inspiratory muscles in order to improve their strength and endurance (Bissett et al., 2019; Figueiredo et al., 2020).

In the ICU setting, loading of inspiratory muscles can be achieved by temporarily adjusting pressure support settings on a mechanical ventilator during physiotherapy sessions. On MV, pressure support gives inspiratory assistance to the patient during inspiration therefore it has a tendency to unload inspiratory muscles (Morrow and Van Aswegen, 2015, p.81). The reduction of pressure support enforces resistance to inspiration and greater muscle activity is required to achieve active inspiration (Morrow and Van Aswegen, 2015, p.81). A reduction of

pressure support of about 2–3 cm H₂O is done whilst the patient performs diaphragmatic breathing using the changes in inspiratory tidal volume as biofeedback (Elkins and Dentice, 2015; Morrow and Van Aswegen, 2015, p.81).

The temporary decrease in trigger sensitivity of the MV can also be used as a method of inspiratory muscle training. The trigger sensitivity is set to 20% of baseline maximum inspiratory pressure and patients practice deep breathing at this setting for five minutes twice daily (Stillier, 2013; Elkins and Dentice, 2015; Morrow and Van Aswegen, 2015, p.82). The duration of training and the resistance to inspiration is gradually increased. For inspiratory muscle strength to improve, resistance levels of 40–60% of baseline maximum inspiratory pressure should be used (Morrow and Van Aswegen, 2015, p.82).

Spring-loaded one-way valve inspiratory muscle training devices can also be used in inspiratory muscle training for patients who are able to take some spontaneous breaths on MV or have recently been extubated (Silva et al., 2013; Morrow and Van Aswegen, 2015, p.81). The critically ill patient with multiple fractures can actively participate whilst in a supported semi-fowlers position in bed or upright in a chair. The device is attached to the intubated patient using a T-piece connector whilst oxygen therapy is supplied at the same time if indicated (Kendall et al., 2018). The spring-loaded device allows for reproducibility of the patient's efforts, facilitating a more precise progression in muscle strengthening efforts (Bissett et al., 2019).

Inspiratory muscle training reduces the risk of pulmonary complications and reduces hospital length of stay, especially in critically ill patients, and in those undergoing pulmonary surgery. Shorter IMT intervention times at higher levels of resistance increase inspiratory muscle strength, whilst longer intervention times at lower levels of resistance improve endurance (Carvalho, Paisani and Lunardi, 2011; Figueiredo et al., 2020). The impact of IMT on preventing pulmonary complications is seen to be stronger when IMT is combined with physical exercise, performed progressively over longer periods, in sessions with increasing muscle loading (Kendall et al., 2018). However, there are several conditions in the ICU where IMT would not be applicable, for example, in patients who have acutely worsening conditions, experiencing severe pain, shortness of breath, hemoptysis, or hemodynamic instability (Bissett et al., 2019). In addition, there is a scarcity of evidence on IMT use in the patients with polytrauma whether globally or in Namibia.

2.8.1.4 Early Exercise and Mobilisation

2.8.1.4.1 Early Mobilisation

Patients with critical illness experience a wide array of distressing symptoms during hospitalisation in intensive care settings which include severe pain, anxiety, delirium, weakness, and insomnia (Pun et al., 2019; Balas et al., 2022). Caring for critically ill patients is highly complex as these multiple symptoms are often managed with heavy sedation, anaesthesia, immobilisation, and social isolation (Pun et al., 2019). In the past, daily goals of care for these patients were managed by addressing individual organ dysfunction, as opposed to an integrated holistic method of approach, and intensive care team members achieved these goals in isolation from other healthcare professionals (Costa et al., 2019; Pun et al., 2019). Evidence increasingly suggests that the way ICU teams decide to manage critically ill patients and patients with trauma can have important negative prognostic implications on the patient and their families (Bouman et al., 2017). A comprehensive ICU care bundle was developed which consists of the following individual elements: (A) assess, prevent, and manage pain; (B) both spontaneous awakening trials (SATs) and spontaneous breathing trials (SBTs); (C) choice of analgesia and sedation; (D) delirium: assess, prevent, and manage; (E) early mobility and exercise; (F) family engagement and empowerment; (G) good handoff communication; and (H) handout of relevant materials on post-intensive care syndrome (Inoue et al., 2019; Pun et al., 2019; Balas et al., 2022). This bundle of care is termed the ABCDEFGH treatment bundle. This bundle of care is a cohesive, interdisciplinary approach which seeks to enhance ICU team dynamics and performance in order to provide optimal patient and family centred outcomes (Barr et al., 2020; Balas et al., 2022).

Early mobilisation of patients in acute care is performed according to strict guidelines in clinically stable patients (Wang, Wu and Wang, 2018; Dong et al., 2021). In Southern Africa, early mobilisation by physiotherapists in the ICU setting is seen to be feasible, safe and a current usual care physiotherapy practice (Lottering and Van Aswegen, 2016; Tadyanemhandu, Van Aswegen and Ntsiea, 2022). Early mobilisation is also well supported in managing patients with trunk trauma and multiple orthopaedic injuries (Plani, Van Aswegen and Morrow, 2015, p. 343; Van Aswegen, 2020). Patients who are hemodynamically unstable, on high FiO₂ and high ventilator support are not suitable for aggressive mobilisation. The risk associated with mobilizing a critically ill patient should not outweigh the benefit (Jacob et al., 2021). Functional mobility activities in the ICU which include progressive mobilisation activities such as supine to sit, sitting at the edge of the bed, standing, transfers and ambulation are the hallmark of early progressive mobilisation in patients with multiple

fractures (Schober and Thornton, 2013; Andrzejowski, Holch and Giannoudis, 2021). Their role includes the management of respiratory complications (Elkins and Dentice, 2022; Weinberg, Roos and Van Aswegen, 2022).

In patients with trunk trauma, postoperative mobilisation following abdominal surgery is a usual care physiotherapy practice (Van Aswegen, 2020). Early mobilisation also reduces the duration of immobility and complications associated with immobility such as ICUAW. As much as 37% reduction in the likelihood of developing ICUAW was noted by Anekwe et al. (2020) in a meta-analysis that evaluated the impact of early mobilisation on reducing ICUAW. Using the ABCDEFGH bundle of care, physiotherapists can directly influence early mobilisation of patients. This can be effectively carried out if there is inter-disciplinary team engagement which addresses adequate pain management, sedation levels which allow active participation in physiotherapy treatment and overall team engagement to achieve family centred outcomes so that rehabilitation outcomes that depend on family support can be achieved (Tadyanemhandu, van Aswegen and Ntsiea, 2022).

An expedited discharge and treatment program can result in successful discharge within three days in patients with traumatic rib fractures in which pain control is optimized, early mobilisation is employed, and respiratory care is made a priority (Dalton et al., 2019). Strategies involving interruption of sedation, the provision of physiotherapy and occupational therapy in early hospitalisation in critical care patient management has been reported to result in improved functional outcomes at ICU discharge (Tadyanemhandu and Manie, 2016). In the intensive care facility, there is need for continuous improvement in collaborative participation in order to achieve clinically significant improvements in bundle performance (Balas et al., 2022).

2.8.1.5 Early Exercise

Exercise therapy in the ICU aims to achieve early mobilisation, facilitate weaning, optimize arterial oxygenation and improve functional independence by increasing muscle strength and endurance (Denehy and Berney, 2006). In the ICU, in-bed exercises are feasible and implementable as they are generally initially low intensity (Medrinal et al., 2018). The prescription and implementation of exercises by the physiotherapist for this patient demographic is mostly based on the patient's clinical presentation (Jacob et al., 2021).

In a study by Dong et al. (2021) in which 80 patients on prolonged MV received early physiotherapy (in bed mobilisation, ROM exercises, as well as progressive mobilisation as

tolerated), it was concluded that the group which received early physiotherapy had quicker weaning outcomes and early extubation. Muscle specific exercises therapy such as inspiratory muscle strengthening has also been shown to arrest diaphragmatic dysfunction thereby improving weaning outcomes and reducing the hospital length of stay (Silva et al., 2013; Supinski et al., 2018). Three days of early physiotherapy interventions have been proven to improve diaphragmatic atrophy in patients on MV (Dong et al., 2021).

Low resistance, multiple repetitions of resistive exercise activities enhance muscle mass, augment force generation, and increase oxidative enzymes. This in turn improves oxygen extraction and efficiency of oxygen kinetics in muscles (Sommers et al., 2015). Concerning these physiological responses in the critical care patient scenario, patients should be given three sets of eight to ten repetitions at 40% of one repetition maximum (1RM) to achieve a lasting physiological response that helps maintain or improve muscle strength and increase cardiac output (Gosselink et al., 2008).

Peripheral muscle strengthening exercises are reported to form usual physiotherapy care practices in ICUs in South Africa (Lottering and Van Aswegen, 2016). In-bed exercises can be initiated when tolerated in gravity eliminated positions for muscles with 2/5 strength on the MRC-SS scale. When critically ill patients are stable enough, gradual progression of mobility can be carried out in order to carry out activities such as mobilizing patients over the edge of the bed with feet supported on the floor to perform active or active assisted lower and upper limb strengthening exercises against gravity (Main and Denehy, 2016, p.702). When tolerated resistance can be added in the form of the therapist resisting active ROM exercises, therabands can also be utilized to load upper and lower limbs (Zhao et al., 2020).

Active and resisted exercises should be done to maintain muscle strength in the unaffected limbs of patients with polytrauma (Van Aswegen, Plani and Morrow, 2015, p.355). The maintenance of muscle strength in the unaffected limbs and core muscles is an important component of early exercise to reduce the loss of muscle mass and muscle strength (Takeda, Tanino and Miyasaka, 2017). Patients with multiple orthopaedic injuries require global body conditioning to ensure that they have adequate muscle strength in their unaffected limbs to perform ADLs and gain early functional independence (Van Aswegen, Plani and Morrow, 2015, p. 355). It is important to work on this whilst the patient with multiple orthopaedic injuries is not yet allowed to bear weight through the injured limbs. Patients with multiple lower limb fractures require greater upper body strength in order to do transfers if bearing full weight on their lower extremities is not permissible.

Multiple precautions and considerations are applied in exercise prescription and management of patients with multiple orthopaedic injuries. For example, the presence of pain out of proportion to the type of injury in lower extremity injuries may be indicative of compartment syndrome which should be surgically managed if suspected (Ersoy and Pomeranz, 2016; Tosounidis and Giannoudis, 2016). In general, fracture sites must be supported during therapy to avoid excessive movement. Rotation and excessive pain on fractures should be avoided and adequate support during exercises and mobilisation should be given to fracture sites (Plani, Van Aswegen and Morrow, 2015, p.349). The degree of permissible weight bearing should be established prior to mobilisation (Jacob et al., 2021). The incidence of delayed union, mal-union and non-union can be reduced by ensuring weight bearing is done correctly (Plani, Van Aswegen and Morrow, 2015, p.352). Resistance distal to fractures should not be applied prematurely.

2.8.1.6 Functional Exercises

Physiotherapy programs to improve physical function expose patients to active activities, such as in-bed mobility training (rolling and bridging), lying to sitting activities, or sitting upright unsupported, transferring from bed into a chair and standing; all of which can be done initially with assistance but progressively with diminishing assistance (Connolly et al., 2015, Worrappan et al., 2022). The amount of assistance given to a patient in order for them to accomplish physical tasks is gradually reduced in order to achieve a level of independent function (Nordon-Craft et al., 2012; Ahmad, 2018). Functional mobility activities increase minute ventilation as tidal volume increases in upright positions such as sitting or standing versus supine positions in bed; in addition the heart rate, blood pressure and mean arterial pressure also increases which improves cardiopulmonary endurance (Tadyanemhandu and Manie, 2016; Tadyanemhandu, Van Aswegen and Ntsiea, 2022).

2.8.1.7 The Maintenance of Range of Motion in Polytrauma

Muscle length and joint integrity can be improved or maintained in patients with critical illness and those with fractures through adequate positioning of limbs, the use of passive muscle stretches, passive, active assisted or active ROM exercises (Main and Denehy, 2016, p.706). As part of usual care physiotherapy practice, unresponsive patients who are on MV should undergo passive range of motion exercises (PROM) for all limbs daily; these can be done by giving ten repetitions for each joint in all cardinal directions (Medrinal et al., 2018). Splints are usually considered in patients who present with shortening of two-joint muscles. Finger flexors

and ankle plantar flexors are two joint muscles that commonly require splinting in the critically ill patient who is immobilized (Khan, Zaman and Doza, 2015).

After thoracic trauma, the majority of patients have chest wall pain and/or shoulder pain, and if they have an intercostal drain, it may cause them to immobilize the arm on that side, potentially leading to reduced shoulder ROM and impaired thoracic mobility (Ahmad, 2018; Van Aswegen, 2020). For this reason, active assisted or active ROM exercises for the shoulder within pain limits can be started as early as possible, with attention to the chest tube site. Aiming to achieve 90 degrees shoulder abduction, shoulder elevation and full scapular mobility within pain limits as early as day one post-surgery is recommended to improve thoracic mobility and reduce impairments (Parry et al., 2015; Ahmad, 2018). In addition, the scapulae on the operated side (for patients that have had thoracic surgery), or on the side with the intercostal drain can be gently mobilized through its full range, while the patient is in the side-lying position. This will help improve glenohumeral mobility (Allemann et al., 2019).

2.8.2 Pain Management for Chest Trauma

Non-pharmacological options in the management of rib fracture pain such as, transcutaneous electrical nerve stimulations (TENS), acupuncture as well as respiratory physiotherapy modalities such as active cycle of breathing techniques (ACBT), splinted cough, incentive spirometry, IPPB, continuous positive airway pressure (CPAP), optimal positioning, as well as early physiotherapeutic exercises are effective in pain management (Dalton et al., 2019; Weinberg, Roos and Van Aswegen, 2022). In a global study on trunk trauma, patient education on pain neuroscience was the most commonly used pain management strategy by specialized trauma physiotherapists (Van Aswegen et al., 2020).

In the awake and cooperative patient with multiple orthopaedic injuries, the fracture sites can be stabilized during active exercises to reduce joint stiffness and therefore pain intensity (Van Aswegen, Plani and Morrow, 2015, p. 354). In patients with fractures in the extremities, elevation of the limb reduces oedema and improves the patients pain experience (Van Aswegen, Plani and Morrow, 2015, p.354). A notable contribution can also be made by physiotherapists to the emotional well-being of a patient with chest trauma by the use of relaxation interventions which can lessen anxiety and fear, improve sleep quality, thereby reducing the severity of pain and shortness of breath (Gosselink et al., 2008).

2.9 **BARRIERS TO PHYSIOTHERAPY MANAGEMENT OF PATIENTS WITH POLYTRAUMA**

In developing countries, higher risk of delays in accessing medical services are linked to limited resources such as poorer quality of pre-hospital and in-hospital care for trauma patients (Zimmerman et al., 2020). In Sub-Saharan Africa, many hospitals lack medical staff that are suitably trained in emergency care and in the management of critically injured patients resulting in poorer patient outcomes even after treatment (Zimmerman et al., 2020). In Namibia, social and physical barriers exist for patients in need of accessing healthcare services in the public and private sector (Shumba and Moodley, 2017). Accessibility to medical services and lack of knowledge of available services are barriers affecting uptake of these services. The utilisation of these services in Namibia is also affected by poverty (Gibson et al., 2022).

Globally the management of patients with blunt chest trauma in acute care settings and the implementation of multidisciplinary care pathways is marred by lack of enthusiasm among team members, a resistance to change and lack of suitable existing evidence for the implementation of new strategies (Unsworth, Curtis and Asha, 2015). Barriers affecting early mobilisation in the ICU include poor motivation by members of the staff, lack of awareness of the benefits to patient outcomes or purely negative perceptions associated with the task (Jacob et al., 2021; Tadyanemhandu, Van Aswegen and Ntsiea, 2022). Chest tubes, catheters, continued intravenous intake of fluids and inadequate pain control, sedation and the patient being too ill to be mobilised are also important barriers to early ambulation in physiotherapy sessions (Schober and Thornton, 2013; Slinger and Naidu, 2019; Tadyanemhandu, Van Aswegen and Ntsiea, 2022).

Physiotherapists who work in South African and Zimbabwean ICUs express that the use of sedation scales which gradually reduce the level of sedation in ICU is a positive factor which encourages the implementation of early mobilisation in the units (Tadyanemhandu, Van Aswegen and Ntsiea, 2022). Effective communication with multidisciplinary team members, a collaborative approach to patient care and sharing of knowledge are some enablers to interprofessional teamwork identified by physiotherapists working in adult ICU settings in South Africa (Ntinga and Van Aswegen, 2020). Differing paradigms of teamwork among health professionals was highlighted as a cause of tension in the ICU inter-professional collaborations (Tadyanemhandu, Van Aswegen and Ntsiea, 2022).

2.10 DISCHARGE DESTINATIONS FOLLOWING ACUTE CARE DISCHARGE

Outcome measure such as the CPAX tool, PFIT and Barthel index are able to predict discharge destinations for patients recovering from severe illness (Denehy et al., 2013). Patients with polytrauma may suffer from ongoing physical, cognitive, and psychological difficulties which dictate the level of support needed post-acute care discharge (Mccarthy et al., 2021; Balogh, 2022). The ultimate discharge destination from an acute care facility is home when there is continuation of care (McCarthy et al., 2021). In a meta-analysis that evaluated the association between the level of trauma care and outcomes of patients with severe physical injuries, it was noted that admission in higher level trauma centres is associated with a larger percentage of patients being discharged directly home (Ditshuizen et al., 2023). Higher level trauma facilities have more accessible resources to cater for patients with high ISS. The management and rehabilitation of the trauma patient at these centres is intensive from the onset which improves their functional outcomes (Ditshuizen et al., 2023).

In a prospective, multicentre, cohort study by Pun et al. (2019) it was reported that discharge destinations other than home were inversely proportional to compliance with the ABCDEF bundle of care. This means that with the effective implementation of the ABCDEF bundle of care, the likelihood of patients being discharged directly home increases (Pun et al., 2019). The multidisciplinary team and their efforts in managing the patient with critical illness plays a role in patients obtaining the necessary cognitive and physical outcomes that influence the discharge destination from acute care (Skinner et al., 2015).

Low level trauma facilities are a considered option for patients that require more active rehabilitation of patients to improve their physical and cognitive function (Nordon-Craft et al., 2012). As much as 25% of survivors of critical illness are discharged to subacute facilities following acute care discharge (Skinner et al., 2015). Subacute level of care such as stepdown facilities are an option for trauma patients that require prolonged but less intensive medical care and long term intensive rehabilitation (Nordon-Craft et al., 2012; Denehy et al., 2013). These patients can tolerate treatment sessions of longer duration. In addition, some patients are discharged from an acute care ward, and admitted into a hospital ward at the same facility. This is ideal for patients who require continuity in their management and less intensive medical care (Nordon-Craft et al., 2012; Ditshuizen et al., 2023).

There is no documented information on discharge destinations for patients with polytrauma when discharged from acute care facilities in Namibia. In addition, there is a global scarcity of information regarding discharge destinations of patients with polytrauma when they leave acute care facilities.

2.11 CONCLUSION

Physical trauma is often a tragic incident resulting in multifaceted injuries that complicate an individual's life and that of family members and caregivers. Motor vehicle crashes are the largest contributing factor to polytrauma and risk-taking behaviours by young males result in them being the demographic frequently affected. As polytrauma is a complex pathology, patient outcomes can be enhanced by a collaborative approach to patient care, effective communication and sharing of knowledge among multidisciplinary team members. The physiotherapist plays an important role in the prioritisation of problems in the trauma patient throughout the length of illness and acute care admission. Effective physiotherapy interventions which enhance patient outcomes involve the implementation of current treatment strategies, the identification of aims and parameters of treatment, ensuring changes in physical function are monitored whilst ensuring that the treatment of choice is therapeutic, effective and safe. Physiotherapists who manage patients with polytrauma manage respiratory complications, prevent and treat detrimental effects of immobility, maintain joint and muscle integrity and implement early exercise and mobility strategies. The length of hospital stay can be positively influenced by inspiratory muscle strengthening, early mobilisation and early exercise making physiotherapy interventions an important factor affecting patients discharge. Discharge destination is influenced by the patient's severity of injury and response to treatment received in an acute care setting.

There is a paucity of information on Namibian research studies that highlight MVC statistics and the occurrence of polytrauma or the rate of admission of such patients into acute care settings. There is also no documented information on the use of intervention strategies or outcome measures in the physiotherapy management of patients in acute care settings in Namibia. In addition, information on discharge destinations for patients with polytrauma when discharged from acute care facilities in Namibia is unavailable.

CHAPTER 3

3 METHODOLOGY

This section details how the online survey was conducted. Included in this section is the study design, sample size considerations, study procedures, ethical considerations, instrumentation, data collection and statistical analysis followed to answer the study objectives.

3.1 STUDY DESIGN

A cross-sectional survey was conducted using an electronic survey tool.

3.2 PARTICIPANTS

3.2.1 Study Sample Selection

The study participants were physiotherapists registered with the Health Professions Council of Namibia (HPCNA) practicing in state and private institutions in Namibia. The participants had to be working in acute care facilities where patients with polytrauma are managed. Approximately seventeen hospitals in Namibia have the capacity to admit and manage patients with acute polytrauma. This includes five referral state hospitals and twelve privately owned institutions. These facilities may also contain emergency, surgical, medical, maternity and rehabilitation wards.

3.2.2 Inclusion Criteria

All registered physiotherapists practicing in Namibia's state and/or private acute care facilities were invited to participate. These participants were expected to have had current contact (in the last six months) with patients with polytrauma in acute care facilities where patients with polytrauma are managed.

3.2.3 Exclusion Criteria

Physiotherapists registered by the HPCNA but not practicing in Namibia at the time of the survey were excluded. Physiotherapy students still undergoing training for their undergraduate physiotherapy program were also excluded.

3.2.4 Sample Size

Convenience sampling was used in this study. All 133 physiotherapists registered with HPCNA in the last quarter of 2022 who were working in public and private acute care facilities were invited to participate. An electronic survey link was distributed via the Namibian Society of Physiotherapy (NSP) database and physiotherapy contact lists. A minimum response rate of 30% was expected for the survey (Nulty, 2008).

3.3 STUDY PROCEDURES

3.3.1 Instrumentation

A study specific questionnaire (see **Appendix A**) was developed with the aim to extract information which would help the researcher describe the physiotherapy management of patients with polytrauma in acute care settings found in the public and private sectors in Namibia. A questionnaire which consisted of closed-ended and open-ended response options was developed with guidance from the research supervisor and existing evidence in research literature.

Content validation of the questionnaire was carried out by two specialists in the field of Traumatology physiotherapy from South Africa and Zimbabwe. Adjustments to the content of the study instrument was made according to recommendations given. The experts recommended that early mobilisation activities in the questionnaire be divided into in-bed mobilisation and out of bed mobilisation activities. Outcome measures such as the FIM, ICU mobility scale and the Berg scale were added to the list of outcome measures in the questionnaire used to evaluate patient's response to treatment of their neuromusculoskeletal system. Barriers to physiotherapy service delivery to patients with polytrauma such as insufficient medical aid funds and delay to fracture management were also added to the specific section in the questionnaire.

A pilot study was done using two physiotherapists as participants to assess the duration of completion of the survey questionnaire and the ease of completing questions in the survey questionnaire. This helped the researcher identify some questions which were not clear to the participants as well as ensure a workable flow to the sequence of questions on the REDCap survey distribution application.

The final version of the questionnaire consisted of sections on demographic information of participants (Larsen et al., 2016); patient gender (Larsen et al., 2016); mechanisms of injury; physiotherapy treatment strategies (respiratory and neuromusculoskeletal system) (Denehy and Berney 2006; Skinner et al 2015; Tadyanemhandu and Manie 2016; Van Aswegen 2020);

outcome measures (Beshay et al., 2020; Curtis et al., 2016; Skinner et al., 2015; Van Aswegen, 2020); patient discharge destinations; rehabilitation services offered to patients during and after hospitalisation (Larsen et al., 2016); and barriers and enablers to physiotherapy service delivery (Curtis et al., 2016; Skinner et al., 2015).

The first section of the questionnaire aimed to extract sociodemographic information of the participants to understand the profile of physiotherapists working with patients with polytrauma. The second section of the questionnaire gathered information pertaining to the profile of patients admitted with polytrauma to Namibian healthcare services. Information was gathered about the most frequently injured gender, type and mechanisms of injury as well as body regions frequently injured. The third section looked at physiotherapy treatment strategies used to manage these patients from a respiratory and neuromusculoskeletal standpoint. The fourth section looked at outcome measures used by physiotherapists to assess response to treatment and guide treatment progression. In this section the frequency of use of established respiratory and functional outcome measures such as the assessment of chest radiography, respiratory sounds, level of dyspnoea, CPAx, PFIT, FSS-ICU tools among others was evaluated. Outcome measures used to influence treatment progression were also evaluated (Table 3.1).

Table 3.1: Outcome Measures used to Influence Physiotherapy Treatment Progression for Patients with Polytrauma.

Outcome Measures	Use/Importance
Self-Reported Measure	A subjective measure, often captured by use of a questionnaire, in order to objectify a patient's perception to their treatment or condition. Useful in enhancing the quality of communication between therapist and patient.
Performance-Based Measure	Qualitative or quantitative measure used in the assessment of physical tasks or activity as part of objective assessment.
Observer-Based Measure	Evaluation of observable outcomes related to patient's conditions as reported by other individuals who regularly observe patient on a daily basis.
Clinician-Based Measure	Assessment carried out by trained professional in this case a physiotherapist

(Kelly et al., 2014; Bouazza et al., 2017; Glimmerveen, Holewijn and Vermeer, 2023)

Discharge destinations as well as rehabilitation programs after treatment in acute care facilities was also evaluated. In the last segment of the questionnaire barriers and enablers to the delivery of physiotherapy services to patients during and after their hospitalisation was evaluated.

3.3.2 Data Collection Procedure

The final version of the questionnaire was made available electronically using REDCap software (held by the University of the Witwatersrand, Johannesburg, South Africa) and shared via the NSP database and physiotherapy contact lists on the 15th of November 2022. The survey link was live up until 16th of April 2023, thus the data collection was approximately five months. Reminders to complete the survey were sent to potential participants once a week for three consecutive weeks.

The NSP public survey link was shared with physiotherapists that are registered with the HPCNA but are also members of the NSP; this group of physiotherapists works in both private and state institutions. The physiotherapist contact list was used to source participants that work in public or private institutions and were registered by HPCNA but not members of the NSP.

3.4 ETHICAL CONSIDERATIONS

The researcher completed the TRREE Module 1: Introduction to Research Ethics on <https://elearning.trree.org/> on the 28th of September 2021 (**Appendix B**). In order for this study to commence, ethical approval was sought and obtained from the University of the Witwatersrand's Human Research Ethics (Medical) Committee (**Appendix C**). This was obtained on 18/03/22 with the ethical clearance number of M171007. The Biomedical Research Ethics Committee of the Ministry of Health and Social Services of Namibia also provided ethical approval on 14/07/22 with reference 22/4/2/3 (**Appendix D**). Approval to distribute the electronic questionnaire via the NSP database was given by chairperson of the NSP (**Appendix E**).

The front page of the electronic survey contained detailed information on the study aims and methods. Information on anonymity of participants and their responses on completed questionnaires was guaranteed as it was coded automatically on REDCap whilst access to completed questionnaires was restricted to no other persons other than the researchers involved in the study. If the participant completed the survey, it was assumed that they provided consent to participate in the study (Appendix A).

3.5 DATA ANALYSIS

Data was captured on REDCap. It was exported into an Excel file which was imported into Statistical Package for the Social Sciences (SPSS) version 28 for analysis. Nominal and ordinal type data were obtained in this survey. Descriptive statistics were used to summarise the data obtained. Categorical data was summarized as frequencies and percentages and presented in

tables, pie charts, tables, and graphs. The Shapiro Wilk test was used to determine the normality of the continuous data obtained, for example years of clinical practice. Continuous data were summarised as medians and interquartile ranges. Some questions allowed participants to enter their own responses. Data obtained with these questions were treated as qualitative and content analysis was used to summarise participant responses.

CHAPTER 4

4 RESULTS

Of the 133 physiotherapists registered to practice in Namibia by the HPCNA at the end of 2022, 55 took part in the survey. Therefore, the response rate to this survey was 41%. Three survey responses were excluded from the data analysis as the responses were incomplete, therefore 52 responses were considered in this analysis.

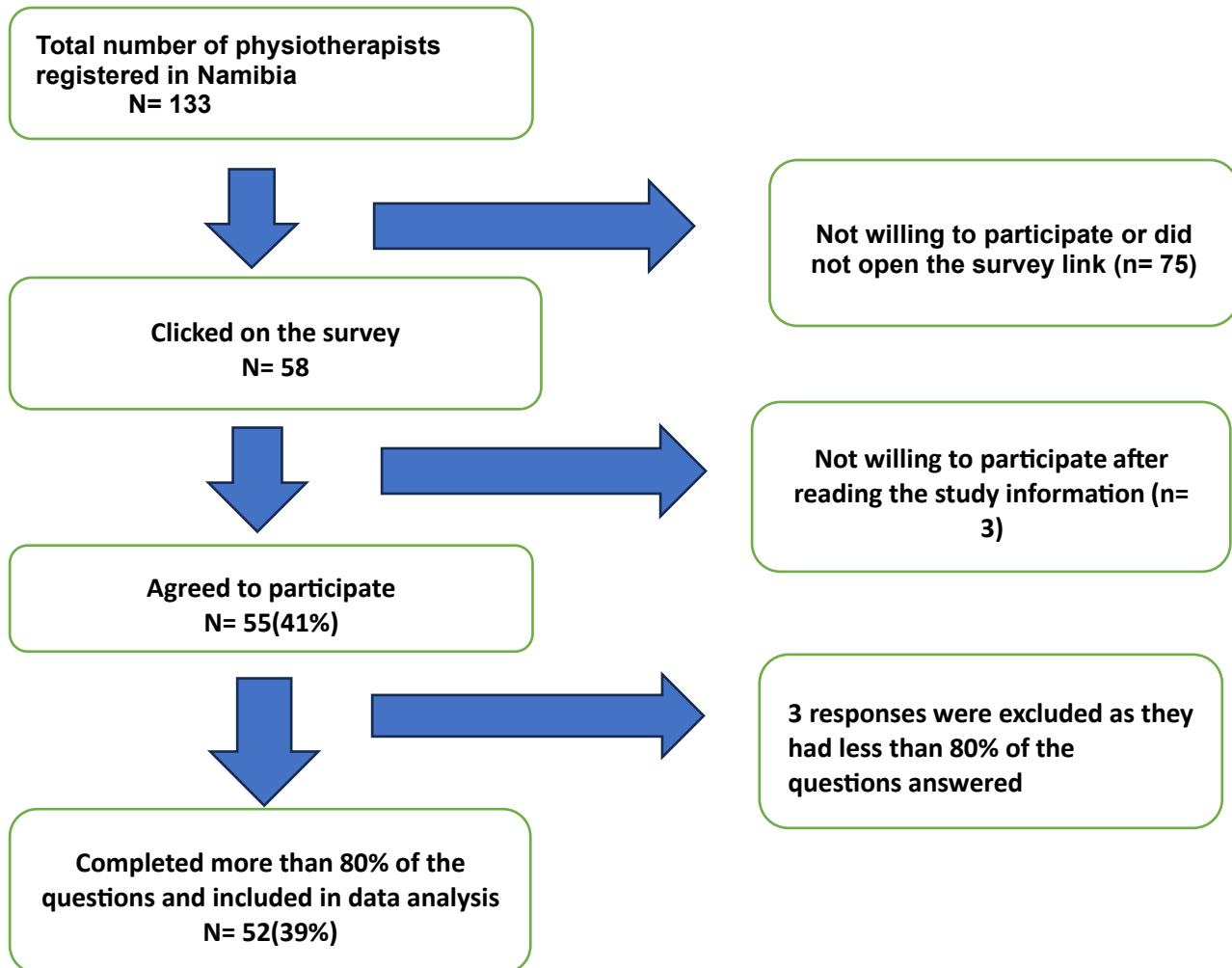


Figure 4.1: Survey Distribution Process

4.1 SOCIO-DEMOGRAPHIC DATA OF PHYSIOTHERAPISTS

Female physiotherapists who responded were 64% (n=33), whilst male physiotherapists were 37% (n=19). The median age of the respondents was 30 (IQR= 28-31; 95% CI: 30, 34) years. The youngest respondent was 23 years whilst the oldest was 58 years.

The median years of practice as a physiotherapist was six (IQR= 4-8; 95% CI: 6, 9) years. The physiotherapists with the lowest and highest number of years in practice was one year and 28 years respectively.

The qualifications of physiotherapists are reported below (Fig. 4.2).

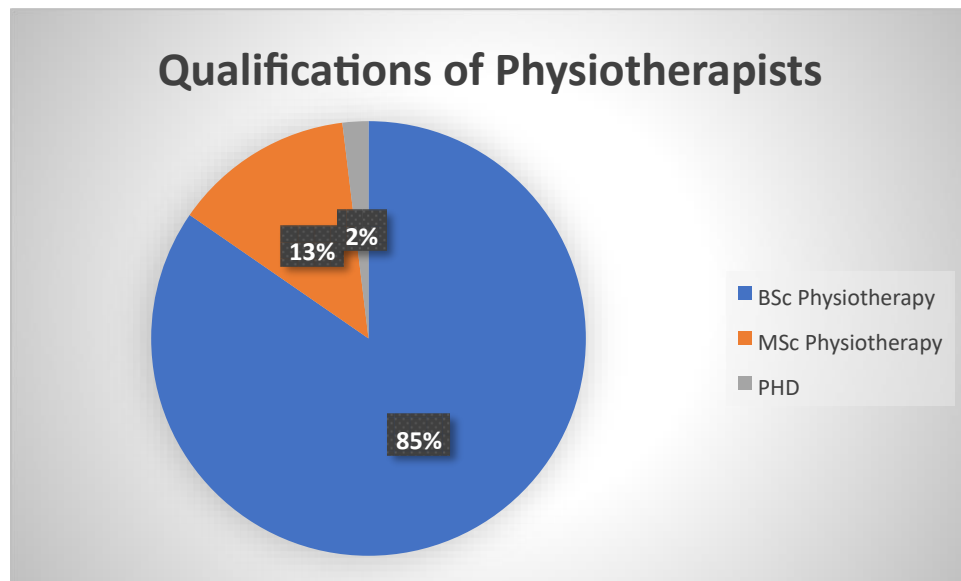


Figure 4.2: Qualification of Physiotherapy Respondents (n=52)

Most of the physiotherapists (85%; n= 44) had a BSc degree, whilst 13%(n=7) had an MSc in physiotherapy and only one had a PhD degree (2%) (Fig. 4.2).

Twelve (23%) of the 52 respondents did not have a postgraduate qualification in a specific field of physiotherapy practice. The most frequently reported post graduate qualification in a specific field of physiotherapy was in Orthopaedic physiotherapy (n=13; 25%), followed by Sports physiotherapy (n=12; 25%). No respondents had specialised in Traumatology physiotherapy (Fig.4.3).

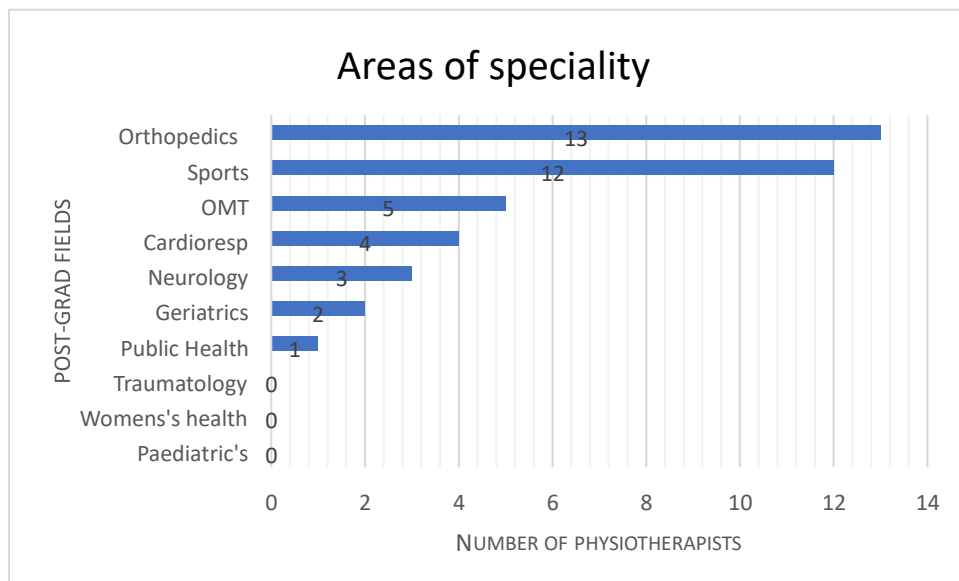


Figure 4.3: Postgraduate Qualification held in Specific Fields of Physiotherapy (n=52)

Some of the physiotherapists (n=18; 35%) worked in private institutions, whilst 16 physiotherapists (31%) worked in public institutions. Physiotherapists who worked in both public and private institutions made up 35% (n=18) of the respondents.

The median number of months worked by physiotherapists at hospital facilities where patients with polytrauma are managed was 12 (IQR= 5-30) months with a minimum range of one month and maximum range of 204 months.

All 52 respondents reported that they had treated patients with polytrauma in the past six months, as this was a requirement for them to proceed with answering the rest of the questionnaire.

Twenty-two participants (42%) reported that they managed patients with polytrauma in the ICU setting, whilst 16 (31%) reported that they managed patients with polytrauma in the hospital ward (Fig. 4.3). One respondent said that they managed patients with polytrauma in 'other settings'. These 'other settings' included 'all the above' mentioned hospital settings which includes the ICU, head injury unit, high dependency unit, step down facility and hospital ward (Fig. 4.3).

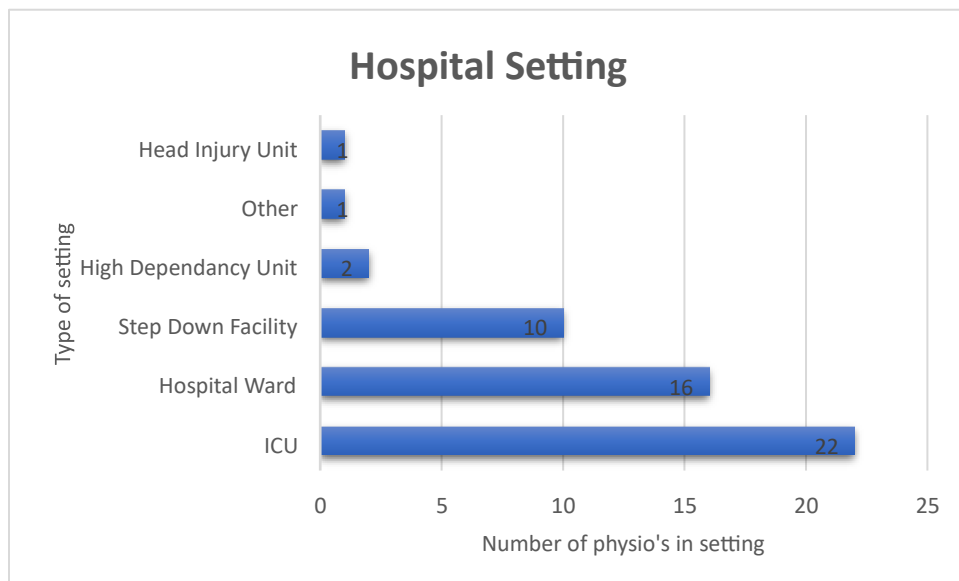


Figure 4.4: Hospital Settings where Patients with Polytrauma were Managed by Respondents (n=52)

4.2 PROFILE OF PATIENTS PRESENTING WITH POLYTRAUMA.

Out of the 10 last patients with polytrauma that the physiotherapists managed, 93% (n=48) were male whilst 8% (n=4) were female.

The mechanisms of trauma resulting in polytrauma injury for patients seen by physiotherapists in Namibia are summarised in figure 4.5.

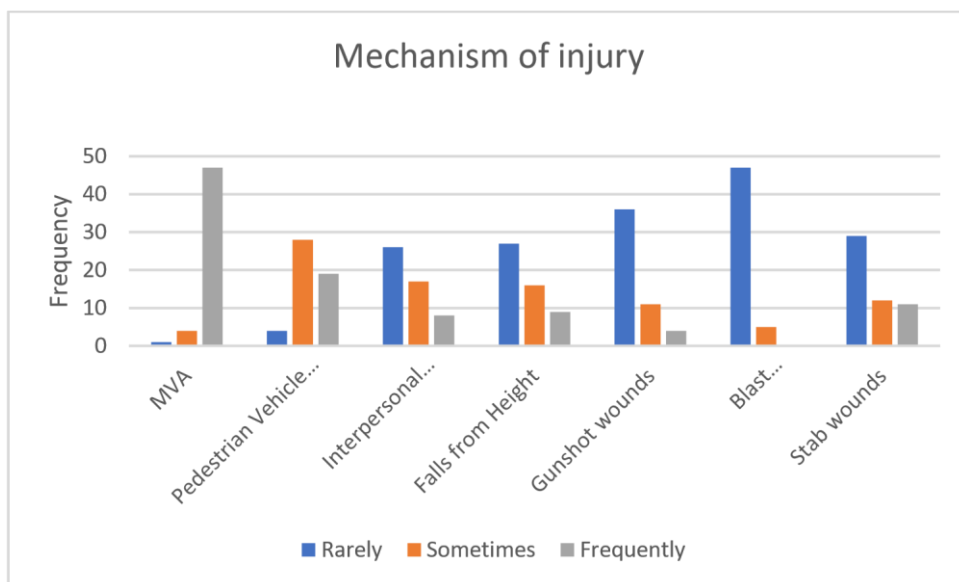


Figure 4.5: Mechanism of Injury of Patient Admitted with Polytrauma

Motor vehicle collisions (MVC) were reported to be the most frequent cause of polytrauma (n=47) by 90% of the respondents. Most of the respondents (55%, n=28) also reported that pedestrian vehicle collisions 'sometimes' resulted in polytrauma in the patient demographic they encountered whilst 37% (n=19) reported that pedestrian vehicle collisions 'frequently' resulted in polytrauma.

Interpersonal violence falls from a height, blast injury, gunshot injury, and stab injury were all rare causes of polytrauma (see Fig. 4.4).

Other mechanisms of injury reported to contribute to polytrauma were sport injuries. Two (4%) of the 52 respondents reported that sport injuries such as rugby injuries and injuries due to mountain biking were mechanisms which resulted in polytrauma based on patients managed at their hospital facilities.

The frequency of injury to body regions as a result of polytrauma was also evaluated (Fig.4.6).

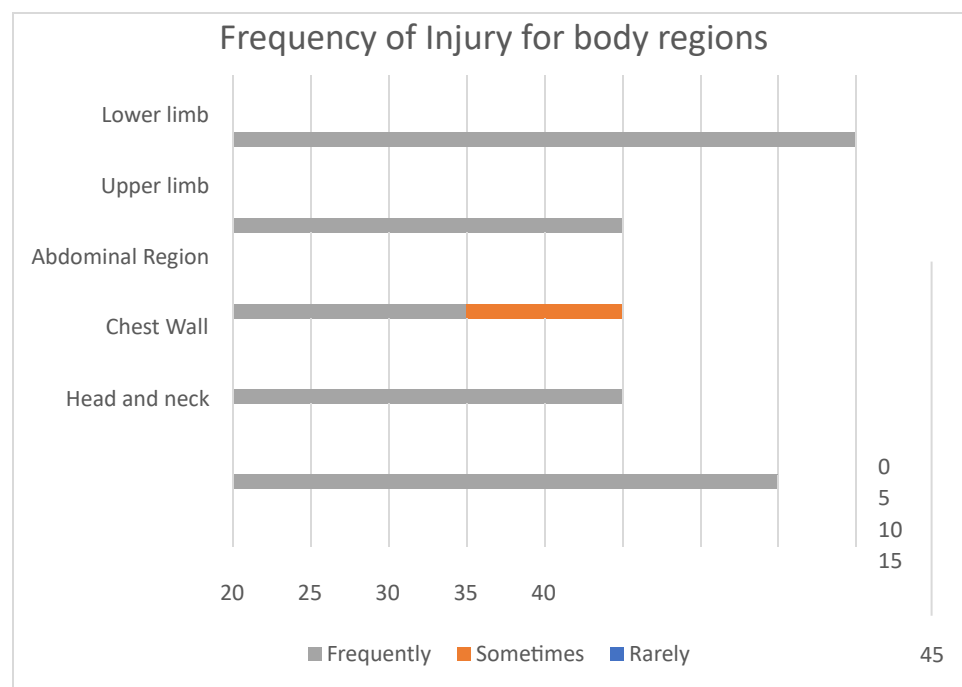


Figure 4.6: Body Regions often Injured in Polytrauma Patients in Namibia

The lower limbs (77%, n=40), head and neck regions (71%, n=37), and thorax (56%, n=29) were reported by the physiotherapists as regions frequently injured in their patients with polytrauma. The abdominal wall was reported to be 'sometimes' injured by 48% of the physiotherapists

(n=25).

4.3 PHYSIOTHERAPY TREATMENT STRATEGIES

Respondents used various physiotherapy treatment strategies to optimise respiratory system function for their patients with polytrauma. These strategies are summarised in Table 4.1.

Table 4.1: Physiotherapy Techniques used by Respondents for Optimizing Respiratory System Function for Patients with Polytrauma

Technique	Rarely Used <i>freq (%)</i>	Sometimes Used <i>freq (%)</i>	Frequently Used <i>freq (%)</i>
1. Breathing exercises	0 (0)	8 (16)	44 (85)
2. Suctioning	4 (8)	6 (12)	42 (81)
3. Manual Chest Therapy	2 (4)	11 (21)	39 (75)
4. Body position for optimizing oxygenation	5 (10)	9 (17)	38 (73)
5. Respiratory muscle strengthening	3 (6)	14 (27)	35 (67)
6. ACBT	4 (8)	14 (27)	34 (65)
7. Incentive spirometry	10 (19)	14 (27)	34 (65)
8. PEP therapy	7 (14)	14 (27)	31 (60)
9. Body position for postural drainage	5 (10)	19 (37)	28 (54)
10. Nebulisation therapy	13 (25)	14 (27)	25 (48)
11. Autogenic drainage	22 (42)	21 (40)	9 (17)
12. IPPB	27 (52)	19 (37)	6 (12)
13. Ventilation hyperinflation	29 (56)	18 (35)	5 (10)
14. Manual hyperinflation	32 (62)	19 (37)	1 (2)

*ACBT – Active Cycle of Breathing Technique; IPPB – Intermittent Positive Pressure Breathing;
PEP – Positive Expiratory Pressure

Most of the physiotherapists reported that they ‘frequently used’ breathing exercises (85%), suctioning (81%), manual chest therapy (75%), body positioning to optimize oxygenation (73%), respiratory muscle strengthening (67%), PEP therapy (54%), body positioning to aid postural drainage (54%), nebulisation therapy (48%), and incentive spirometry (42%) in order to optimize/restore respiratory function.

Physiotherapy techniques which were ‘rarely used’ by most of the respondents were manual hyperinflation (62%), ventilator hyperinflation (56%) and IPPB (52%). Respondents had an

opportunity to mention other techniques they use to optimize respiratory function in patients with polytrauma in addition to the above stated. Inclusive of the techniques mentioned above in Table 4.1 respondents stated that they also used chest wall excursion exercises (n=1; 2%), supported forced expiratory techniques (FETs) i.e., huffing and coughing (n=1; 2%), aerobic exercise (n=1; 2%), physical activities (n=1; 2%), and mobilisation activities (n=1; 2%).

Various physiotherapy treatment strategies were used by respondents to maintain/restore function of the neuromusculoskeletal system for patients with polytrauma. These strategies are summarised in Table 4.2.

Table 4.2: Physiotherapy Techniques used by Respondents to Maintain/Restore Optimal Function of the Neuromusculoskeletal System for Patients With Polytrauma

Technique	Rarely used <i>freq (%)</i>	Sometimes <i>freq (%)</i>	Frequently <i>freq (%)</i>
1. Early mobilisation out of bed	0 (0)	3(6)	49(94)
2. Active ROM	0(0)	4(8)	48(92)
3. Passive ROM	0(0)	4(8)	48(92)
4. In bed mobilisation	0(0)	5(10)	47(90)
5. Strengthening exercises	0(0)	6(12)	46(89)
6. Functional exercises	0(0)	10(19)	42(81)
7. Balance retraining	2(4)	16(31)	34(66)
8. Marching on the spot	4(8)	18(35)	30(58)
9. Stair climbing	5(10)	17(33)	30(58)
10. Brisk walking	10(19)	16(31)	26(50)
11. Neurological stimulation	14(27)	22(42)	16(31)
12. Application of splints	16(31)	23(44)	13(25)

*ROM- range of motion

The most frequently reported physiotherapy techniques used by the respondents to maintain or restore neuromusculoskeletal system function for their patients were early mobilisation out of bed (n=49; 94%), active ROM (n=48; 92%), passive ROM (n=48; 92%), in bed mobilisation (n=46; 89%), and functional exercises (n=42; 81%). Less frequently used interventions include balance retraining (n=34; 66%), marching on the spot (n=30; 58%), stair climbing (n=30; 58%), and brisk walking (n=26; 50%) to restore/maintain optimal neuromusculoskeletal system function in patients with polytrauma.

4.4 OUTCOME MEASURES

Respondents used various physiotherapy outcome measures to evaluate respiratory system function in their patients with polytrauma. The outcome measures are summarised below (Fig.4.7).

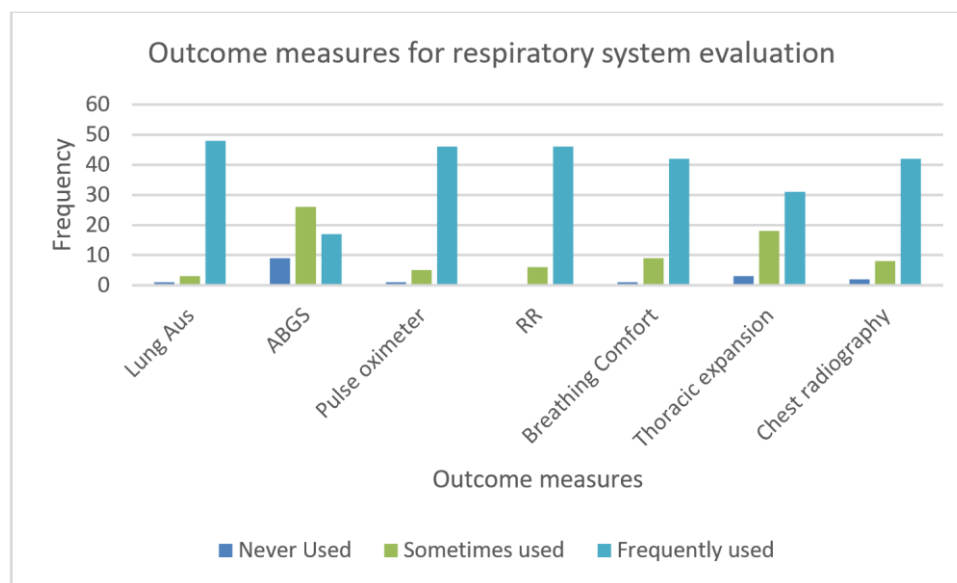


Figure 4.7: Outcome Measures used by Respondents to Evaluate Patients with Polytrauma's Response to Treatment of their Respiratory System (n= 52)

The most frequently used outcome measures by Namibian physiotherapists for the evaluation of treatment of the respiratory system were lung auscultation (n=48; 92%), pulse oximetry (n=46; 86%), assessment of respiratory rate (n=46; 86%), assessment of breathing comfort/discomfort (n=42; 81%), and chest radiography (n=42; 81%). Arterial blood gases were 'sometimes used' as an outcome measure by most of the respondents (n=26; 50%) (Fig.4.6).

Various physiotherapy outcome measures were used by respondents to evaluate the neuromusculoskeletal response to physiotherapy treatment in patients with polytrauma. These outcome measures are summarised in Table 4.3.

Table 4.3: Physiotherapy Outcome Measure used to Evaluate Patients with Polytrauma's Response to Treatment of their Neuromusculoskeletal System

Outcome Measures	Never Used <i>freq (%)</i>	Sometimes used <i>freq (%)</i>	Frequently used <i>freq (%)</i>
------------------	-------------------------------	-----------------------------------	------------------------------------

1. Muscle Power	1(2)	8(15)	43(83)
2. MRC-SS	1(2)	8(15)	43(83)
3. ROM	2(4)	11(21)	39(75)
4. Exercise capacity	4(8)	11(21)	37(71)
5. Balance Scales	5(10)	16(31)	31(60)
6. ICU mobility	16(31)	8(15)	28(54)
7. Barthel Index	10(19)	15(29)	27(52)
8. FIM	12(24)	17(33)	22(43)
9. FSS-ICU	25(48)	17(33)	10(19)
10. CPAx	34(67)	11(22)	6(12)
11. PFIT	35(67)	12(23)	5(10)
12. DEMMI	41(79)	9(17)	2(4)

*MRC-SS- Medical Research Council Sum Score; ROM- Range of Motion; FIM- Functional Independence Measure; FSS-ICU – Functional Status Score ICU; CPAx - Chelsea Critical Care Physical Assessment; PFIT – Physical Function Intensive Care Test, DEMMI- de Morton Mobility Index

Responding to a list of predetermined outcome measures, the majority of the physiotherapists reported that they ‘frequently used’ the following outcome measures in the evaluation of a patient’s response to physiotherapy treatment of the neuromuscular system: muscle power (n=43; 83%), and MRC-SS (n=43; 83%). The PFIT and DEMMI were reported to be ‘never used’ by the majority of the physiotherapists (n=35; 67% and n=41; 79%) respectively.

Factors that influenced progression of physiotherapy management of patients with polytrauma are summarised below (Fig. 4.8).

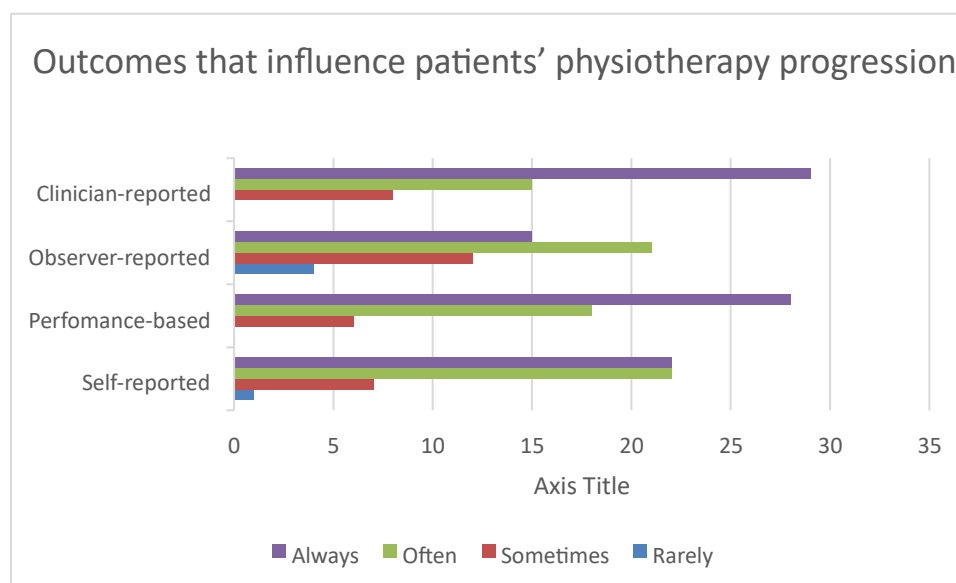


Figure 4.8: Outcomes that Influence Progression in Physiotherapy Management of Patients with Polytrauma (n= 52).

Respondents reported that they ‘always’ relied on clinician-based measures (n=29; 56%), performance-based measures (n=28; 54%) and self-reported measures (n=22; 42%) to determine progression in their physiotherapy management of patients with polytrauma. Observer-reported measures were ‘often’ used by 40% (n=21) of the respondents (Fig 4.7). Not all of the respondents answered this question.

4.5 LENGTH OF HOSPITAL STAY

Physiotherapists responded to various categories outlining the length of stay of patients with polytrauma at acute care facilities. Their responses are summarised below (Fig 4.9).

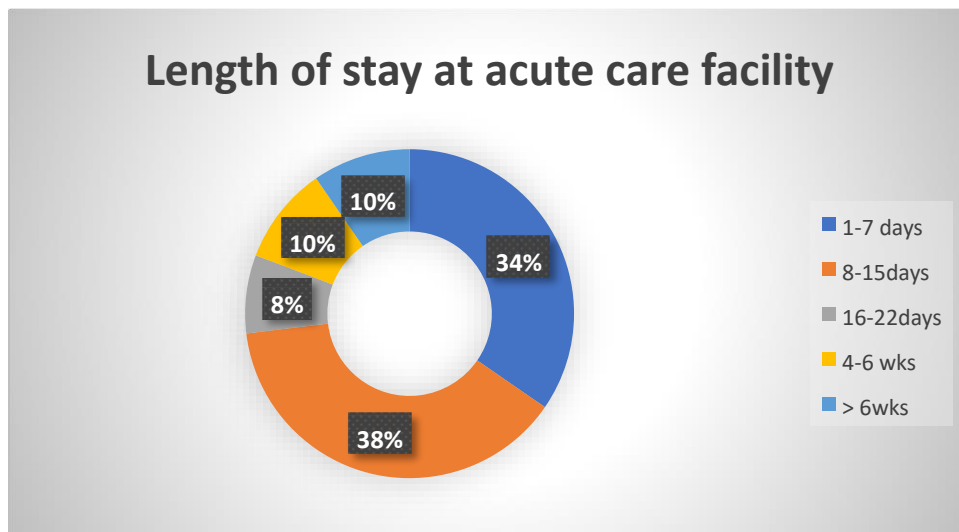


Figure 4.9: Patient Length of Stay (days and weeks) in Acute Care Facilities after Polytrauma as Reported by Namibian Physiotherapists (n=52).

Not all physiotherapists answered this question. Of those who did respond, most (n=20, 38%) reported that patients stayed between eight to 15 days in the hospital, whilst 34% (n=18) reported that patients stayed at their facility for one to seven days (Fig.4.8). The least number of respondents (n=5; 10%), reported that patients stayed at their facility for more than six weeks.

4.6 DISCHARGE DESTINATIONS

When asked where patients with polytrauma are discharged to from acute care settings, 48%(n=25) reported that these patients are discharged into a stepdown facility for extended care, whilst 40%(n=21) stated that the patients were discharged home. Other respondents (n=19; 37%) reported that the patients are discharged into a subacute facility of the same institution.

When asked which factors determine patients discharge from acute care facilities into another facility, most of the respondents 85%(n=44) stated that functional outcomes were an influencing factor whilst 35%(n=18) reported that hospital length of stay was a determining factor. Fewer physiotherapists 14%(n=7) stated psychological outcomes whilst 8%(n=4) stated occupational outcomes as factors that determine patients discharge from an acute care facility.

Of the 52 respondents, 17%(n=9) took the opportunity to state 'other factors' determining patients discharge from an acute care facility. Out of the responses given, 12%(n=6) reported that hemodynamic stability or medical stability determined discharge from an acute care facility.

Other factors stated include availability of funds to cover medical care (n=1;2%), dependency on supplementary oxygen (n=1;2%), and a patient's home setup and availability of a caregiver (n=1;2%).

4.7 **REHABILITATION PROGRAMS**

Out of the 52 respondents, 69%(n=36) took the opportunity to provide information on rehabilitation programs they give to patients following hospital discharge. Fewer physiotherapists 31%(n=16) did not respond to this question and the reasons for this omission are not clear. Most (n=9;25%) reported that they give home exercise programs which focused on respiratory rehabilitation, cardiopulmonary endurance, as well as patient and caregiver education. Depending on the patient's condition or presentation, some physiotherapists (n=8;22%) stated that they provided a generalised exercise program. This generalised program may be made up of physiotherapeutic exercises as well as progressive mobilisation activities.

Fewer physiotherapists (n=8;15%) used strengthening and ROM exercises as a rehabilitation program of choice. These strengthening and ROM exercise activities are given by the respondents to improve independent mobility and aid return to work. Some respondents (n=4;8%) reported that they give referrals for outpatient rehabilitation for further management by the nearest community physiotherapist. Only one respondent reported that these referrals are accompanied by printed exercises for the patient.

Some respondents (n=3;6%) mentioned that they provided functional exercise programs to patients with polytrauma as part of their rehabilitation program. These functional exercises may be customised, focusing on ADLs and return to work. Cardiovascular exercises were mentioned by the respondents (n=3;6%) as exercises given to participants as part of the rehabilitation program. These cardiovascular exercises focused on cardiovascular endurance and aerobic training. One physiotherapist prescribed chest expansion exercises to patients with polytrauma post discharge from an acute care facility.

4.8 **BARRIERS TO PHYSIOTHERAPY SERVICE DELIVERY**

Respondents reported on the influence of various barriers that might impact physiotherapy service delivery to patients with polytrauma during their hospital stay. These barriers are summarised in Table 4.4.

Table 4.4: Barriers to Physiotherapy Service Delivery to Patients with Polytrauma during their Hospital Stay

Barriers	Strongly disagree freq (%)	Disagree freq (%)	Neutral freq (%)	Agree freq (%)	Strongly agree freq (%)
1. Lack of adequate financial resources	2(4)	4(8)	7(14)	14(27)	25(48)
2. Lack of adequate human resources	4(8)	8(15)	7(14)	18(35)	15(29)
3. Lack of knowledge on physiotherapy and its role by team members	4(8)	8(15)	7(14)	20(39)	13(25)
4. Lack of sufficient time for rehabilitation of patients	7(14)	9(17)	8(15)	16(31)	12(23)
5. Poor treatment adherence by patients	0(0)	7(14)	13(25)	22(42)	10(19)
6. Communication and language barriers with patients	3(6)	8(15)	12(23)	19(37)	10(19)
7. Lack of support from members of the team	6(12)	11(21)	9(17)	17(32)	9(17)
8. Lack of knowledge by patients on role of physiotherapy	8(15)	6(12)	8(15)	22(42)	8(15)
9. Lack of knowledge on evidence-based practices	11(21)	11(21)	10(19)	13(25)	7(14)

Most of the respondents (n=25; 48%) 'strongly agreed' that lack of adequate financial resources was a barrier that commonly affected physiotherapy service delivery during patients' hospital stay. Lack of adequate human resources was also 'strongly agreed' upon by 29%(n=15) of the respondents as a barrier to service delivery. Some respondents 39%(n=20) 'agreed', whilst 25%(n=13) 'strongly agreed' that lack of knowledge on physiotherapy and its role in polytrauma by other members of the team was a barrier affecting physiotherapy service delivery to patients with polytrauma whilst they are admitted in hospital.

Some respondents took the opportunity to state 'other' barriers affecting physiotherapy service delivery for patients with polytrauma during their hospital stay. Long distances that patients should travel to access rehabilitation services (n=3;6%), lack of family/caregiver support in patient's rehabilitation (n=2;4%), lack of patient motivation (n=2;4%), resistance from medical doctors to implement suggestions by physiotherapists (n=1;2%), lack of adequate equipment and poor hospital hygiene were mentioned.

Respondents reported on the influence of various barriers that might impact physiotherapy service delivery to patients with polytrauma after discharge from an acute care facility. These barriers are summarised in Table 4.5.

Table 4.5: Barriers to Physiotherapy Service Delivery to Patients with Polytrauma after Hospital Discharge

Barriers	Strongly disagree freq (%)	Disagree freq (%)	Neutral freq (%)	Agree freq (%)	Strongly agree freq (%)
1. Lack of adequate financial resources	1(2)	4(8)	9(17)	16(31)	22(42)
2. Lack of adequate support system by caregivers	1(2)	4(8)	13(25)	18(35)	16(31)
3. Lack of knowledge on physiotherapy by team members	2(4)	6(12)	11(21)	18(35)	15(29)
4. Lack of knowledge by patients on role of physiotherapy	1(2)	5(10)	6(12)	25(48)	15(29)
5. Poor treatment adherence by patients	0(0)	4(8)	9(17)	25(48)	14(27)
6. Communication barriers between members of the team in different facilities	7(14)	10(19)	13(25)	10(19)	12(23)
7. Lack of adequate human resources	4(8)	8(15)	10(20)	18(35)	11(22)
8. Lack of sufficient time for post-discharge physiotherapy	7(14)	5(10)	14(27)	15(29)	11(21)
9. Lack of knowledge on evidence based postdischarge treatment strategies	8(15)	10(19)	15(29)	16(30)	3(6)

From a set of predetermined options, the majority of the respondents 42%(n=22) 'strongly agreed' that the lack of adequate financial resources was a barrier affecting physiotherapy service delivery post-discharge whilst 31%(n=16) also 'strongly agreed' that lack of adequate support system for patients by family/caregivers was a notable barrier. Some respondents (n=25;48%) 'agreed' that lack of knowledge by patients with polytrauma on role of physiotherapy post-discharge was a barrier impacting physiotherapy service delivery.

Some respondents (n=18;35%) 'agreed' that lack of adequate human resources was a notable barrier. The lack of knowledge on current evidence based post-discharge treatment strategies for patients with polytrauma by the physiotherapist was also 'agreed' upon by 31%(n=16) of the respondents as a barrier affecting physiotherapy service delivery post-discharge.

4.9 ENABLERS TO PHYSIOTHERAPY SERVICE DELIVERY

4.9.1 Enablers During Hospital Stay

Out of 52 respondents, 89%(n=46) took the opportunity to state enablers that positively influenced physiotherapy service delivery to patients with polytrauma during their hospital stay. These enablers were a supportive multidisciplinary team (n=27;52%) and a patient's own compliance to treatment and self-motivation to their recovery (n=6;12%) which impacted positively on physiotherapy service delivery.

The availability of adequate human resources in relation to adequately trained physiotherapists was reported by 8%(n=4) of the respondents as another enabler, whilst 6%(n=3) of the respondents stated that the availability of adequate financial resources towards physiotherapy was a positive influence towards the provision of physiotherapy services to patients with polytrauma whilst admitted in hospital.

Respondents also reported on presence of a supportive family (n=2;4%), ability to host family meetings (n=2;4%) and the availability of suitable hospital equipment and resources (n=2;4%) as enablers to physiotherapy service delivery to patients with polytrauma during their hospital stay.

4.9.2 Enablers Post-Discharge

Out of 52 respondents, 87%(n=45) took the opportunity to state factors that enable physiotherapy service delivery to patients with polytrauma post-discharge. The presence of good family support was reported by 21%(n=11) of the participants as an enabler, whilst 19%(n=10) reported that a patient's compliance to their treatment and own self-motivation positively impacted physiotherapy service provision post-discharge.

Respondents also stated that the knowledge about physiotherapy treatment strategies and provision of a home exercise program (n=8;15%), the availability of good referral systems for continual care (n=7;14%) as well as the presence of multidisciplinary team support (n=5;10%) were factors that positively influenced physiotherapy service delivery to patients after hospital

discharge. The availability of financial resources was a factor highlighted by some respondents (n=4;8%) to impact on physiotherapy service delivery post-discharge in patients with polytrauma.

CHAPTER 5

5 DISCUSSION

The findings from this survey address the knowledge gap on physiotherapy management of patients with polytrauma injury in acute care private and public healthcare sectors in Namibia. The only existing study that investigated physiotherapy care of patients with polytrauma is exploratory-descriptive in nature and was conducted in Brazil (Padovani et al. 2017). The results from the current study are compared primarily with that by Padovani et al. (2017) and with those from South Africa by Van Aswegen (2020), which described the management of patients with trunk trauma, by Lottering and Van Aswegen, (2016) in a study which explored physiotherapy practices in the ICU as well as a global survey that explored physiotherapy management of major trauma by Van Aswegen et al., (2020).

5.1 RESPONSE RATE OF THE CURRENT SURVEY

This research was done among practicing physiotherapists as literature supports their role in rehabilitating patients with polytrauma. At the time the study was conducted, 133 physiotherapists were registered with the Health Professions Council of Namibia. Namibia has a high rate of motor vehicle accidents and physical violence. This online survey targeted physiotherapists practicing in Namibia to capture their responses on how they manage patients with polytrauma from intentional and nonintentional causes.

Online surveys are expected to yield lower response rates than surveys administered on paper regardless of various practices which may be used to improve their response rates (Nulty, 2008). In an online survey that investigated the use of outcome measures by physiotherapists in Netherlands, a 16% response rate was found (Swinkels et al., 2011). The current study had a 41.4% response rate, which was higher than the reported 30% response rate by Nulty, (2008). The higher response rate for this study may be because of a longer data collection period of six months. In addition, a contact list was used to contact physiotherapists telephonically to boost online survey responses.

5.2 SOCIO-DEMOGRAPHICS

In this study, female physiotherapists made up most of the respondents (64%). This is similar to 83% of female physiotherapy respondents in a study which identified the minimum standards of clinical practice needed to ensure safe and independent practice in South African ICUs (Hanekom et al., 2015). In a study that explored barriers and facilitators to early mobilisation of patients in

ICU settings by physiotherapists in South Africa and Zimbabwe, 63% of the respondents were female (Tadyanemhandu, Van Aswegen and Ntsiea, 2022). This finding in our study which infers that there were more female respondents than male respondents is not unusual as physiotherapy is a female-dominant profession.

The age range of respondents was young with a median age of 30 years (IQR= 28-31) and an median years of clinical practice of six years (IQR= 3.3-7). In addition, the respondents had an average length of experience with patients with polytrauma of 12 months. The physiotherapy program offered by the University of Namibia is approximately six years old. Therefore, less Namibian physiotherapists study abroad, and more are retained within the Namibian healthcare sector after graduation. This may account for the relatively young age of respondents, few years of clinical practice as well as limited experience with patients with polytrauma.

In a study that looked at South African physiotherapists working in ICU, 46% of the respondents held a postgraduate qualification related to cardiopulmonary physiotherapy (Lottering and Van Aswegen, 2016); however, in this study only eight percent of the respondents had a postgraduate qualification in cardiorespiratory physiotherapy; with 23% not having any postgraduate qualification. A higher proportion of respondents were younger physiotherapists who may not have specialised yet in a specific physiotherapy discipline. Some of the respondents may be graduates of the new University of Namibia physiotherapy program.

The results of this study show that about one third of the respondents worked in private institutions, another third worked in public institutions; whilst another third worked in both public and private institutions. Physiotherapists who work in private settings are frequently self-employed and thus have a higher interest in ensuring required standards of practice (Hanekom et al., 2015). The even distribution of physiotherapists working in public or private institutions, or both may be explained by the low numbers of practicing physiotherapists across Namibia necessitating some physiotherapists to work in both sectors due to limited human resources.

Due to the high degree of complexity that the acute patient with polytrauma represents to the multidisciplinary team in regards to the provision of their treatment plan, the ICU unit is a specialised setting in which these patients are frequently managed (Padovani, Silva and Tanaka, 2017). Similarly, in this study the ICU was the hospital setting in which patients with polytrauma were frequently seen followed by the hospital ward and then stepdown facilities. In-hospital management of acute patients with polytrauma is also done in hospital wards (Van Aswegen,

2020), whilst functional rehabilitation of the subacute patient is effectively done in stepdown facilities (Skinner et al., 2015).

5.3 PROFILE OF PATIENTS PRESENTING WITH POLYTRAUMA

The majority of patients with polytrauma managed by the respondents were male. This is consistent with findings in studies that looked at similar patients by Haider et al. (2017) in Austria, Jacob et al. (2021) in Qatar, McCarthy et al. (2021) in United States of America in which more than half of patients who suffered from polytrauma were male. Respondents reported that the most frequent mechanism of injury resulting in polytrauma was motor vehicle crashes. This is consistent with findings from studies done in Namibia, South Africa, United States, and Australia which show that patients who suffer from polytrauma are frequently young males who are victims of motor vehicle crashes (Skinner et al., 2015; Amweelo, 2016; Haider et al., 2017, McCarthy et al., 2021). In Namibia, the higher incidence of MVCs in young males is attributed to risk-taking behaviours, whilst low impact injury mechanisms such as falls are seen more in females (Tomas, Ashipala and Tomas, 2021).

Stab wounds and gunshot wounds were reported by Namibian physiotherapists to account for a smaller proportion of patients who presented with polytrauma. Similarly, Duckworth and Lezzi (2010), reported that unintentional injuries such as MVCs account for a larger proportion of physical injuries in comparison to intentional injuries such as injuries from physical violence resulting in stab wounds and gunshot wounds.

Respondents stated that the most frequently injured region of the body was the lower limbs followed by the head and neck region. This is consistent with findings by Mejaddam and Velmahos (2012), von Rüden et al, (2013), Larsen et al, (2016) in which the most frequently injured region requiring rehabilitation by physiotherapists was the lower limb region. Lower limb injuries in motor vehicle drivers and passengers can occur due to knee impaction with the dashboard or car seat resulting in acetabular fractures, hip/knee dislocations or tibial and fibular fractures; whilst foot and ankle fractures in drivers can occur as a result of forceful application of brakes and toe-pan intrusion (Ammori and Abu-Zidan, 2018).

5.4 TREATMENT STRATEGIES TO OPTIMISE RESPIRATORY FUNCTION

In the acute patient who is sedated and minimally cooperative, the primary focus of physiotherapy is to improve the respiratory system function and prevent complications associated with immobility such as atelectasis, ventilator induced pneumonia and ventilator induced diaphragmatic

dysfunction (Van Aswegen, Morrow and Van Aswegen, 2015, p.135). In this study, physiotherapy respondents commonly used breathing exercises, suctioning, manual chest therapy, body positioning to optimize oxygenation, ACBT, PEP therapy, body positioning to aid postural drainage, nebulisation therapy, and incentive spirometry to optimize/restore their polytrauma patients' respiratory function. Manual chest clearance techniques, nebulisation and humidification therapy assist with improving bronchial hygiene, aid pulmonary re-expansion and prevent ventilator associated pneumonia (Tadyanemhandu and Manie, 2016; Wang, Pan and Hu, 2019). Respiratory muscle strengthening/IMT reduces the likelihood of diaphragmatic dysfunction in patients on MV; this facilitates weaning from MV and reduces pulmonary complications which may otherwise increase hospital length of stay (Elkins and Dentice, 2015; Bissett et al., 2019). In this study, the majority of the respondents frequently used respiratory muscle strengthening/IMT as a technique to optimize/restore the respiratory function of their patients with polytrauma. This is an important finding among physiotherapists managing patients with polytrauma in acute care settings in Namibia as there is a scarcity of evidence on IMT use in polytrauma globally.

Physiotherapists practicing in South African acute care settings used similar techniques to their counterparts in Namibia to optimize/restore respiratory function. South African physiotherapists were reported to frequently use manual chest clearance techniques (94%), in-bed mobilisation (84%), suctioning (82%), out-of-bed mobilisation (78%), and deep breathing exercises (77%) (Lottering and Van Aswegen, 2016). These techniques make up usual care physiotherapy treatment strategies to manage respiratory conditions in acute care facilities (Skinner et al., 2015; Padovani, Silva and Tanaka, 2017; Anekwe et al., 2020).

Interestingly, techniques that are used less frequently globally such as manual chest therapy techniques, and inspiratory muscle training were frequently used by South African physiotherapists in ICU settings (Lottering and Van Aswegen, 2016) and Namibian physiotherapists in the current study. There is growing evidence which supports the use of active cardiorespiratory physiotherapy techniques as opposed to passive strategies (Sommers et al., 2015; Bissett et al., 2019; Balas et al., 2022; Elkins and Dentice, 2022). In the management of critically ill patients in South African and Zimbabwean acute care facilities in public hospitals, a common barrier to active physiotherapy interventions is patient unresponsiveness (Tadyanemhandu, Van Aswegen and Ntsiea, 2022). Physiotherapy practice is new in Namibia and the physiotherapy management of patients in these southern African countries may be different from other countries where the ABCDEFGH bundle of care is prioritised in patient care (Balas et al., 2022).

Ventilator hyperinflation, MHI and IPPB were less frequently used by Namibian physiotherapists in their patient management. Correspondingly, physiotherapy techniques which were seldom used by the majority of the physiotherapists in a non-systematic narrative review by Van Aswegen, (2020) were manual hyperinflation, ventilator hyperinflation and IPPB. Physiotherapists in surgical ICUs in South Africa also reported that IPPB was used to a lesser extent as part of usual care practice (Hanekom, Louw and Coetzee, 2012); this finding conflicts with findings by Lottering and Van Aswegen, (2016) in which IPPB was frequently used in critical care. Mechanical ventilator adjustments, and manual hyperinflation were also reported to be less frequently used by physiotherapists in acute care settings in South Africa (Lottering and Van Aswegen, 2016). In Namibia physiotherapy techniques which involve MV adjustments such as in ventilator hyperinflation may be less used due to the lack of experienced physiotherapists working in these settings. In addition, students at the University of Namibia have no access to IPPB devices during their training program, therefore the use of this device is not fully covered in their curriculum.

5.5 TREATMENT STRATEGIES TO OPTIMISE NEUROMUSCULAR SYSTEM

Complications related with critical illness and associated deconditioning such as ICUAW, pressure ulcers, muscle atrophy, loss of muscle length and joint integrity can be prevented by early exercise and mobilisation as well as joint protection strategies (Van Aswegen, Plani and Morrow, 2015, p.356; Spurrier and Stapley, 2016). The results from this study infer that the most frequently used physiotherapy intervention to maintain or restore neuromusculoskeletal system function was early mobilisation out of bed. Our finding is consistent with a global study by Van Aswegen et al, (2020) in which early mobilisation in patients with major chest trauma is frequently used and easily implementable. However, our findings conflict with findings by Tadyanemhandu, Van Aswegen and Ntsiea, (2022) in which early mobilisation was not frequently used in South African and Zimbabwean ICUs due to delays in surgical stabilisation of fractures. In Namibia, patients who are victims of MVCs are funded by the MVA fund and have faster transfers to trauma facilities, including private facilities where stabilisation of fractures is done without much delay (Chatukuta et al., 2021). As the majority of the polytrauma patients in Namibia are victims of MVCs this positively influences early mobilisation in this patient demographic.

Active ROM, passive ROM, in bed mobilisation, and functional exercises were also frequently used. These techniques were immensely popular among respondents such that no-one reported not using them in patient care. This is consistent with findings by Hanekom et al, (2012) on South African surgical ICU patients, Lottering and Van Aswegen, (2016) on South African critically ill

patients, Jacob et al. (2021) on patients with polytrauma, Tadyanemhandu et al. (2022) on South African and Zimbabwean critically ill patients, who reported that these techniques form part of usual care physiotherapy practices in acute care facilities.

Good static and dynamic balance following critical illness is important in ensuring safety during progressive mobilisation activities such as supine to sitting, sit to stand, walking and stair climbing (Morrow and Van Aswegen, 2015, p.72). Our findings indicate that balance retraining and stair climbing with/without walking aids were frequently used techniques to improve the neuromusculoskeletal system. In addition, for patients without lower limb fractures progressive functional mobilisation techniques such as marching on the spot and brisk walking were techniques frequently used to improve the function of neuromusculoskeletal system in patients with polytrauma.

In a similar study by Padovani et al. (2017) progressive mobilisation activities were seen to form part of the therapeutic care model in patients with polytrauma as these activities are safe to implement and easy to sustain in the ICU setting. Although our respondents also reported that the lower limb region is frequently injured, the feasibility of balance retraining and progressive mobilisation activities is enabled by timely surgical stabilisation of fractures in beneficiaries of the MVA fund. In addition, our study was open to all physiotherapists who had contact with patients with polytrauma in the last six months; it is possible that some respondents responded to this question without full appreciation of patients with polytrauma and the complexity of the condition and associated challenges in its management.

5.6 OUTCOME MEASURES FOR THE RESPIRATORY AND NEUROMUSCULOSKELETAL SYSTEM

In patients with critical illness and severe orthopaedic injuries, outcome measures used are variable and are determined by injury severity, site of the injury as well as the number of injured regions involved. Outcome measures are important to determine patients' responses to physiotherapy treatment administered and evaluate the effectiveness of treatment techniques employed (Lottering and Van Aswegen, 2016). Ultimately, the chosen outcome measures should address the patient's function and address the extent to which the premorbid status can be attained and to what degree patients can return to their premorbid status (Van Aswegen, Plani and Morrow, 2015, p.356).

The respondents to this survey most frequently used lung auscultation, pulse oximetry, assessment of respiratory rate, assessment of breathing comfort/discomfort, chest x-ray, and thoracic expansion for assessment of the respiratory system. Arterial blood gases were occasionally used as an outcome measure by most of the respondents in this study. In the acute care setting in which patients on MV are managed, lung auscultation, breathing comfort, chest xray, oximetry, arterial blood gases are frequently used (Van Aswegen and Morrow, 2015, p.184; Chou et al., 2016; Ahmad, 2018). The use of these outcome measures in this present study is consistent with South African clinical physiotherapy practice guidelines on routine patient assessment in acute care settings (Hanekom et al., 2015), as well as the Dutch Society of Intensive Care recommendations (Sommers et al., 2015).

In the management of patients with critical illness, emphasis has been placed on the use of validated outcome measures such as the Chelsea Critical Care Physical Assessment (CPAx) tool and Physical Function in ICU test (PFIT) in order to assess patient function and progress in the management of patients recovering from critical illness (Parry et al., 2015; Lottering and Van Aswegen, 2016). In this study the CPax tool, DEMMI and the PFIT were rarely used by most of the respondents. In the management of patients with physical trauma it is suggested that more experienced trauma physiotherapists use outcome measures as part of routine patient care (Van Aswegen et al., 2020). The younger demographic of physiotherapists in this study as well as limited specialisation by Namibian physiotherapists may contribute to a reduced use of validated outcome measures as they may not fully appreciate the importance of such measures in patient care.

In the acute care setting, physiotherapy assessment focuses on physical deconditioning and related complications such as muscle weakness, loss of joint mobility, impaired independent function and decrease in exercise capacity (Mpempeletsi et al., 2015; Doiron and Hoffmann, 2018). In this study, frequently used outcome measures to evaluate patient response to physiotherapy treatment of the neuromuscular system were muscle power using the MRC-SS, joint range of motion as well as exercise capacity. The MRC-SS is a frequently used measure in critical care to quantify muscle weakness; as well as in the clinical diagnosis of ICU-acquired weakness (ICUAW) which is made based on a MRC-SS of less than 48/60 (Denehy et al., 2013; Samosawala, Vaishali and Chakravarthy Kalyana, 2016). Following an ICU stay, reduced exercise capacity affects quality of life in ICU survivors and indicates a need for rehabilitation but most importantly underscores the need for assessment and measures to prevent or lessen deconditioning and loss of physical function (Mpempeletsi et al., 2015). There is expert consensus

in support of the use of goniometry in passive and active ROM measurements, exercise capacity assessment as well as use of the MRC-SS in the intensive care (Sommers et al., 2015).

The ease of use of validated outcome measures in the clinical setting is determined by the patient's ability to participate during evaluation and their level of cardiopulmonary endurance. This is influenced by level of consciousness, illness severity, injured regions and level of ventilation support given. Validated outcome measures which are easy to implement during routine assessment of patients include the CPAx, FIM and Barthel index. The CPAx tool is a comprehensive multisystem tool therefore it is time efficient. The FIM and Barthel index evaluate functional limitations in the critically ill patient demographic who can actively participate during treatment. In addition, in the critically ill patient with reduced cardiovascular endurance and lower limb orthopaedic injuries, the 6-min walk test can be broken down into two-minute walking intervals (Reid et al., 2015). This allows the evaluation of the critically ill patient to be done using short achievable tasks.

5.7 FACTORS AFFECTING DISCHARGE

Length of stay in an acute care facility for patients with polytrauma is expected to be longer than that of patients without polytrauma, due to the higher severity of injury. Most of the respondents in this study reported that patients with polytrauma stayed between eight to 15 days in Namibian acute care facilities. In critically ill patients on MV, early progressive mobilisation into an upright position aids functional recovery and reduces hospital stay (Ahmad M, 2018; Dalton et al., 2019; McCarthy et al., 2021). This means that the length of hospital stay can be positively influenced by early mobilisation and exercise making physiotherapy interventions an important factor affecting patients' length of stay.

Most of the respondents reported that patients with polytrauma are discharged into stepdown or subacute facilities for extended care whilst some are discharged home. The movement of patients into a subacute level of medical care is often linked with an increased ability to tolerate treatment sessions for longer periods (Nordon-Craft et al., 2012). This means that physiotherapy treatment strategies may be more effective as participation improves. When patients are discharged home the continuity of care may be lost.

In this study, functional outcomes and hospital length of stay were factors reported to influence patients' discharge from acute care facilities. Functional outcomes in polytrauma are not limited to physical function; they can refer to both physical and mental health as well as the social condition

of the patient within the context of The International Classification of Function, Disability and Health (ICF) (Andrzejowski, Holch and Giannoudis, 2021). In acute care facilities prolonged hospitalisation increases medical costs and can expose patients to complications such as hospital-acquired pneumonia, and the psychosocial impact of trauma such as quality of life and loss of productivity (Butcher, D'Este and Balogh, 2014). It is important to evaluate the patient within a biopsychosocial framework to determine holistic improvement in condition before discharge. The rehabilitation of a patient with polytrauma extends beyond acute care to the reintegration of the patient into the home and community (Khan, Amatya and Hoffman, 2012).

5.8 REHABILITATION PROGRAMS

Home exercise programs which focus on respiratory rehabilitation, cardiopulmonary endurance, as well as patient and caregiver education were reported to form part of exercise programs routinely given by the respondents to patients with polytrauma after discharge from acute care. Depending on the patient's condition or presentation, some respondents stated that they provided physiotherapeutic exercises as well as progressive mobilisation activities. To a lesser extent, it was reported that referrals for further outpatient rehabilitation by the nearest community physiotherapist were given to the patients by the Namibian physiotherapists. The loss of continuity of care given to patients with polytrauma by Namibian physiotherapists after hospital discharge may result in complications such as ICUAW and PICS to not be identified and adequately managed. Both ICUAW and PICs greatly affects QoL and physical function to survivors of critical illness with lasting negative effects which can persist for up to five years post discharge (Rawal, Yadav and Kumar, 2017; Inoue et al., 2019). This may imply that patients with polytrauma who survive critical illness and are discharged from acute care facilities in Namibia may remain with cognitive, functional and physical impairments prolonging return to pre-ICU condition and return to work.

In-home physiotherapy sessions for survivors of critical illness are more effective as they encourage continuance of care compared to rehabilitation programs that patients have to follow without supervision (Colbenson et al., 2019). In spite of patients receiving a home exercise program; they often struggle to follow the programs properly (Ahmad, 2018). Telehealth improves compliance to home programs and bridges the gap between limited accessibility to rehabilitation services when there are human resource constraints and patients needing to travel to access these services (Mccarthy et al., 2021). Patient compliance, self-motivation and family or caregiver supervision also improves adherence to home exercise programs (Ahmad, 2018). This emphasizes the need for supervised exercise training programs. In Namibia, the availability of

medical professionals may limit patient follow-up as well as access to further community rehabilitation (Shumba et al., 2018), let alone in-home physiotherapy care post-acute care discharge for those recovering from polytrauma in Namibia.

5.9 BARRIERS AND ENABLERS TO PHYSIOTHERAPY SERVICE PROVISION

Polytrauma due to MVC is commonly reported in Africa (Amweelo, 2016; Zimmerman et al., 2020). In Namibia, victims of MVC's are beneficiaries to the Motor Vehicle Accident Fund of Namibia which caps its hospital assistance to about N\$1.5 million per individual. This means that most of these patients are not directly responsible for their hospital bills (Chatukuta et al., 2021). However, the lack of adequate financial resources is a factor mentioned by most of the respondents as a barrier to in-hospital physiotherapy service delivery. Patients with polytrauma from injuries that are not related to MVC's such as falls from a height or physical violence are likely to face constraints in raising financial resources for their hospital costs as they are not covered by the Motor Vehicle Accident Fund.

In this study, the lack of adequate human resources in the physiotherapy profession and insufficient knowledge by team members about the role of physiotherapy in care of patients with polytrauma injury were factors reported to affect in-hospital physiotherapy service delivery. A key factor in determining the physiotherapy activities which can be done with patients in acute care at any given time is the availability of manpower to assist with activities such as early progressive mobilisation (Tadyanemhandu, Van Aswegen and Ntsiea, 2022). In addition to inadequate human resources, awareness and training programs which result in the transfer of knowledge to ICU team members are factors seen to increase the rate of early mobilisation (Al Hanna et al., 2020; Tadyanemhandu, Van Aswegen and Ntsiea, 2022). Lack of adequate human resources affecting rehabilitation personnel managing patients with polytrauma may also negatively affect skills transfer from clinicians in teaching hospitals to physiotherapy students managing these patients. As a consequence, graduates from the University of Namibia may not fully receive adequate exposure to patients with polytrauma during their training.

The long distances that patients need to travel to access rehabilitation services after hospital discharge is a notable barrier affecting the uptake of physiotherapy services by patients recovering from polytrauma injury. Within the framework of community based rehabilitation (CBR), there is evidence that supports reduced accessibility to rehabilitation services and the delivery of disability and rehabilitation programs in Namibia (Shumba et al., 2018). Namibia is the third less densely populated country in the world with about three people per kilometre (Lihongeni Mulama, 2015).

Therefore, most individuals may have reduced access to physiotherapy services after discharge from acute care facilities which are often centralised. The 133 physiotherapists registered by HPCNA at the time of this study would be hard pressed to provide rehabilitation services to patients throughout this vast country.

Inadequate support systems for patients by their family/caregivers was a notable barrier to the continuity of physiotherapy after discharge from an acute care facility. Family engagement and empowerment is important as generally 25% of patients require assistance in carrying out ADLs for about 12 months after ICU discharge (Colbenson, Johnson and Wilson, 2019). In addition, the combined effects of the extended care which needs to be given to the survivor of critical injury and illness by the family and the tremendous effects of major adjustments to their working life and its financial implications, can lead to family/caregivers anxiety, depression and post-traumatic stress disorder (Rawal, Yadav and Kumar, 2017; Inoue et al., 2019). It is thus important that the patients' support system be actively involved in their rehabilitation. Caregivers can thus benefit from support systems and education by the multidisciplinary team which may ease the caregiver burden of care.

A supportive multidisciplinary team was reported by most of the respondents as an enabler to rehabilitation service delivery to patients with polytrauma during a patient's stay in an acute care facility. In a study that explored physiotherapy management of patients with severe polytrauma (Padovani et al. 2017), communication among multidisciplinary team members about the changes found in patient evaluation positively influenced early mobilisation strategies. Our finding is also in line with that reported by Tadyanemhandu et al. (2022) which highlighted that clearly defined roles and accountability among members of an interdisciplinary team in the ICU may positively influence early mobilisation efforts.

The ability of a patient to comply with treatment and self-motivation for recovery were factors which were also reported as enablers to physiotherapy service delivery during hospitalisation of patients with polytrauma. Patient motivation, satisfaction, and perceived effectiveness of treatment by the patient are factors closely related to compliance with treatment (Main and Denehy, 2016, p.251). In a study that investigated polytrauma following non-occupational falls, a good prognosis was anticipated based on patient motivation (Olson and Olson, 2015). On a practical level, the use of objective physical function outcome measures, progressive mobilisation activities, and devices that provide biofeedback such as the flutter device, incentive spirometer and oscillatory PEP, enhance patient motivation and adherence to treatment (Main and Denehy, 2016, p.624). This

finding in our study which infers that adherence to treatment and self-motivation for recovery are enablers to physiotherapy service delivery is not unusual. The management of patients with polytrauma is complex, functional impairments and activity limitations persist in the long term after discharge; it is important that patients are receptive to treatment and follow through with treatment for better physical and mental health outcomes.

5.10 LIMITATIONS

The use of a descriptive cross-sectional study design limits the causal conclusions that may be drawn from the present study, and therefore the generalizability of the results. The survey was sent to all physiotherapists in Namibia that were either members of the HPCNA alone or combined members of the HPCNA as well as the Namibian Society of Physiotherapy. There was no database for physiotherapists that work directly with trauma patients which meant the survey was open to all physiotherapists practicing in Namibia. A snowball sampling technique would have benefitted our study as physiotherapists working in this specific area of interest know each other.

The likelihood of physiotherapists working in other fields and participating in this study exists. Based on the responses given, early mobilisation and early exercise activities such as marching on the spot and stair climbing were frequently reported as being used as early functional activities with the patients. However, these functional activities may be challenging to carry out in a patient who has multiple lower limb fractures and is critically ill and dependent on ventilator support. Although our questionnaire was worded in a way that frequently brought that patient with polytrauma into context, the responses given in our study may have been by some physiotherapists who did not base their responses entirely on patients with polytrauma alone.

The University of Namibia School of Occupational and Physiotherapy which is the only institution teaching physiotherapy in the country, is relatively new. Most of the participants, although relatively younger, may not have been graduates of this institution. The older participants in this study may have been graduates of other institutions in neighbouring countries. In comparison, physiotherapy practice in the management of patients with critical illness in ICU settings between Namibia and South Africa appears relatively similar. It could be that some physiotherapists returned to Namibia to work as qualified physiotherapists after acquiring their qualifications from South Africa.

Patients with polytrauma in Namibia may suffer from persistent complications associated with critical illness such as PICS and ICUAW due to loss of continuity in their care post-acute care discharge. In addition, human resource constraints affecting physiotherapy service provision may

limit patient follow-up. In this study, only one physiotherapist provided printed exercises to ensure the continual active participation of patients in their rehabilitation post-discharge.

The survey questionnaire design makes it difficult to ascertain whether the techniques used by participants to optimise the neuromusculoskeletal function of patients with polytrauma were administered while patients received mechanical ventilation or after they were removed from MV. Statistical analyses of the items in the questionnaire were not assessed during the developmental stage. This research report contributes 50% to the degree. Adding these statistical analyses would have grown the project beyond the expectations for the 50% research report. The design and focus of this study does not allow interpretation of the efficiency of the treatment interventions used by respondents in the physiotherapy management of patients with polytrauma in Namibia, as well as their associated clinical outcomes. This needs exploration in the form of clinical trials.

CHAPTER 6

6 CONCLUSION AND RECOMMENDATIONS

This study examined the physiotherapy management of patients with polytrauma in Namibian private and public acute care facilities. The respondents answered questions regarding the physiotherapists and patient demographics, treatment strategies, the use of outcome measures, factors associated with patient discharge as well as factors associated with service delivery to these patients within and after discharge from acute care facilities. The physiotherapy management of patients with polytrauma during acute care hospitalisation, after discharge and factors associated with the management of these patients is a field of clinical practice that requires further research. The physiotherapists who participated in this survey worked in public and private sector whilst some worked in both. The majority of the respondents did not hold a postgraduate physiotherapy qualification in a relevant field such as traumatology, orthopaedic surgery or cardiorespiratory physiotherapy.

In this study, respiratory physiotherapy techniques such as breathing exercises, suctioning, manual chest physiotherapy, positioning to improve oxygenation and for postural drainage, respiratory muscle strengthening, ACBT, incentive spirometry use and PEP therapy, are measures which are widely utilised by Namibian physiotherapists in the management of their patients with polytrauma. Early progressive mobilisation, range of motion exercises, strengthening exercises, functional exercise activities and balance training are frequently used strategies to improve the function of the neuromusculoskeletal system of these patients. Techniques which require ventilator adjustments are reported to be less frequently used as they may require more specialisation in the field of cardiorespiratory care. It seems that there is a limited use of validated outcome measures such as CPAx, PFIT, DEMMI in clinical practice by physiotherapists who work with patients with polytrauma in Namibia. The lack of human and financial resources are factors reported to impact physiotherapy service delivery.

It is important to evaluate patients with polytrauma within a biopsychosocial framework to determine improvement in their condition before discharge from an acute care facility. Therefore, it was important to structure the survey questions to capture physiotherapists responses within the International Classification of Function, Disability and Health (ICF) framework. Further research is needed to find out whether physiotherapists in Namibia could employ strategies that patients could implement to assist in adherence to home exercise programs in case of loss of continuity in their care.

6.1 IMPLICATIONS AND RECOMMENDATIONS FOR FUTURE STUDY

6.1.1 Implications for Clinical Practice

There is a global scarcity of documented usual care physiotherapy practices in managing patients with polytrauma injuries in acute care settings. Namibia has a high incidence of MVCs which contribute to physical injuries. Physiotherapists play a known and pivotal role in the delivery of multidisciplinary team-based care in acute care settings in the management of patients with polytrauma. This study describes the usual care practices of physiotherapists as they manage patients with polytrauma in acute care public and private settings in Namibia. It starts to address the existing gap in the literature regarding this topic. The results of this study may aid the development of clinical practice guidelines for patient management. It is imperative to establish through further clinical trials how physiotherapy treatment interventions are applied in patient care and how these impact on patients' clinical outcomes. Validation of patient outcome measures used in usual care of polytrauma patients by practicing physiotherapists is recommended.

Namibia is a sparsely populated country with physiotherapy human resource constraints. Patients often need to travel for long distances to access healthcare services which are centralised. For these reasons, it is important to explore methods to improve adherence to home exercise programs in patients with polytrauma where continuity of care is lost. Findings from this study provide a platform from which intervention-based studies can be conducted to better understand the effect of physiotherapy management on patient outcomes after polytrauma.

6.1.2 Implications for Policy

In Namibia, the CBR program underpins all policies and legislation as a key strategy for providing rehabilitation services according to the National Disability Council Act of 2004 (Republic of Namibia 2004). This means that there is no direct provision for rehabilitation programs outside of CBR in this act (Shumba and Moodley, 2017). This excludes acute care facilities from the rehabilitation policy. For a country with high MVC's and physical violence there is need to ensure that the provision of rehabilitation services in acute care facilities where physical injuries are initially managed, is well covered by policy and legislation.

There is need to ensure that physiotherapists who work in these facilities receive specialised training as polytrauma is a complex pathology. There is evidence that validated outcome

measures are not being used by physiotherapists in Namibia, yet evidence points to the fact that use of validated outcome measures form part of usual care practice for physiotherapy management of patients in acute care facilities. Specialised physiotherapists are more likely to use validated outcome measures and use specific treatment strategies that benefit patient outcomes. Therefore, policies should be put in place to encourage training and specialisation in this physiotherapy domain.

Findings from this study bring into consideration that lack of adequate financial resources is a barrier to the provision of physiotherapy services to patients with polytrauma during admission and after discharge. Policies which improve the allocation of financial resources by the Ministry of Health and Social Services of Namibia towards patients with polytrauma who are not covered by the MVA fund may improve service provision for these patients.

6.1.3 Implications for Research

A more in-depth qualitative study into the physiotherapist's role in the management of patients with polytrauma in acute care settings in private and public sector in Namibia is needed. Using a qualitative design may help fill in blind spots in current findings and provide deeper insight on the topic. This may be done by focus groups of physiotherapists that only work in trauma care. Such information may be useful in drafting minimum standards of practice guidelines in this setting, to bridge the gap between physiotherapy in polytrauma curricula from various universities. In a future study it may be worth exploring the educational content provided by the University of Namibia to evaluate whether the curriculum reflects current practice in the management of patients with polytrauma. This may guide and shape expectations for the implementation of minimum practice guidelines. The response rate to this survey was slightly higher than the projected 30%, and the questionnaire used in this study was content validated. The items within the questionnaire should be tested for reliability before it is used for future research.

REFERENCES

- Ahmad M (2018) 'Essentials of physiotherapy after thoracic surgery: What physiotherapists need to know. A narrative review. Korean Journal of Thoracic and Cardiovascular Surgery [revista en Internet] 2018 [acceso 29 de agosto de 2020]; 51(5): 293-307.', 6516, pp. 293–307. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6200172/>.
- Akar, O. et al. (2017) 'Efficacy of neuromuscular electrical stimulation in patients with COPD followed in intensive care unit', *Clinical Respiratory Journal*, 11(6), pp. 743–750. doi: hmad M (2018) 'Essentials of physiotherapy after thoracic surgery: What physiotherapists need to know. A narrative review. Korean Journal of Thoracic and Cardiovascular Surgery [revista en Internet] 2018 [acceso 29 de agosto de 2020]; 51(5): 293-307.', 6516, pp. 293–307.
- Al Hanna, R. et al. (2020) 'Multidisciplinary rehabilitation in persons with multiple trauma: A systematic review', *Journal of Rehabilitation Medicine*, 52(10). doi: 10.2340/16501977-2737.
- Allemann, F. et al. (2019) 'Risk factors for complications and adverse outcomes in polytrauma patients with associated upper extremity injuries', *Patient Safety in Surgery*, 13(1), pp. 1–9. doi: 10.1186/s13037019-0187-3.
- Ammori, M. B. and Abu-Zidan, F. M. (2018) 'The biomechanics of lower limb injuries in frontal-impact road traffic collisions', *African Health Sciences*, 18(2), pp. 321–332. doi: 10.4314/ahs.v18i2.17.
- Amweelo, M. (2016) 'The Road Safety in Namibia: Focus on Road Traffic Accidents', *International Science and Technology Journal. Namibia Amweelo/ISTJN*, 7, pp. 103–119.
- Andrzejowski, P., Holch, P. and Giannoudis, P. V. (2021) 'Measuring functional outcomes in major trauma: can we do better?', *European Journal of Trauma and Emergency Surgery*, (0123456789). doi: 10.1007/s00068-021-01720-1.
- Anekwe, D. E. et al. (2020) 'Early rehabilitation reduces the likelihood of developing intensive care unit-acquired weakness: a systematic review and meta-analysis', *Physiotherapy (United Kingdom)*, 107, pp. 1–10. doi: 10.1016/j.physio.2019.12.004.
- Balas, M. C. et al. (2022) 'Effects of a National Quality Improvement Collaborative on Abcdef Bundle Implementation', *American Journal of Critical Care*, 31(1), pp. 54–64. doi: 10.4037/ajcc2022768. Balke, M. et al. (2022) 'Therapeutic Potential of Electromyostimulation (EMS) in Critically Ill Patients - A Systematic Review', *Frontiers in Physiology*, 13(May). doi: 10.3389/fphys.2022.865437.
- Barr, J. et al. (2020) 'Organizational Characteristics Associated With ICU Liberation (ABCDEF) Bundle Implementation by Adult ICUs in Michigan', *Critical Care Explorations*, 2(8), p. e0169. doi: 10.1097/cce.0000000000000169.
- Beshay, M. et al. (2020) 'Analysis of risk factors in thoracic trauma patients with a comparison of a modern trauma centre: A mono-centre study', *World Journal of Emergency Surgery*, 15(1). doi: 10.1186/s13017-020-00324-1.

- Bissett, B. et al. (2019) 'Inspiratory muscle training for intensive care patients: A multidisciplinary practical guide for clinicians', *Australian Critical Care*, 32(3), pp. 249–255. doi: 10.1016/j.aucc.2018.06.001.
- Bouman, A. I. E. et al. (2017) 'Effects of an integrated "Fast Track" rehabilitation service for multi-trauma patients: A non-randomized clinical trial in the Netherlands', *PLoS ONE*, 12(1), pp. 1–16. doi: 10.1371/journal.pone.0170047.
- Bourdin, G. et al. (2012) 'Comparison of Alpha 200 and CoughAssist as intermittent positive pressure breathing devices: A bench study', *Respiratory Care*, 57(7), pp. 1129–1136. doi: 10.4187/respcare.01344.
- Butcher, N. and Balogh, Z. J. (2009) 'The definition of polytrauma: the need for international consensus', *Injury*, 40(SUPPL. 4), pp. 12–22. doi: 10.1016/j.injury.2009.10.032.
- Butcher, N. E., D'Este, C. and Balogh, Z. J. (2014) 'The quest for a universal definition of polytrauma: A trauma registry-based validation study', *Journal of Trauma and Acute Care Surgery*, 77(4), pp. 620–623. doi: 10.1097/TA.0000000000000404.
- Carvalho, C. R. F., Paisani, D. M. and Lunardi, A. C. (2011) 'Incentive spirometry in major surgeries: a systematic review', *Brazilian Journal of Physical Therapy*, 15(5), pp. 343–350. doi: 10.1590/s141335552011005000025.
- Castro, A. A. M. et al. (2013) 'Chest physiotherapy effectiveness to reduce hospitalization and mechanical ventilation length of stay, pulmonary infection rate and mortality in ICU patients', *Respiratory Medicine*, 107(1), pp. 68–74. doi: 10.1016/j.rmed.2012.09.016.
- Chatukuta, M. et al. (2021) 'Road traffic injuries in Namibia: health services, public health and the motor vehicle accident fund', *International Journal of Injury Control and Safety Promotion*, 28(2), pp. 167–178. doi: 10.1080/17457300.2021.1879870.
- Choi, J. S. P. and Jones, A. Y. M. (2005a) 'Effects of manual hyperinflation and suctioning on respiratory mechanics in mechanically ventilated patients with ventilator-associated pneumonia', *Australian Journal of Physiotherapy*, 51(1), pp. 25–30. doi: 10.1016/S0004-9514(05)70050-7.
- Chou, R. et al. (2016) 'Management of postoperative pain: A clinical practice guideline from the American pain society, the American society of regional anaesthesia and pain medicine, and the American society of anesthesiologists' committee on regional anaesthesia , executive commi', *Journal of Pain*, 17(2), pp. 131–157. doi: 10.1016/j.jpain.2015.12.008.
- Chrysou, K. et al. (2017) 'Lessons from a large trauma center: Impact of blunt chest trauma in polytrauma patients-still a relevant problem?', *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*. doi: 10.1186/s13049-017-0384-y.
- Colbenson GA, Johnson A, Wilson ME. Post-intensive care syndrome: impact, prevention, and management. *Breathe* 2019; 15: 98–101.
- Connolly, B. et al. (2015) 'Recovery from critical illness (Review)', *Cochrane Database of Systematic Reviews*, (6). doi: 10.1002/14651858.CD008632.pub2.www.cochranelibrary.com. Costa, D. K. et al.

- (2019) 'Implementation in a Quality Collaborative', *Journal of Critical Care*, pp. 1–6. doi: 10.1016/j.jcrc.2017.09.180.ICU.
- Curtis, K. et al. (2017) 'Implementation evaluation and refinement of an intervention to improve blunt chest injury management - A mixed-methods study', *Journal of Clinical Nursing*, 26(23–24), pp. 4506–4518. doi: 10.1111/jocn.13782.
- Dafoe S, Rushworth L, Stiller K. The Effectiveness of Kinesiotaping for Patients with Fractured Ribs: A Single-subject Experimental Design. *The Internet Journal of Allied Health Sciences and Practice*. 2020 Jan 10;18(1), Article 8.
- Dalton, M. K. et al. (2019) 'The expedited discharge of patients with multiple traumatic rib fractures is cost-effective', *Journal of Injury*, 50(1), pp. 109–112. doi: 10.1016/j.injury.2018.10.014.
- Demchuk, A. M. and Chatburn, R. L. (2021) 'Performance characteristics of positive expiratory pressure devices', *Respiratory Care*, 66(3), pp. 482–493. doi: 10.4187/respcare.08150.
- Denehy, L. and Berney, S. (2006) 'Physiotherapy in the intensive care unit', *Physical Therapy Reviews*, 11(1), pp. 49–56. doi: 10.1179/108331906X98921.
- Denehy, L. et al. (2013) 'A physical function test for use in the intensive care unit: Validity, responsiveness, and predictive utility of the physical function ICU test (scored)', *Physical Therapy*, 93(12), pp. 1644–1645. doi: 10.2522/ptj.20120310
- Derakhtanjani, A. S. et al. (2019) 'Comparison the effect of active cyclic breathing technique and routine chest physiotherapy on pain and respiratory parameters after coronary artery graft surgery: A randomized clinical trial', *Anesthesiology and Pain Medicine*, 9(5). doi: 10.5812/aapm.94654.
- Ditshuizen, J. C. Van et al. (2023) 'Evaluating associations between level of trauma care and outcomes of patients with specific severe injuries: a systematic review and meta-analysis', *Journal of Trauma and Acute Care Surgery*, doi: 10.1097/TA.0000000000003890.
- Dobscha, S. K. et al. (2008) 'Evidence-based Synthesis Program Pain in Patients with Polytrauma : A Systematic Review', Department of Veterans Affairs Veterans Health Administration Health Services Research & Development Service Washington, DC 20420
- Dogrul, B. N. et al. (2020) 'Blunt trauma related chest wall and pulmonary injuries: An overview', *Chinese Journal of Traumatology - English Edition*, 23(3), pp. 125–138. doi: 10.1016/j.cjtee.2020.04.003.
- Doiron KA, Hoffmann TC, B. E. (2018) 'adults in the intensive care unit (Review)', *Cochrane Database of Systematic Reviews Early*. doi: 10.1002/14651858.CD010754.pub2.www.cochranelibrary.com.
- Dong, Z. et al. (2021) 'Early rehabilitation relieves diaphragm dysfunction induced by prolonged mechanical ventilation: a randomised control study', *BMC Pulmonary Medicine*, pp. 1–8. doi: 10.1186/s12890-021-01461-2.
- Driessen, M. L. S. et al. (2021) 'Evaluation of the Berlin polytrauma definition: A Dutch nationwide observational study', *The journal of trauma and acute care surgery*, 90(4), pp. 694–699. doi: 10.1097/TA.0000000000003071.

- Duckworth, M. P. and Iezzi, T. (2010) 'Physical Injuries, Pain, and Psychological Trauma: Pathways to Disability', *Psychological Injury and Law*, 3(3), pp. 241–253. doi: 10.1007/s12207-010-9086-8.
- Due, D. et al. (2016) 'The Poly-Traumatized Patient with Fractures', *The Poly-Traumatized Patient with Fractures*, pp. 1–7. doi: 10.1007/978-3-662-47212-5.
- Elkins, M. and Dentice, R. (2015) 'Inspiratory muscle training facilitates weaning from mechanical ventilation among patients in the intensive care unit: A systematic review', *Journal of Physiotherapy*, 61(3), pp. 125–134. doi: 10.1016/j.jphys.2015.05.016.
- Ersoy, H. and Pomeranz, S. J. (2016) 'Complex Regional Pain Syndrome', *Journal of surgical orthopaedic advances*, 25(2), pp. 117–120. doi: 10.1055/a-1898-2454.
- Faizan Saeed Syed et al. (2022) 'Effectiveness of autogenic drainage Vs incentive spirometry in intensive care unit', *International Journal of Frontline Research and Reviews*, 1(1), pp. 001–006. doi: 10.56355/ijfrr.2022.1.1.0001.
- Figueiredo, R. I. N. et al. (2020) 'Inspiratory muscle training in copd', *Respiratory Care*, 65(8), pp. 1189–1201. doi: 10.4187/respcare.07098.
- Gibson, P., Ananias, J., Freeman, R., & Chilwalo, N. (2022, May 18). Social Work and Social Policy in Namibia. *Encyclopedia of Social Work*. Retrieved 25 Feb. 2024, from <https://oxfordre.com/socialwork/view/10.1093/acrefore/9780199975839.001.0001/acrefore9780199975839-e-1469>.
- Gessner, D. M., Horn, J. L. and Lowenberg, D. W. (2020) 'Pain management in the orthopaedic trauma patient: Non-opioid solutions', *Injury*, 51, pp. S28–S36. doi: 10.1016/j.injury.2019.04.008.
- Glimmerveen, A., Holewijn, S. and Vermeer, S. (2023) 'Association between clinician reported outcome and patient reported outcome measures one year after stroke', *Journal of Stroke and Cerebrovascular Diseases*, 32(8), p. 107156. doi: 10.1016/j.jstrokecerebrovasdis.2023.107156.
- Gosselink, R. et al. (2008) 'Physiotherapy for adult patients with critical illness: Recommendations of the European Respiratory Society and European Society of Intensive Care Medicine Task Force on Physiotherapy for Critically Ill Patients', *Intensive Care Medicine*, 34(7), pp. 1188–1199. doi: 10.1007/s00134-008-1026-7.
- González-Robledo, J., Martín-González, F., Sánchez-Barba, M., Sánchez-Hernández, F., and MorenoGarcía, M. N. (2017). Multi-classifier systems for predicting neurological outcome of patients with severe trauma and polytrauma in intensive care units. *Journal of Medical Systems*, 41(9). <https://doi.org/10.1007/s109160170789-1>
- Guérin, C. et al. (2010) 'The short-term effects of intermittent positive pressure breathing treatments on ventilation in patients with neuromuscular disease', *Respiratory Care*, 55(7), pp. 866–872.
- Haider, T. et al. (2017) 'Thoracic trauma and acute respiratory distress syndrome in polytraumatized patients: A retrospective analysis', *Minerva Anestesiologica*, 83(10), pp. 1026–1033. doi: 10.23736/S0375-9393.17.11728-1.

- Hanekom, S. D., Louw, Q. and Coetzee, A. (2012) 'The way in which a physiotherapy service is structured can improve patient outcome from a surgical intensive care: A controlled clinical trial', *Critical Care*, 16(6). doi: 10.1186/cc11894.
- Hanekom, S. et al. (2015) 'Developing minimum clinical standards for physiotherapy in South African intensive care units: The nominal group technique in action', *Journal of Evaluation in Clinical Practice*, 21(1), pp. 118–127. doi: 10.1111/jep.12257.
- Hermans, G. and Van den Berghe, G. (2015) 'Clinical review: Intensive care unit acquired weakness', *Critical Care*, 19(1), pp. 1–9. doi: 10.1186/s13054-015-0993-7.
- Hermans G, De Jonghe B, Bruyninckx F, Van den Berghe G. Interventions for preventing critical illness polyneuropathy and critical illness myopathy. *Cochrane Database of Systematic Reviews* 2014, Issue 1. Art. No.: CD006832. DOI: 10.1002/14651858.CD006832.pub3.
- Hietbrink, F. and Leenen, L. P. H. (2016) 'The Poly-Traumatized Patient with Fractures: A MultiDisciplinary Approach, DOI 10.1007/978-3-662-47212-5_8.
- Hodgson, C. (2017) 'Daily rehabilitation improves physical function at 6 months, but not hospital length of stay, in patients with acute respiratory failure [commentary]', *Journal of Physiotherapy*, 63(1), p. 49. doi: 10.1016/j.jphys.2016.10.004.
- Hodgson, C. L. and Tipping, C. J. (2017) 'Physiotherapy management of intensive care unit-acquired weakness', *Journal of Physiotherapy*, 63(1), pp. 4–10. doi: 10.1016/j.jphys.2016.10.011.
- Inoue, S. et al. (2019) 'Post-intensive care syndrome: its pathophysiology, prevention, and future directions', *Acute Medicine and Surgery*, 6(3), pp. 233–246. doi: 10.1002/ams2.415.
- Jacob, P. et al. (2021) 'Physiotherapy in severe polytrauma patients: a therapeutic care model', *Journal of Acute Care Physical Therapy*, 24(1), pp. 37–48. doi: 10.1097/jat.0000000000000140.
- Kayambu, G., Boots, R. and Paratz, J. (2013) 'Physical therapy for the critically ill in the ICU: A systematic review and meta-analysis', *Critical Care Medicine*, 41(6), pp. 1543–1554. doi: 10.1097/CCM.0b013e31827ca637.
- Kelly, D. et al. (2017) 'Identifying barriers to delivering the awakening and breathing coordination , delirium , and early exercise / mobility bundle to minimize adverse outcomes for mechanically ventilated patients', *Chest*, 152(2), pp. 304–311. doi: 10.1016/j.chest.2017.03.05
- Kelly, M. L. et al. (2014) 'Comparing clinician- and patient-reported outcome measures after hemicraniectomy for ischemic stroke', *Clinical Neurology and Neurosurgery*, 126, pp. 24–29. doi: 10.1016/j.clineuro.2014.08.007.
- Kendall, F. et al. (2018) 'Inspiratory muscle training is effective to reduce postoperative pulmonary complications and length of hospital stay: a systematic review and meta-analysis', *Disability and Rehabilitation*, 40(8), pp. 864–882. doi: 10.1080/09638288.2016.1277396.
- Khan, F., Amatya, B. and Hoffman, K. (2012) 'Systematic review of multidisciplinary rehabilitation in patients with multiple trauma', *British Journal of Surgery*, 99(SUPPL. 1), pp. 88–96. doi: 10.1002/bjs.7776.

- Khan, M. S. Z., Zaman, A. K. A. and Doza, A. A. U. (2015) 'Physical rehabilitation in the ICU', Bangladesh Critical Care Journal, 3(2), pp. 63–66. doi: 10.3329/bccj.v3i2.25113.
- Kim, M. and Moore, J. E. (2020) 'Chest trauma: current recommendations for rib fractures, pneumothorax, and other injuries', Current Anesthesiology Reports, 10(1), pp. 61–68. doi: 10.1007/s40140-020-00374-w.
- Larsen, P. et al. (2016) 'One-year development of QOL following orthopaedic polytrauma: a prospective observational cohort study of 53 patients', Archives of Orthopaedic and Trauma Surgery, 136(11), pp. 1539–1546. doi: 10.1007/s00402-016-2550-5.
- Larsen, P., Goethgen, C. B., Rasmussen, S., Iyer, A. B., and Elsoe, R. (2016). One-year development of QOL following orthopaedic polytrauma: a prospective observational cohort study of 53 patients. Archives of Orthopaedic and Trauma Surgery, 136(11), 1539–1546. <https://doi.org/10.1007/s00402-016-2550-5>
- Lee, C. et al. (2021) 'The polytrauma patient: Current concepts and evolving care', OTA International: The Open Access Journal of Orthopaedic Trauma, 4(2S), p. e108. doi: 10.1097/oi9.0000000000000108.
- Lenjani, B., Rashiti, P., Bunjaku, I., Demiri, A., Shabani, G., and Lenjani, D. (2019). Polytrauma Management and Links to EMS. Albanian Journal of Trauma and Emergency Surgery, 3(2), 1–7. <https://doi.org/10.32391/ajtes.v3i2.51>
- Mulama L., (2015). Office of the president, National Planning Commission, Republic of Namibia., Policy Brief 2015.
- Lockstone, J. et al. (2023) 'Benefits and risks of ventilator hyperinflation in mechanically ventilated intensive care patients: A systematic review and meta-analysis', Australian Critical Care. doi: 10.1016/j.aucc.2023.01.005.
- Lottering, M. and Van Aswegen, H. (2016) 'Physiotherapy practice in South African intensive care units', Southern African Journal of Critical Care, 32(1), pp. 11–16. doi: 10.7196/SAJCC.2016.v32i1.248.
- Main, E. and Denehy, L. (2016) Cardiorespiratory Physiotherapy. 5th edition 250-292. <https://ebookcentral-proquest-com.ezproxy.flinders.edu.au/lib/flinders/reader.action?>
- Marques, R. et al. (2017) 'Inspiratory Muscle Training in the Intensive Care Unit: A New Perspective Inspiratory Muscle Training in the Intensive Care Unit: A New Perspective', (November). doi: 10.14740/jocmr3169w.
- Martin, A. D. et al. (2011) 'Inspiratory muscle strength training improves weaning outcome in failure to wean patients: a randomized trial', pp. 1–12.
- Martin, M. (2019). Violence Against Women and Children in Namibia: Perspectives and Systematic Measures to Support Perpetrators. October 2017, 36–42.
- Mccarthy, M. R. et al. (2021) Chapter 90: Rehabilitation of the polytrauma patient. Introduction To Polytrauma. 1-10. 2021-04-27 1:49 P
- Medrinal, C. et al. (2018) 'Comparison of exercise intensity during four early rehabilitation techniques in sedated and ventilated patients in ICU: A randomised cross-over trial', Critical Care, 22(1), pp. 1–8. doi: 10.1186/s13054-018-2030-0.

- Mejaddam, A. Y. and Velmahos, G. C. (2012) 'Randomized controlled trials affecting polytrauma care', *European Journal of Trauma and Emergency Surgery*, 38(3), pp. 211–221. doi: 10.1007/s00068-0110141-2.
- Morrow, B. and van Aswegen, H. (2015) 'Physiotherapy modalities, markers and outcome measures', in *Cardiopulmonary Physiotherapy in Trauma: An Evidence-Based Approach*. 1st edn, pp. 65–149. doi: 10.1142/9781783266524_0004.
- Mpempetsi, P. et al. (2015) 'Physiotherapy in the intensive care unit', *Pneumon*, 28(4), pp. 340–350.
- Murphy, D. et al. (2020) 'Peripheral neuropathic pain', *NeuroRehabilitation*, 47(3), pp. 265–283. doi: 10.3233/nre-208002.
- Myers, T. R. (2007) 'Positive expiratory pressure and oscillatory positive expiratory pressure therapies', *Respiratory Care*, 52(10), pp. 1308–1326.
- Nauth, A. et al. (2021) 'Polytrauma: update on basic science and clinical evidence', *OTA International: The Open Access Journal of Orthopaedic Trauma*, 4(1), p. e116. doi: 10.1097/oi9.0000000000000116.
- Njelesani, J., Couto, S. and Cameron, D. (2011) 'Disability and rehabilitation in Tanzania: A review of the literature', *Disability and Rehabilitation*, 33(23–24), pp. 2196–2207. doi: 10.3109/09638288.2011.563817.
- Nordon-Craft, A. et al. (2012) 'Intensive care unit-acquired weakness: Implications for physical therapist management', *Physical Therapy*, 92(12), pp. 1494–1506. doi: 10.2522/ptj.20110117.
- Ntinga, M. N. and van Aswegen, H. (2020) 'Physiotherapists' perceptions of collaborations with interprofessional team members in an ICU setting', *Southern African Journal of Critical Care*, 36(2), pp. 86–91. doi: 10.7196/SAJCC.2020.V36I2.431.
- Nulty, D. D. (2008) 'The adequacy of response rates to online and paper surveys: What can be done?', *Assessment and Evaluation in Higher Education*, 33(3), pp. 301–314. doi: 10.1080/02602930701293231.
- Padovani, C., Silva, J. M. da, and Tanaka, C. (2017). Physiotherapy in severe polytrauma patients: a therapeutic care model. *Acta Fisiátrica*, 24(1). <https://doi.org/10.5935/0104-7795.20170007>
- Olson, Brittany, "Multiple Fracture following Non-Occupational Fall: A Case Report" (2015). Physical Therapy Scholarly Projects. 591. <https://commons.und.edu/pt-grad/591>
- Ore, V., Nasic, S. and Riad, J. (2020) 'Lower extremity range of motion and alignment: A reliability and concurrent validity study of goniometric and three-dimensional motion analysis measurement,' *Heliyon*, 6(8), p. e04713. <https://doi.org/10.1016/j.heliyon.2020.e04713>.
- Parry, S. M. et al. (2015) 'Assessment of impairment and activity limitations in the critically ill: a systematic review of measurement instruments and their clinimetric properties', *Intensive Care Medicine*, 41(5), pp. 744–762. doi: 10.1007/s00134-015-3672-x.
- Pieczkoski, S. M., Margarites, A. G. F. and Sbruzzi, G. (2017) 'Noninvasive ventilation during immediate postoperative period in cardiac surgery patients: Systematic review and meta-analysis', *Brazilian Journal of Cardiovascular Surgery*, 32(4), pp. 301–311. doi: 10.21470/1678-9741-2017-0032.

- Pun, B. T. et al. (2019) 'Caring for critically ill patients with the ABCDEF bundle', *Critical Care Medicine*, 47(1), pp. 3–14. doi: 10.1097/ccm.0000000000003482.
- Rau, C. S. et al. (2017) 'Polytrauma defined by the new berlin definition: A validation test based on propensity-score matching approach', *International Journal of Environmental Research and Public Health*, 14(9), pp. 4–13. doi: 10.3390/ijerph14091045.
- Rawal, G., Yadav, S. and Kumar, R. (2017) 'Post-intensive care syndrome: An overview', *Journal of Translational Internal Medicine*, 5(2), pp. 90–92. doi: 10.1515/jtim-2016-0016.
- Reid, L. et al. (2015) 'Going places: Does the two-minute walk test predict the six-minute walk test in lower extremity amputees?', *Journal of Rehabilitation Medicine*, 47(3), pp. 256–261. doi: 10.2340/16501977-1916. Restrepo, R. D. et al. (2011) 'Incentive Spirometry: 2011', *Respiratory Care*, 56(10), pp. 1600–1604. doi: 10.4187/respcare.01471.
- Romanini, W. et al. (2007) 'The effects of intermittent positive pressure and incentive spirometry in the postoperative of myocardial revascularization', *Arquivos Brasileiros de Cardiologia*, 89(2), pp. 9499,105-110.
- Samosawala, N., Vaishali, K. and Chakravarthy Kalyana, B. (2016) 'Measurement of muscle strength with handheld dynamometer in Intensive Care Unit', *Indian Journal of Critical Care Medicine*, 20(1), pp. 21–26. doi: 10.4103/0972-5229.173683.
- Saranteas, T. et al. (2019) 'Acute pain management in trauma: Anatomy, ultrasound-guided peripheral nerve blocks and special considerations', *Minerva Anestesiologica*, 85(7), pp. 763–773. doi: 10.23736/S0375-9393.19.13145-8.
- Schober, A. E. and Thornton, K. C. (2013) 'Early Mobilization in the Intensive Care Unit', *Current Anesthesiology Reports*, 3(2), pp. 73–78. doi: 10.1007/s40140-013-0013-x.
- Shumba, T. W. and Moodley, I. (2017) 'Review of policy and legislative framework for disability services in Namibia', pp. 1–8.
- Shumba, T. W. and Moodley, I. (no date) 'Experiences of Persons with Disabilities and their Quality of Life in Two Namibian Villages', 32(2), pp. 6–29. doi: 10.47985/dcidj.408.
- Shumba, T.W. & Moodley, I., 2018, 'Implementation of disability policy framework in Namibia: A qualitative study', *South African Journal of Physiotherapy* 74(1), a400. <https://doi.org/10.4102/sajp.v74i1.400>
- Silva IS, Fregonezi GAF, Dias FAL, Ribeiro CTD, Guerra RO, Ferreira GMH. Inspiratory muscle training for asthma. *Cochrane Database of Systematic Reviews* 2013, Issue 9. Art. No.: CD003792. DOI: 10.1002/14651858.CD003792.pub2.
- Skinner, E. H. et al. (2015) 'Usual care physiotherapy during acute hospitalization in subjects admitted to the ICU: An observational cohort study', *Respiratory Care*, 60(10), pp. 1476–1485. doi: 10.4187/respcare.04064.
- Slinger, P. D. and Naidu, B. (2019) 'Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS V) Society and the European Society of Thoracic Surgeons (ESTS)', 55(October 2018), pp. 91–115. doi: 10.1093/ejcts/ezy301.

- Sommers, J. et al. (2015) 'Physiotherapy in the ICU: an evidence-based, expert-driven, practical statement', *Critical Care*, 19(Suppl 1), p. P558. doi: 10.1186/cc14638.
- Spurrier, E. and Stapley, S. A. (2016) 'Orthopaedic Problems in the Critically Injured Patient', pp. 335–358. doi: 10.1007/978-3-319-28758-4_14.
- Stahel, P. F., Heyde, C. E. and Ertel, W. (2005) 'Current concepts of polytrauma management', *European Journal of Trauma*, 31(3), pp. 200–211. doi: 10.1007/s00068-005-2028-6.
- Stiller, K. (2013) 'Physiotherapy in intensive care: An updated systematic review', *Chest*, 144(3), pp. 825–847. doi: 10.1378/chest.12-2930.
- Sumann, G. et al. (2020) 'Multiple trauma management in mountain environments - a scoping review: Evidence based guidelines of the International Commission for Mountain Emergency Medicine (ICAR MedCom). Intended for physicians and other advanced life support personnel', *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, 28(1), pp. 1–22. doi: 10.1186/s13049-020-00790-1.
- Supinski, G. S. et al. (2018) 'Diaphragm Dysfunction in Critical Illness', *Chest*, 153(4), pp. 1040–1051. doi: 10.1016/j.chest.2017.08.1157.
- Swinkels, R. A. H. M. et al. (2011) 'Current use and barriers and facilitators for implementation of standardised measures in physical therapy in the Netherlands', *BMC Musculoskeletal Disorders*, 12(1), p. 106. doi: 10.1186/1471-2474-12-106.
- Tadyanemhandu, C., van Aswegen, H. and Ntsiea, V. (2022) 'Barriers and facilitators to implementation of early mobilisation of critically ill patients in Zimbabwean and South African public sector hospitals: a qualitative study', *Disability and Rehabilitation*, 44(22), pp. 6699–6709. doi: 10.1080/09638288.2021.1970827.
- Tadyanemhandu, C. and Manie, S. (2016) 'Implementation of the physical function ICU test tool in a resource constrained intensive care unit to promote early mobilisation of critically ill patients- a feasibility study', *Archives of Physiotherapy*, 6(1), pp. 1–10. doi: 10.1186/s40945-016-0026-0.
- Takeda, K., Tanino, G. and Miyasaka, H. (2017) 'Review of devices used in neuromuscular electrical stimulation for stroke rehabilitation', *Medical Devices: Evidence and Research*, 10, pp. 207–213. doi: 10.2147/MDER.S123464.
- Tomas, N., Ashipala, D. O. and Tomas, T. N. (2021) 'Falls and fall injuries as societal challenges in Namibia', *Integrated Care and Fall Prevention in Active and Healthy Aging*, 2020, pp. 242–249. doi: 10.4018/978-1-7998-4411-2.ch013.
- Tosounidis, T. and Giannoudis, P. V. (2016) 'The Poly-Traumatized Patient with Fractures', *The PolyTraumatized Patient with Fractures*. Springer Berlin Heidelberg. doi:10.1007/978-3-662-47212-5.
- Tucci, M. R. et al. (2019) 'Manual hyperinflation: Is it effective?', *Respiratory Care*, 64(7), pp. 870–873. doi: 10.4187/respcare.07152.
- Turculeă, C. Æ. et al. (2021) 'Polytrauma: The European paradigm', *Chirurgia (Romania)*, 116(6), pp. 664–668. doi: 10.21614/CHIRURGIA.116.6.664.

- Unsworth, A., Curtis, K. and Asha, E. E. (2015) 'Treatments for blunt chest trauma and their impact on patient outcomes and health service delivery', *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, 23(1), pp. 1–9. doi: 10.1186/s13049-015-0091-5.
- Van Aswegen, H. (2015) 'to Trauma', in *Cardiopulmonary Physiotherapy In Trauma: An Evidence-based Approach*, pp. 1–28.
- Van Aswegen, H. (2020) 'Physiotherapy management of patients with trunk trauma: A state-of-the-art review', *South African Journal of Physiotherapy*, 76(1), pp. 1–8. doi: 10.4102/sajp.v76i1.1406.
- Van Aswegen, H. et al. (2020) 'Physiotherapy management of patients with major chest trauma: Results from a global survey', *Trauma (United Kingdom)*, 22(2), pp. 133–141. doi: 10.1177/1460408619850918.
- Van Aswegen, H., Morrow, B., 2015. *Cardiopulmonary physiotherapy in trauma: An evidence-based approach*, *Cardiopulmonary Physiotherapy in Trauma: An Evidence-Based Approach*. Imperial College Press. doi:10.1142/P994
- Volsko, T. A., DiFiore, J. M. and Chatburn, R. L. (2003) 'Performance comparison of two oscillating positive expiratory pressure devices: Acapella versus flutter', *Respiratory Care*, 48(2), pp. 124–130.
- Vicente, D. A. et al. (2022) 'Cellular microRNAs correlate with clinical parameters in multiple injury patients', *Journal of Trauma and Acute Care Surgery*, 93(4), pp. 427–438. doi: 10.1097/TA.00000000000003708.
- Wang, M. Y., Pan, L. and Hu, X. J. (2019) 'Chest physiotherapy for the prevention of ventilator-associated pneumonia: A meta-analysis', *American Journal of Infection Control*, 47(7), pp. 755–760. doi: 10.1016/j.ajic.2018.12.015.
- Wang, T. H. (2018) 'Chest physiotherapy with early mobilization may improve extubation outcome in critically ill patients in the intensive care units', (July), pp. 2613–2621. doi: 10.1111/crj.12965.
- World Economic Forum., 2020. *The global competitiveness report: How countries are performing on the road to recovery*, World Economic Forum, pp. 1-95.
- Worraphan, S. et al., 2020. *Effects of Inspiratory Muscle Training and Early Mobilization on Weaning of Mechanical Ventilation: A Systematic Review and Network Meta-analysis*. *Archives of Physical Medicine and Rehabilitation*. doi:10.1016/j.apmr.2020.07.004
- Yach, J.D., 2007. *Polytrauma Considerations*, in: *Core Knowledge in Orthopaedics: Trauma*. Elsevier, pp. 18–32. doi:10.1016/B978-0-323-03424-1.10002-6
- Zein, H. et al., 2016. *Ventilator weaning and spontaneous breathing trials; an educational review*. *Emergency* 4, 65–71.
- Zhao, L. H. M. et al. (2020) 'Establishing essential cardiopulmonary physiotherapy services in acute care settings in China', *Journal of Rehabilitation Medicine*, 52(7). doi: 10.2340/16501977-2715.
- Zimmerman, A. et al., 2020. *An analysis of emergency care delays experienced by traumatic brain injury patients presenting to a regional referral hospital in a low-income country*. doi:10.1371/journal.pone.0240528

APPENDIX A

□ PARTICIPANT INFORMATION SHEET

PARTICIPANT INFORMATION SHEET

Study Title: Investigating the physiotherapy management of patients with polytrauma admitted to acute care settings and factors that influence service delivery after discharge: a Namibian survey

Dear potential participant

My name is Hannah Chirombo. I am a physiotherapist working in Windhoek currently registered for postgraduate studies (MSc Physiotherapy) with University of Witwatersrand School of Health Sciences. I am performing a research study investigating the physiotherapy management of patients with polytrauma in acute care settings in Namibia. This study intends to identify interventions and outcome measures used by physiotherapists in managing patients with polytrauma in private and state-owned acute care settings. It also aims to identify any barriers or enablers in physiotherapy service delivery to these patients.

In this survey, polytrauma is defined as two or more physical injuries to regions or organ systems, one of which may be life threatening, resulting in “physical, cognitive, psychological, or psychosocial impairments” and functional disability. In this definition of polytrauma, traumatic injuries to the brain or spinal cord and injuries sustained from burns are not included. An acute care setting in this case would be any setting in a public or private hospital in Namibia at which patients with these injuries are admitted for management.

Findings from this study will add to the body of knowledge on physiotherapy management of patients with polytrauma in our setting. This may aid in the development of clinical practice guidelines and in the creation of a platform from which intervention-based studies can be conducted to better understand the effect of physiotherapy management on patient outcomes. This study has been given ethical clearance by the Human Research Ethics Committee, Faculty of Health Sciences of the University of Witwatersrand and the Ministry of Health and Social Services of Namibia.

Why are you being asked to participate?

You are being invited to participate in this survey because you are a practicing physiotherapist registered in Namibia.

What are the risks?

There are no known risks associated with your participation in this survey.

What is the Cost?

Participation in this survey will be online, therefore you will use a small amount of data whilst answering the questionnaire.

Confidentiality and Anonymity

Your anonymity in answering the questionnaire will be fully respected, no one will be able to see or access your answers other than the researchers involved in the study. Personal information which might identify you will not be requested. REDCap automatically codes each completed questionnaire to ensure anonymity of the participant.

What are your rights?

Participation in this survey is entirely voluntary. Should you decide to participate, it is expected that you provide answers on the electronic questionnaire provided and save and submit after completion.

The survey link is provided below, if it doesn't open automatically kindly copy and paste it onto your browser.

<https://redcap.core.wits.ac.za/redcap/surveys/?s=CE8JK9AE47AELTAM>

Contact Details

Should you require further details or have any queries regarding the study, please contact me (Hannah Chirombo) on +264816913905 or at hchirombo@gmail.com. If you have any concerns about the way this study is being conducted, you may contact the Witwatersrand University Human Research Ethics (Medical) Committee: Chair, Prof

Clement Penny at clement.penny@wits.ac.za. The email addresses for the Ethics Committee secretariat are Zanele.ndlovu@wits.ac.za and Rhulani.mukansi@wits.ac.za.

QUESTIONNAIRE

SECTION A: SOCIO-DEMOGRAPHIC DATA OF PHYSIOTHERAPIST

- 1) Age in years:
- 2) Gender ☐ Male ☐ Female
- 3) How many years have you been practicing as a physiotherapist?
- 4) What tertiary qualifications do you hold?
- ☐ BSc Physiotherapy ☐ MSc Physiotherapy ☐ PhD
- 5) If you have any post graduate physiotherapy qualifications, what specialty is it in?
- ☐ Orthopaedic Physiotherapy ☐ Orthopaedic Manipulative Therapy
- ☐ Cardiorespiratory Physiotherapy ☐ Sports Physiotherapy
- ☐ Traumatology Physiotherapy ☐ Neurology
- ☐ Women's Health ☐ Pediatrics
- ☐ Geriatrics
- 6) Do you manage patients with polytrauma at a public or private facility?
- ☐ Public ☐ Private ☐ Both

7) How long have you been working at the above facility/facilities? months

8) Have you treated patients with polytrauma in the last 6 months? ☐ YES ☐

NO

If you answered **No**, thank you for your participation.

You will not be required to complete the rest of the questionnaire.

9) If you answered **Yes** to the question above (8), what type of setting do you manage these patients?

- ☐ Intensive Care Unit ☐ High Dependency Unit
☐ Head Injury Unit ☐ Hospital Ward

SECTION B: PROFILE OF PATIENTS WITH POLYTRAUMA YOU MANAGE.

1) Out of the 10 last patients with polytrauma you managed, what gender was the majority of them?

- ☐ Male ☐ Female

2) a) How often do the following mechanisms of injury lead to polytrauma for the patients admitted to your hospital?

Type of polytrauma Injury	Rarely	Sometimes	Frequently
Motor vehicle accidents	☐	☐	☐
Pedestrian Vehicle accident	☐	☐	☐
Interpersonal Violence and physical altercations	☐	☐	☐
Falls from a height	☐	☐	☐
Gunshot wounds	☐	☐	☐
Blast injuries/ Explosives	☐	☐	☐

b) What other mechanisms of injury leading to polytrauma have you encountered in the patients you have managed?

.....
.....

3) Which body regions are frequently injured in these patients?

Body Region	Rarely	Sometimes	Frequently
Head and neck	☐	☐	☐
Chest wall	☐	☐	☐
Abdominal region	☐	☐	☐
Upper limb region	☐	☐	☐
Lower limbs	☐	☐	☐

(Larsen et al., 2016)

SECTION C: PHYSIOTHERAPY TREATMENT STRATEGIES

- I. a) How often do you use the techniques listed below to maintain/ restore optimal function of the respiratory system in patients with polytrauma admitted to your hospital?

Technique	Rarely	Sometimes	Frequently
Manual chest therapy techniques (percussions, vibrations, shakings applied to the chest wall)	☐	☐	☐
Active Cycle of Breathing Techniques (ACBT)	☐	☐	☐
Incentive Spirometry	☐	☐	☐
Intermittent Positive Pressure Breathing (IPPB)	☐	☐	☐
Positive Expiratory Pressure Therapy (e.g. bubble PEP bottle, flutter device)	☐	☐	☐
Body positioning for postural drainage	☐	☐	☐
Body positioning to optimize oxygenation	☐	☐	☐
Nebulisation Therapy	☐	☐	☐
Manual hyperinflation	☐	☐	☐
Suctioning	☐	☐	☐
Ventilator hyperinflation	☐	☐	☐
Respiratory muscle strengthening	☐	☐	☐

(Tadyanemhandu and Manie, 2016; Denehy and Berney, 2006)

- b) Are there any other techniques not mentioned above which you use in the management of patients with polytrauma to optimize/restore respiratory function? State them below.

.....

- II. How often do you use the techniques listed below to maintain/ restore optimal function of the neuromusculoskeletal system in patients with polytrauma admitted to your hospital?

Technique	Rarely	Sometimes	Frequently
Passive ROM exercises in bed	☐	☐	☐
Active ROM exercises in bed	☐	☐	☐
Strengthening exercises in bed	☐	☐	☐
Early mobilisation of patient out of bed	☐	☐	☐
Marching on the spot	☐	☐	☐
Brisk walking	☐	☐	☐
Stair walking	☐	☐	☐
Functional exercises	☐	☐	☐
Balance retraining	☐	☐	☐
Neurological stimulation techniques (e.g., electrical stimulation, tactile stimulation)	☐	☐	☐

(Skinner et al., 2015; Van Aswegen, 2020; Tadyanemhandu and Manie, 2016; Curtis et al., 2016)

SECTION D: OUTCOME MEASURES

- I. Which outcome measures do you use to evaluate your patient with polytrauma's response to treatment of their respiratory system?

Outcome Measure	Never used	Sometimes used	Frequently used
Lung auscultation/ Respiratory sounds	☐	☐	☐
Arterial blood gas results	☐	☐	☐
Pulse oximeter	☐	☐	☐
Respiratory rate	☐	☐	☐
Breathing comfort/discomfort (level of dyspnoea)	☐	☐	☐
Thoracic expansion	☐	☐	☐
Chest radiography (e.g. x-rays, CT -scans etc.)	☐	☐	☐

(Skinner et al., 2015;; Beshay et al., 2020; 2016; Van Aswegen, 2020)

- II. Which outcome measures do you use to evaluate your patient with polytrauma's response to treatment of their neuromusculoskeletal system?

Outcome Measure	Never used	Sometimes used	Frequently
Functional Status Score for ICU (FSS -ICU)	☐	☐	☐
Chelsea Critical Care Physical Assessment Score (CPAx)	☐	☐	☐
Physical Function Test for ICU-scored (PFIT-s)	☐	☐	☐
De Morton Mobility Index for ICU (DEMMI)	☐	☐	☐
Barthel Index	☐	☐	☐
ROM - Goniometry	☐	☐	☐
Muscle Power (e.g., dynamometer, Medical Research Council Sum Score (MRC-SS), manual muscle testing)	☐	☐	☐
Medical Research Council Sum Score (MRC-SS)	☐	☐	☐
Exercise capacity (e.g. step-test, 6-minute walk test, etc.)	☐	☐	☐

(Tadyanemhandu and Manie, 2016; Allemann et al., 2019)

- III. To what extent do the factors listed below influence progression in your physiotherapy management of these patients?

Outcome measure	Rarely	Sometimes	Often	Always
Self-reported measures	☐	☐	☐	☐
Performance- based measures	☐	☐	☐	☐
Observer- reported measures	☐	☐	☐	☐
Clinician reported measures.	☐	☐	☐	☐

(Andrzejowski, Holch and Giannoudis, 2021)

- IV. How long do patients with polytrauma tend to stay whilst receiving treatment in the acute care facility that you work in?

- | | |
|--|--------------------------------------|
| ☐ 1-7 days | ☐ 8 – 15 days |
| ☐ 16- 22days | ☐ 4 – 6 weeks |
| ☐ more than 6 weeks | |

SECTION E: DISCHARGE DESTINATION

- I. When a patient is discharged from the above facility where are they normally discharged to?

Select all that apply:

- ☐ Subacute facility at the same institution
- ☐ Stepdown facility for extended care at another institution

- ☐ Home
- ☐ Other (specify).....

II. What factors determine your patients' discharge from an acute care facility into another facility?

- ☐ Hospital length of stay
- ☐ Functional outcomes
- ☐ Psychological outcomes
- ☐ Occupational outcomes
- ☐ Other (specify).....

SECTION F: REHABILITATION PROGRAMS

I. a) Do you normally provide a discharge program for patients with polytrauma?

- ☐ YES ☐ NO

b) If you answered **NO**, do give a reason for your answer

.....

.....

II. What type of rehabilitation programs do you give to these patients following hospital discharge?

.....

.....

(Larsen et al., 2016)

SECTION G: BARRIERS AND ENABLERS

- I. a) The following are barriers that might influence your physiotherapy service delivery to patients with polytrauma **during their hospital stay**. Indicate to what extent each of these listed barriers influence physiotherapy service delivery at your setting?

Barriers	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Lack of support from members of the team	☐	☐	☐	☐	☐
Lack of knowledge by patients on role of physiotherapy	☐	☐	☐	☐	☐
Lack of knowledge on physiotherapy and its role in polytrauma by other members of the team	☐	☐	☐	☐	☐
Poor treatment adherence by patients	☐	☐	☐	☐	☐
Communication and language barriers with patients	☐	☐	☐	☐	☐
Lack of sufficient time for rehabilitation of patients	☐	☐	☐	☐	☐
Lack of knowledge on current evidence-based treatment strategies for patients with polytrauma by the physiotherapist	☐	☐	☐	☐	☐
Lack of adequate human resources	☐	☐	☐	☐	☐

(Skinner et al., 2015; Curtis et al., 2016; Jacob et al., 2021) b)

Other barriers

.....

- II. The following are barriers that might influence your physiotherapy service delivery to patients with polytrauma **post-discharge from an acute care facility**.

Indicate to what extend each of these listed barriers influence physiotherapy service delivery at your setting?

Barriers	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Lack of knowledge on physiotherapy and its role in post-discharge rehabilitation in polytrauma by other members of the medical team	☐	☐	☐	☐	☐
Lack of knowledge by patients on role of physiotherapy post-discharge	☐	☐	☐	☐	☐
Lack of adequate support system for patients by family/caregivers	☐	☐	☐	☐	☐
Poor treatment adherence by patients	☐	☐	☐	☐	☐
Communication barriers between members of the rehabilitation team in different treatment facilities	☐	☐	☐	☐	☐

Lack of sufficient time for effective post-discharge physiotherapy programs for polytrauma patients	☐	☐	☐	☐	☐
Lack of knowledge on current evidence-based post-discharge treatment strategies for patients with polytrauma by the physiotherapist	☐	☐	☐	☐	☐
Lack of adequate human resources	☐	☐	☐	☐	☐

(Skinner et al., 2015; Curtis et al., 2016, Jacob et al., 2021))

III. What enablers positively influence the physiotherapy service delivery to patients with polytrauma in your setting during their hospital stay?

.....

.....

IV. What enablers positively influence the physiotherapy service delivery to patients with polytrauma post-discharge?

.....

.....

Thank you for participating

APPENDIX B

TRREE MODULE 1: INTRODUCTION TO RESEARCH ETHICS



Zertifikat Certificado Certificat Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale

Promoting the highest ethical standards in the protection of biomedical research participants



Clinical Trials Centre
The University of Hong Kong

Certificat de formation - Training
Certificate

Ce document atteste que - this document certifies that Hannah Chirombo a complété avec succès - has successfully completed Introduction to Research Ethics du programme de formation TRREE en évaluation éthique de la recherche of the TRREE training programme in research ethics evaluation

Release Date: 2021/09/28

CID : FiHL0MZp79Professeur Dominique Sprumont

Coordinateur



TRREE Coordinator

Continuing Education

Program (5



Credits)Continuing Education Programms

Programme de Formation continue (5

Crédits)Programmes de formation continue

Ce programme est soutenu par - This program is supported by :

European and Developing Countries Clinical Trials Partnership (EDCTP) (www.edctp.org) -

Swiss National Science Foundation (www.snf.ch) - Canadian Institutes of Health Research

(<http://www.cihr-irsc.gc.ca/e/2891.html>) -

REV 201703101 Swiss Academy of Medical Science (SAMS/ASSM/SAMW) (www.samw.ch) -

Commission for Research Partnerships with Developing Countries (www.kfpe.ch)

APPENDIX C

ETHICAL APPROVAL HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)



R49 Ms HE Chirombo

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL) CLEARANCE CERTIFICATE NO. M211028

NAME:
(Principal Investigator)

Ms HE Chirombo

DEPARTMENT:

School of Therapeutic Sciences
Department of Physiotherapy
Medical School
University

PROJECT TITLE:

*Investigating the physiotherapy management of patients
with polytrauma in acute care settings: a Namibian
survey*

DATE CONSIDERED:

2021/10/29

DECISION:

Approved unconditionally

CONDITIONS:

NOTE:

If contact information regarding student study participants is required,
please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>

SUPERVISOR:

Professor H van Aswegen

APPROVED BY:


Dr CB Penny, Chairperson, HREC (Medical)

DATE OF APPROVAL:

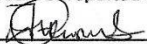
2022/03/18

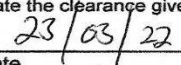
This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

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 submit details to the Committee. **I agree to submit a yearly progress report.** When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **October** and therefore reports and re-certification will be due in the month of **October** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).


Signature of Principal Investigator


Date

APPENDIX D

BIOMEDICAL RESEARCH ETHICS COMMITTEE OF THE MINISTRY OF HEALTH AND SOCIAL SERVICES OF NAMIBIA



REPUBLIC OF NAMIBIA

MINISTRY OF HEALTH AND SOCIAL SERVICES

Ministerial Building
Harvey Street
Private Bag 13198, Windhoek

OFFICE OF THE EXECUTIVE DIRECTOR

Tel: No: 061 -203 2507
Fax No: 061-222 558
Andreas.Shipanga@mhss.gov.na

Ref: 22/4/2/3
Enquiries: Mr. A. Shipanga

Date: 14 July 2022

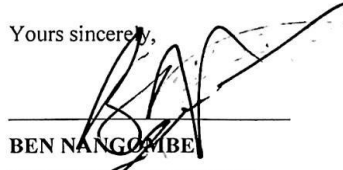
Ms. Hannah Chirombo
University of Witwatersrand
Johannesburg
South Africa

Dear Ms. Chirombo

Re: Investigating the physiotherapy management of patients with polytrauma in acute care settings: a Namibian survey.

1. Reference is made to your application to conduct the above-mentioned study.
2. The proposal has been evaluated and found to have merit.
3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**
 - 3.1 The data to be collected must only be used for academic purpose;
 - 3.2 No other data should be collected other than the data stated in the proposal;
 - 3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
 - 3.4 A quarterly report to be submitted to the Ministry's Research Unit;
 - 3.5 Preliminary findings to be submitted upon completion of the study;
 - 3.6 Final report to be submitted upon completion of the study;
 - 3.7 Separate permission should be sought from the Ministry for the publication of the findings.
4. All the cost implications that will result from this study will be the responsibility of the applicant and **not** of the MoHSS.

Yours sincerely,


BEN NANGOMBE
EXECUTIVE DIRECTOR

All official correspondence must be addressed to the Executive Director.



APPENDIX E

□ CHECKLIST FOR REPORTING OF SURVEY STUDIES (CROSS)

Section/Topic	Item	Item Description	Reported on page #
Title and abstract			
Title and abstract	1a	State the word “survey” along with a commonly used term in title or abstract to introduce the study’s design.	Cover Page
	1b	Provide an informative summary in the abstract, covering background, objectives, methods, findings/results, interpretation/discussion, and conclusions.	Abstract
Introduction			
Background	2	Provide a background about the rationale of study, what has been previously done, and why this survey is needed.	1
Purpose/aim	3	Identify specific purposes, aims, goals, or objectives of the study.	3
Methods			
Study design	4	Specify the study design in the methods section with a commonly used term (e.g., cross-sectional or longitudinal).	36
	5a	Describe the questionnaire (e.g., number of sections, number of questions, number and names of instruments used).	37
	5b	Describe all questionnaire instruments that were used in the survey to measure particular concepts. Report target population, reported validity and reliability information, scoring/classification procedure, and reference links (if any).	37
	5c	Provide information on pretesting of the questionnaire, if performed (in the article or in an online supplement). Report the method of pretesting, number of times questionnaire was pre-tested, number and demographics of participants used for pretesting, and the level of similarity of demographics between pre-testing participants and sample population.	37
Data collection methods	5d	Questionnaire, if possible, should be fully provided (in the article, or as appendices or as an online supplement).	Appendix A
	6a	Describe the study population (i.e., background, locations, eligibility criteria for participant inclusion in survey, exclusion criteria).	
Sample characteristics	6b	Describe the sampling techniques used (e.g., single stage or multistage sampling, simple random sampling, stratified sampling, cluster sampling, convenience sampling). Specify the locations of sample participants whenever clustered sampling was applied.	36
	6c	Provide information on sample size, along with details of sample size calculation.	36
	6d	Describe how representative the sample is of the study population (or target population if possible), particularly for population-based surveys.	36
	7a	Provide information on modes of questionnaire administration, including the type and number of contacts, the location where the survey was conducted (e.g., outpatient room or by use of online tools, such as SurveyMonkey).	38
Survey administration	7b	Provide information of survey’s time frame, such as periods of recruitment, exposure, and follow-up days.	38
		Provide information on the entry process:	38

	7c	→For non-web-based surveys, provide approaches to minimize human error in data entry. →For web-based surveys, provide approaches to prevent “multiple participation” of participants.	
Study preparation	8	Describe any preparation process before conducting the survey (e.g., interviewers’ training process, advertising the survey).	38

Section/Topic	Item	Item Description	Reported on page #
Ethical considerations	9a	Provide information on ethical approval for the survey if obtained, including informed consent, institutional review board [IRB] approval, Helsinki declaration, and good clinical practice [GCP] declaration (as appropriate).	39
	9b	Provide information about survey anonymity and confidentiality and describe what mechanisms were used to protect unauthorized access.	39
	10a	Describe statistical methods and analytical approach. Report the statistical software that was used for data analysis.	39
Statistical analysis	10b	Report any modification of variables used in the analysis, along with reference (if available).	40
	10c	Report details about how missing data was handled. Include rate of missing items, missing data mechanism (i.e., missing completely at random [MCAR], missing at random [MAR] or missing not at random [MNAR]) and methods used to deal with missing data (e.g., multiple imputation).	40
	10d	State how non-response error was addressed.	40
	10e	For longitudinal surveys, state how loss to follow-up was addressed.	N/A
	10f	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for non-representativeness of the sample.	N/A
	10g	Describe any sensitivity analysis conducted.	N/A
Results			
Respondent characteristics	11a	Report numbers of individuals at each stage of the study. Consider using a flow diagram, if possible.	40
	11b	Provide reasons for non-participation at each stage, if possible.	40
	11c	Report response rate, present the definition of response rate or the formula used to calculate response rate.	-
	11d	Provide information to define how unique visitors are determined. Report number of unique visitors along with relevant proportions (e.g., view proportion, participation proportion, completion proportion).	40
Descriptive results	12	Provide characteristics of study participants, as well as information on potential confounders and assessed outcomes.	41
	13a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates N/A along with 95% confidence intervals and p-values.	N/A
Main findings	13b	For multivariable analysis, provide information on the model building process, N/A model fit statistics, and model assumptions (as appropriate).	N/A
	13c	Provide details about any sensitivity analysis performed. If there are considerable amount of missing data, report sensitivity analyses comparing the results of complete cases with that of the imputed dataset (if possible).	N/A
Discussion			
Limitations	14	Discuss the limitations of the study, considering sources of potential biases and imprecisions, such as non-representativeness of sample, study design, important uncontrolled confounders.	65
Interpretations	15	Give a cautious overall interpretation of results, based on potential biases and imprecisions and suggest areas for future research.	67
Generalizability	16	Discuss the external validity of the results.	68
Other sections			
Role of funding source	17	State whether any funding organization has had any roles in the survey's design, implementation, and analysis.	-

Conflict of interest	18	Declare any potential conflict of interest.	i
Acknowledgements	19	Provide names of organizations/persons that are acknowledged along with their contribution to the research.	Acknowledgements
