Improving Evidence-Based Implementation of Guidelines in Rehabilitation

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List of Abbreviations

ABI:	Acquired Brain Injury
ABIKUS:	Acquired Brain Injury Knowledge Uptake Strategy
ADL:	Activities of Daily Living
AGREE-II:	The Appraisal of Guidelines for Research and Evaluation- II
BCW:	Behaviour Change Wheel
CI:	Confidence Interval
CIHR:	Canadian Institute of Health Research
CIMT:	Constraint-Induced Movement Therapy
COM-B:	Capability, Opportunity, Motivation- Behaviour Model
CPD:	Continuing Professional Development
CPG:	Clinical Practice Guideline
EBP:	Evidence Based Practice
FES:	Functional Electrical Stimulation
FIM:	Functional Independence Measure
GRADE:	Grading of Recommendations Assessment, Development and Evaluation
GRASP:	Graded Repetitive Arm Supplementary Program
KTA Framework:	Knowledge-To-Action Framework
NHMRC:	National Health and Medical Research Council (Australia)
OT:	Occupational Therapy
PRECEDE-PROCEEDE Model:	Predisposing, Reinforcing, and Enabling Constructs in Educational/Environmental Diagnosis and Evaluation - Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development Model.

PRISMA:	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PT:	Physiotherapist
PTA:	Post Traumatic Amnesia
RCT:	Randomised Control Trial
RE-AIM Framework:	Reach, Effectiveness, Adoption, Implementation and Maintenance Framework
SD:	Standard Deviation
STarI:	Standards for Reporting Implementation Studies
TBI:	Traumatic Brain Injury
TDF:	Theoretical Domains Framework
TIDieR:	Template for Intervention Description and Replication
UL:	Upper Limb
WIDER:	Workgroup for Intervention Development and Evaluation Research

Thesis Abstract

Introduction: Despite considerable evidence demonstrating the effectiveness of guideline recommended interventions for neurorehabilitation, implementation of these guidelines in practice remains suboptimal.

Aims: Broadly, this thesis aimed to establish the quality of guideline recommendations for neurorehabilitation, and to explore potential barriers and solutions to their implementation.

Methods: Five interrelated studies were conducted using a variety of research methods. A systematic review was completed which explored the quality of neurorehabilitation practice guidelines (Study One). Following this, an Australian-wide survey to researchers (trialists) was conducted to understand how implementation is planned for as part of trial protocols (Study Two). I then qualitatively explored barriers and motivators to implementing guideline recommendations from the perspectives of clinicians (Study Three). A before-and-after study was then completed to investigate the effectiveness of sustained audit and feedback to increase adherence to guidelines (Study Four). Finally, a non-randomised cluster controlled study was conducted, in which two implementation packages were designed, and their benefit and feasibility explored (Study Five).

Results: In Study One, I identified 20 guidelines in neurorehabilitation and found that they varied widely in quality. Generally, low quality scores were seen across guidelines for their applicability in practice. Study Two revealed that trialists were unsure of when and how to design for implementation in trials, with most relying on passive implementation interventions (such as scientific publication) to implement findings in practice. The third study found clinician barriers related to skill and to resource availability limited the implementation of guideline recommendations in practice. Study Four found audit and feedback to be an effective implementation intervention when positive behavioural support and collaborative partnerships existed between clinicians and researchers. Study Five found a resource-intensive implementation package was beneficial to the implementation of guideline recommendations, feasible to administer, and acceptable to clinicians.

Discussion: Implementing neurorehabilitation guideline recommendations in practice is complex and many barriers exist. Despite this, several recommendations arise from the findings of this thesis which include the importance of: (i) increased behaviour monitoring and clinician accountability to practice; (ii) cohesive collaboration between stakeholders, and; (iii) active, tailored, resource-intensive support to promote implementation.

Statement of Authorship

This thesis includes work by the author that has been published or accepted for publication as described in the text. Except where reference is made in the text of the thesis, this thesis contains no other material published elsewhere or extracted in whole or in part from a thesis accepted for the award of any other degree or diploma. No other person's work has been used without due acknowledgment in the main text of the thesis. This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

All research procedures reported in this thesis were approved by relevant Ethics Committees prior to the commencement of each study. Copies of ethics approvals are provided in Appendix C.

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Laura Jolliffe is the sole author of Chapter One (General Introduction), Chapter Two (Literature Review), and Chapter Eight (Discussion). The remaining chapters (listed below) are multi-authored publications on which Laura Jolliffe was the lead author, with all other contributions acknowledged below. The design, conception, and management of all studies; data collection and analysis; initial drafting and subsequent revisions of publications; as well as response to peer-reviewers was primarily driven by the PhD candidate. Co-authors generally provided advice and/or assistance with study planning and design, interpretation of the data, and critical revision of publication manuscripts.

Jointly authored work

Thesis Chapter	Publication title	Status	Nature and percentage (%) of student contribution	Co-author name(s) and nature of contribution
Three	Systematic review of clinical practice guidelines to identify recommendations for rehabilitation after stroke and other acquired brain injuries	Published: British Medical Journal Open	65%. Conception & design of the research; Data acquisition; Data analysis; Writing manuscript & critical appraisal of content; Management of submission & response to reviewers	1) Natasha Lannin: Conception & design; Data acquisition; Critical appraisal of content; Editing. 2) Tammy Hoffmann: Design; Independent rater for data discrepancies; Critical appraisal of content; Editing. 3) Dominique Cadilhac: Critical appraisal of content; Editing.
Four	Implementing stroke rehabilitation research in Australia: A survey of clinical trialists.	Submitted: under review	60%. Conception & design of the research; Data acquisition; Data analysis; Writing manuscript & critical appraisal of content; Management of submission & response to reviewers	1) Natasha Lannin: Conception & design; Data acquisition; Critical appraisal of content; Editing. 2) Tammy Hoffmann: Design; Data acquisition; Manuscript review. 3) Kate Laver: Conception & design; Manuscript review 4) Annie McCluskey: Manuscript review
Five	Increasing the uptake of stroke upper limb	Published: Australian Occupational	70%. Design of the research; Data acquisition; Data	1) Natasha Lannin: Conception & design; Data acquisition; Critical

Thesis Chapter	Publication title	Status	Nature and percentage (%) of student contribution	Co-author name(s) and nature of contribution
	guideline recommendations with occupational therapists and physiotherapists. A qualitative study using the Theoretical Domains Framework	Therapy Journal	analysis; Writing manuscript & critical appraisal of content; Management of submission & response to reviewers.	appraisal of content; Editing. 2) Tammy Hoffmann: Design; Critical appraisal of content; Editing.
Six	Using audit and feedback to increase clinician adherence to clinical practice guidelines in brain injury rehabilitation: A before and after study	Published: PLOS One	55%. Design of the research; Data acquisition; Data analysis; Writing manuscript & critical appraisal of content; Management of submission & response to reviewers.	1) Natasha Lannin Conception & design; Data analysis; Critical appraisal of content; Editing. 2) Tammy Hoffmann: Data analysis; Critical appraisal of content; Editing. 3) Jacqui Morarty Conception & design; Manuscript review. 4) Maria Crotty: Conception & design; Critical appraisal of content; Manuscript review. 5) Peter Hunter: Conception & design; Manuscript review.

Thesis Chapter	Publication title	Status	Nature and percentage (%) of student contribution	Co-author name(s) and nature of contribution
				6) Ian Cameron: Conception & design; Manuscript review. 7) Xia Li: Data analysis; Editing; Critical appraisal of content
Seven	What is the feasibility and observed effect of two implementation packages for stroke rehabilitation clinicians implementing upper limb guidelines?: A cluster controlled feasibility study.	Submitted: Accepted (BMJ Open Quality), forthcoming publication	70%. Conception & design of research; Acquisition of data; Data analysis; Writing of manuscript & critical appraisal of content; Management of submission & response to reviewers	1) Tammy Hoffmann: Data analysis & interpretation; Critical appraisal of content; Editing. 2) Leonid Churilov: Data analysis; Critical appraisal of content; Editing. 3) Natasha Lannin: Conception & design; Data analysis; Critical appraisal of content; Editing.

Research outputs arising from this thesis

Peer-reviewed publications

1. Jolliffe, L., Lannin, N. A., Cadilhac, D. A., & Hoffmann, T. (2018). Systematic review of clinical practice guidelines to identify recommendations for rehabilitation after stroke and other acquired brain injuries. *British Medical Journal Open, 8*(2). doi:10.1136/bmjopen-2017-018791
2. Jolliffe, L., Hoffmann, T., & Lannin, N. A. (2019). Increasing the uptake of stroke upper limb guideline recommendations with occupational therapists and

physiotherapists. A qualitative study using the Theoretical Domains Framework. *Australian Occupational Therapy Journal*. doi:10.1111/1440-1630.12599

3. Jolliffe, L., Morarty, J., Hoffmann, T., Crotty, M., Hunter, P., Cameron, I. D., Li, X & Lannin, N. A. (2019). Using audit and feedback to increase clinician adherence to clinical practice guidelines in brain injury rehabilitation: A before and after study. *PLoS ONE,* 14(3), e0213525. doi:10.1371/journal.pone.0213525

Peer reviewed conference abstracts: oral presentations

- Jolliffe, L., Hoffmann, T., Churilov, L. & Lannin, N. (2019). Feasibility and benefit of an upper limb implementation package in stroke rehabilitation. *Rehabilitation Medicine Society of Australia and New Zealand (RMSANZ) Annual Scientific Meeting,* Adelaide, Australia, October 22, 2019
- Jolliffe, L., Hoffmann, T. & Lannin, N. (2019). What factors improve compliance with stroke upper limb guideline recommendations? A qualitative study using the theoretical domains framework. *National Occupational Therapy Australia Conference*, Sydney, Australia, July 10-12, 2019
- Jolliffe, L., Hoffmann, T., Churilov, L. & Lannin, N. (2019). Feasibility of an upper limb implementation package for neurological rehabilitation: a pilot clustered longitudinal cohort study. *National Occupational Therapy Australia Conference*, Sydney, Australia, July 10-12, 2019
- Jolliffe, L., Lannin, N. & Hoffmann, T. (2018). Key performance indicator improvement in rehabilitation with frequent audit and feedback mechanisms. *Global Evidence and Implementation Summit*, Melbourne, Australia, 22-24 October, 2018.
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- Jolliffe, L., Lannin, N., Hoffmann, T., Morarty, J., O'Shannessy, E., Hunter, P., Crotty, M. & Cameron, I. (2017). Using audit and feedback to change practice: embedding clinical practice guidelines in acquired brain injury rehabilitation. *National Occupational Therapy Australia Conference*, July 19-21, Perth, Australia.
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- Jolliffe, L., Lannin, N., Hoffmann, T., Morarty, J., O'Shannessy, E., Hunter, P., Crotty, M & Cameron, I. (2017). An audit and feedback program embedded into an ABI Rehabilitation service increased adherence to clinical practice guidelines. *Australasian Society for the Study of Brain Impairment*, 1-3 June, Melbourne, Australia.
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- Jolliffe, L., Lannin, N., Cadilhac, D., & Hoffmann, T. (2018). Systematic review of clinical practice guidelines in the rehabilitation management of stroke: is it time for an international guideline? *11th World Stroke Congress*, Montreal, Canada, October 17-20, 2018.
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- Jolliffe, L., Nicks, R., Lannin, N., Hoffmann, T., Morarty, J., O'Shannessy, E., Hunter, P., Crotty, M. & Cameron, I. (2017). Using audit and feedback to change practice: embedding clinical practice guidelines in acquired brain injury rehabilitation. *Victorian Allied Health Research Conference*, March 31, Melbourne, Australia.

Copyright declaration

Signature: _____

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Date: 26th January 2020

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Chapter 1: General Introduction

1.1 BACKGROUND

Acquired brain injury from stroke and traumatic causes is a major public health issue. Acquired brain injury is the leading cause of disability (Australian Institute of Health and Welfare [AIHW], 2007; Chen et al., 2012), and a major reason for adults requiring nursing home care (Cowman et al., 2010). In 2008, there were 1,000 new cases of severe traumatic brain injury (TBI) Australia wide; 248 of which were sustained in Victoria (Access Economics, 2009). Stroke continues to be the second leading cause of death worldwide, with the incidence increasing each year due to an aging population (Katan & Luft, 2018). In 2017, there were more than 56,000 new and recurrent strokes in Australia (14,239 of those in Victoria) (Deloitte Access Economics, 2017) with approximately 30% of stroke survivors under the age of 65 years (Deloitte Access Economics, 2013). For people living with a brain injury, secondary comorbidities and / or residual disability also have considerable health and economic impacts. Care and rehabilitation after severe brain injury may last for years and involve multiple health professionals and services (Royal College of Physicians and British Society of Rehabilitation Medicine, 2003). The estimated cost for healthcare, long term care and equipment / modifications for people with severe TBI in 2008 was (AUD) $1,429 million dollars, with the lifetime cost per incident case of severe TBI estimated at $4.8 million dollars across Australia (Access Economics, 2009). Approximately 65% of stroke survivors have a disability impacting upon their independence in daily tasks, with the financial burden of stroke in Australia estimated to be $5 billion annually (Deloitte Access Economics, 2013). Therefore, finding ways to improve healthcare to ensure survivors received evidence-based interventions could decrease long-term care costs.

There is substantial evidence demonstrating the effectiveness of neurorehabilitation treatments, along with a body of high-quality research evidence for the cost-effectiveness of rehabilitation (Jackson, McCrone, Mosweu, Siegert, & Turner-Stokes, 2014; Mahler et al., 2008; Murata et al., 2017; O'Connor, Beden, Pilling, & Chamberlain, 2011; Turner-Stokes, 2008). Intensive rehabilitation programs delivered in clinical trials result in improved outcomes at the inpatient level, especially for moderate to severe brain injury survivors (Aronow, 1987; Murata et al., 2017; Slade, Tennant, &

Chamberlain, 2002; Wood, McCrea, Wood, & Merriman, 1999). Synthesis of findings from high quality trials has shown that multidisciplinary rehabilitation delivered by neurological services improves outcomes in adults of working age, and that a greater intensity is likely to lead to faster and possibly greater levels of recovery (Turner-Stokes, Pick, Nair, Disler, & Wade, 2015). Despite support for the efficacy and cost-effectiveness of rehabilitation, research to date shows persistent gaps between evidence and practice (Green et al., 2012).

At the commencement of this thesis, national audit data highlighted substandard levels of adherence to clinical guideline recommendations (Stroke Foundation, 2016) by many Australian rehabilitation providers. While guideline recommendations exist to promote evidence-based practice, health benefits can only reach inpatients if recommended interventions are provided (implemented) within a service. Implementation research, the study of *how* to best implement research into clinical care, is in its infancy in rehabilitation. Further development is needed to improve outcomes for people living with brain injury. Although research from other healthcare fields can be used to guide implementation practices, it is uncertain how applicable that research is in the rehabilitation setting due to differences in practice focus, workplace culture, and contexts (Jones, Roop, Pohar, Albrecht, & Scott, 2015).

A systematic review of effective implementation interventions used in rehabilitation concluded that active, multicomponent interventions can enhance the knowledge and practice behaviours of rehabilitation clinicians (Menon, Korner-Bitensky, Kastner, McKibbon, & Straus, 2009). This recommendation, however, is based only on one randomised controlled trial (RCT) (Stevenson, Lewis, & Hay, 2006), one before-after study (McQueen, Nivison, Husband, & Miller, 2006) and one case series (Verhoef et al., 2004). Of importance to the suite of studies proposed in this thesis, none of those studies were conducted in neurorehabilitation. The included studies were conducted in the practice areas of: back pain (Stevenson et al., 2006), chronic obstructive pulmonary disease (McQueen et al., 2006), and rheumatology (Verhoef et al., 2004). Whilst an updated systematic review of implementation interventions in rehabilitation identified five studies conducted in stroke, no recommendations about interventions could be made (a downgrade from the earlier review) due to the low methodological quality and limited findings of the included studies (Jones et al., 2015). Therefore, a need exists to examine the causes of, and potential solutions for, this research-practice gap best defined as an underuse of research to inform clinical practice in neurorehabilitation.

Barns (2003) described five broad categories of people who may receive neurorehabilitation, which included: (i) those likely to make a full recovery over a short period of time (e.g. people with a mild brain injury such as concussion or a transient ischaemic attack (TIA)), (ii) those who may improve steadily over time however perhaps not to their pre-morbid level of function (e.g. people with a moderate stroke or traumatic brain injury), (iii) those who may make some progress however not improve significantly and will likely have longer term disability (e.g. people with a severe stroke or traumatic brain injury), (iv) those who deteriorate slowly over time (e.g. people diagnosed with a progressive neurological disease such as Parkinson's Disease or multiple sclerosis) and (v) those who will progress steadily and rapidly (e.g. people with motor neurone disease or malignant glioma). There is substantial evidence for the benefit of neurorehabilitation in the recovery trajectory for people in category (ii) and (iii) (moderate and severe brain injury) (Turner-Stokes et al., 2015). Therefore, implementing evidence-based interventions targeted at people in these categories will be the central focus of this thesis.

Henceforth, any future reference to *neurorehabilitation* refers to rehabilitation of those who have acquired moderate or severe brain injury as a result of stroke, trauma, hypoxia or infection to the exclusion of progressive neurological conditions (Chen et al., 2012). Outcomes of the research within this thesis will relate to and deliver robust, locally relevant data to healthcare providers and policy makers, to support innovative strategies for implementation in rehabilitation.

1.2 OBJECTIVE

The core objectives of this thesis were to explore factors contributing to research-practice gaps that currently exist in neurorehabilitation and, to identify and test novel implementation approaches to enhance clinician adherence to clinical practice guideline recommendations. By doing so, results from this research highlight barriers and motivators to implementing recommended care, provide clear strategies for embedding recommended care into a rehabilitation program, and, demonstrate international leadership in implementation effectiveness in neurorehabilitation.

To fulfil this core objective, three important topics needed to be explored: (a) the current state of research evidence, and what it suggests are the optimal interventions in neurorehabilitation; (b) how implementation is planned for and the barriers / motivators to uptake in practice; and (c) the effectiveness of implementation interventions designed to

facilitate the use of recommended interventions in clinical practice. Consequently, this thesis is divided thematically, with each section comprising several individual research questions as outlined below.

1.3 RESEARCH QUESTIONS

Theme one: Evidence-based recommendations for neurorehabilitation

1. What are the evidence-based recommendations reported in national and international clinical practice guidelines?
2. What recommendations for upper limb retraining are reported in national and international clinical practice guidelines?

Theme two: Implementation planning and guideline recommendation uptake in practice

3. How do researchers (clinical trialists) know about the uptake of their researched interventions and plan for implementation when designing a trial protocol?
4. What are the barriers to and motivators of using guideline recommendations in practice from the clinician perspective (i.e. physiotherapists and occupational therapists)?

Theme three: Effectiveness of implementation interventions

5. Are audit and feedback cycles, used as an implementation intervention, effective at creating behaviour change for clinicians working in neurorehabilitation?
6. What is the most effective implementation strategy in neurorehabilitation for (a) creating behaviour change in clinicians and (b) improving inpatient outcomes?

1.4 OUTLINE OF THE THESIS

Research questions one-six are presented as five independent but interrelated studies, with each study representing one chapter in this thesis. Three chapters (Chapter Three, Chapter Five, and Chapter Six) present work which has been published in peer-review journals, and two other chapters (Chapter Four and Chapter Seven) represent manuscripts which are currently under review. For ease of reading, the published chapters and associated references have been reformatted to achieve consistency across the thesis, with the numbering of figures and tables kept continuous throughout.

Study Three (Chapter Five) and Study Five (Chapter Seven) focus on upper limb rehabilitation specifically, because this area of neurorehabilitation (a) is shared by two allied health professions (occupational therapy and physiotherapy); (b) has strong evidence and clear guideline recommendations (Stroke Foundation, 2017); and (c) is known to have low levels of adherence based on national audit data (Stroke Foundation, 2016, 2018). Whilst Studies Three and Five are narrower in scope, lessons learnt will apply more broadly across rehabilitation, given the similarities in context and culture.

Outline of chapters

Chapter Two introduces the role of research evidence in neurorehabilitation (Chapter 2.1) and highlights the discrepancy between evidenced recommendations and current rehabilitation practices (Chapter 2.2). The concept of implementation science is introduced (Chapter 2.3) and key implementation models and frameworks used in healthcare are discussed (Chapter 2.4). The influence of context in implementation is established (Chapter 2.5) and the effectiveness of researched implementation interventions are described (Chapter 2.6). Chapter Two concludes by clarifying why an exploration of the interaction between current practice and effective implementation interventions is required, and the role implementation science plays in this dynamic (Chapter 2.8).

Chapter Three presents a systematic review of clinical practice guidelines that exist to guide clinicians in neurorehabilitation. The review includes a quality rating of each guideline along with a synthesis of recommendations from the top five rated guidelines (Questions one and two). The way in which health researchers (clinical trialists) plan for dissemination and implementation of their study findings in clinical practice is explored in **Chapter Four** using a descriptive cohort design and electronic survey method (Question three). Finally, the perceptions of clinicians working in rehabilitation are qualitatively explored in **Chapter Five**, with barriers and motivators for using clinical practice guideline recommendations captured and mapped against the Theoretical Domains Framework (Question four).

The effectiveness of implementation interventions are explored in **Chapters Six** and **Seven** (Questions five and six). Firstly, **Chapter Six** investigated if a sustained program (> 12 months) of fortnightly audit and feedback influenced clinician behaviour change towards guideline adherence, and if change was sustained when audit and feedback ceased. In **Chapter Seven,** a clustered, controlled feasibility study evaluated

two different implementation packages to establish if they increased clinicians' use of evidence-based interventions in upper limb rehabilitation practice, and if so, what effect this behaviour change (i.e. the provision of evidence-based interventions) had on upper limb outcomes.

While a discussion of individual study findings can be found within each chapter, **Chapter 8** draws these findings together to form conclusions about the research-practice gap in neurorehabilitation and discusses the results of the thesis in a broader context. Recommendations for future research directions are also provided.

1.5 PERSON-CENTRED TERMINOLOGY

Person-centred terminology will be used throughout this thesis to ensure respectful communication, in particular to those living with brain injury (Harvey, 2019). The term *inpatient* will be used instead of *patient, consumer*, or *client* to describe people living with brain injury undergoing inpatient hospital treatment (either in an acute or rehabilitation setting). The term *outpatient* will be used to describe people living with brain injury undergoing outpatient hospital treatment (within the community setting). In Study Five however, recruited inpatients and outpatients will collectively be referred to as *patient participants.* This term is most appropriate for clarity and ease of reading given the two types of recruitment this study had (in which both patient and clinician participants were recruited). Additionally, the supplementary document in Appendix D (Appendix Table 2) (guideline recommendations synthesis) uses the term *patient* given that this is the term used in published guideline documents. No changes have been made to direct quotes of study participants in which the term *patient* has been explicitly used.

Chapter 2: Literature Review

2.1 EFFICACY AND EFFECTIVENESS OF NEUROREHABILITATION

At its core, the subspecialty area of neurorehabilitation refers to a process of education and retraining of skills likely impaired or compromised as a result of damage to the brain (McDowell, 1994). The ultimate aim of rehabilitation is to assist an individual to manage social relationships, daily tasks (including both basic and instrumental), work and leisure activities as independently as possible (Department of Veterans' Affairs, 2016). A specialised team of multidisciplinary clinicians are involved in this process and are responsible for working collaboratively with each other and the inpatient (and/or their family) to set goals, assess disability, develop treatment plans, facilitate interventions, monitor progress and assist with discharge planning (Stroke Foundation, 2017).

Taken together, brain injury from stroke and traumatic causes is a major public health issue and one of the leading causes of disability in Australia (AIHW, 2007). Brain injury from a traumatic cause arises from an external force to the brain or object piercing the skull and damaging brain tissue (Menon, Schwab, Wright, & Maas, 2010). A stroke occurs when blood supply to the brain is compromised, either due to a blood clot (known as ischaemic stroke) or rupture (referred to as haemorrhagic stroke), all causing brain tissue death (AIHW, 2018). Most recent estimates from data collected between 2004-05 suggest that in Australia, 26,000 episodes of inpatient care totalling nearly 206,000 days resulted from TBI (Helps, Henley, & Harrison, 2008). In 2015 it was estimated that 394,000 Australians had a stroke with 37,300 of those requiring acute care hospitalisation (approximately 100 new strokes per day). For those living with brain injury, the associated disability and long-term consequences (such as dependence on care and cost to the individual and government) are significant and lasting. Survivors of moderate or severe TBI and stroke commonly have limitations in activities of daily living, social integration and financial independence (Ma, Chan, & Carruthers, 2014; Mayo, Wood-Dauphinee, Côté, Durcan, & Carlton, 2002; Varjabic, Bakran, Tusek, & Bujisic, 2010). The proportion of people with residual disability from stroke alone is approximately 65% (Deloitte Access Economics, 2013). Given this high burden of disability and in the absence of a cure, much of post-brain injury care relies on rehabilitation interventions (Langhorne & Legg, 2003). Aligned with guideline recommendations, neurorehabilitation

clinicians often provide consistent clinical interventions to inpatients irrespective of mechanism of injury. Whilst certain interventions are specific to cause of brain injury (for example, coma emergence and post traumatic amnesia (PTA) are specific to people with TBI)), other interventions, such as strength training, are recommended interventions irrespective of mechanism of injury (Intercollegiate Stroke Working Party [ISWP], 2016; Lee et al., 2019).

Intensive rehabilitation programs underpinned by research evidence have been shown to result in improved health outcomes and be cost effective (Jackson et al., 2014; Slade et al., 2002). Achieving a program underpinned by evidence is, however, challenging and a number of studies have explored the *barriers* to successful implementation of research findings into hospital services. Additionally, there is now high quality evidence to support the use of many neurorehabilitation interventions such as: constraint-induced movement therapy (CIMT) (Corbetta, Sirtori, Castellini, Moja, & Gatti, 2015) and strength training (Harris & Eng, 2010) to improve arm and hand function; task-specific motor retraining (Veerbeek et al., 2014) and walking training (van Duijnhoven et al., 2016) to improve mobility; and speech and language therapy to improve functional communication (Brady, Kelly, Godwin, Enderby, & Campbell, 2016). Whilst evidence continues to grow and new trials advance knowledge, progress could be made in rehabilitation practices by simply applying what we already know (Langhorne & Legg, 2003). In the past four years, published RCTs in rehabilitation have increased by approximately 2200 per year (Morris et al., 2019). Of the nine diseases or disorders with the highest healthcare burden, neurology (including neurorehabilitation) has the highest number of published RCTs (Hoffmann, Erueti, Thorning, & Glasziou, 2012). This abundance of published research can be difficult for clinicians to navigate (Veerbeek et al., 2014). One solution to managing the ever-increasing volume of research evidence is the synthesis of research in clinical practice guidelines for more ready-uptake in clinical practice (Kredo et al., 2016; Woolf, Grol, Hutchinson, Eccles, & Grimshaw, 1999). In Australia, a not-for-profit advocacy organisation, the *Stroke Foundation,* has led the development of clinical practice guidelines for stroke care since 2002 (Stroke Foundation, 2017). Endorsed by the Australian Government Department of Health and auspiced by the National Health and Medical Research Council (NHMRC), the Stroke Foundation updates the clinical practice guidelines regularly (at least every five years). Australian clinicians are expected to integrate their clinical experience with *conscientious, explicit and judicious use of research evidence* to make clinical decisions about rehabilitation that

they provide (Tse, Lloyd, Penman, King, & Bassett, 2004). Research shows that clinical practice guidelines, when applied, can lead to substantial improvement in inpatient care and economic outcomes (Grimshaw & Russell, 1993; McCullough et al., 2011). Unfortunately, the availability of guidelines alone does not lead to evidence-based practice- they must be implemented (Graham et al., 2006). Recent national audits indicate that clinicians in Australia do not routinely adhere to clinical practice guideline recommendations (Stroke Foundation, 2016, 2018).

2.2 RESEARCH-PRACTICE GAPS

Neurorehabilitation has previously been described in the literature as *evidence tinged* (Walker, 2007). In fact, research estimates that 30 to 40% of inpatients to not receive treatments with proven effectiveness (Graham et al., 2006), and 20 to 25% receive unnecessary or potentially harmful treatment (McGlynn et al., 2003). Despite the high-quality research in neurorehabilitation and the availability of clinical practice guidelines (New Zealand Guideline Group [NZGG], 2006; Scottish Intercollegiate Guidelines Network [SIGN], 2010b; Hebert, Lindsay, et al., 2016; Stroke Foundation, 2017), substantial gaps between knowledge production (proof of benefit for clinical intervention) and knowledge uptake exist (routine use of proven interventions in clinical practice) (Graham et al., 2006). This gap between guideline recommendations and what is provided clinically is commonly referred to as the *research-practice gap* (Walker, Fisher, Korner-Bitensky, McCluskey, & Carey, 2013).

Research-practice gaps are not unique to rehabilitation, but are evident globally across an array of industries including early childhood (Pui-Wah, 2006), education (Honig, Venkateswaran, & McNeil, 2017), the judicial system (Allard, Rayment-McHugh, Adams, Smallbone, & McKillop, 2016; Parsons, Weiss, & Wei, 2017; Rodriguez, 2016) and many areas of healthcare (Evensen, Sanson-Fisher, D'Este, & Fitzgerald, 2010; Riis et al., 2013; Tricco et al., 2018). In healthcare, it has been estimated that implementing research into practice takes around 17 years (Morris, Wooding, & Grant, 2011). This 17-year time-lag has substantial effects on health outcomes with the burden of collective harm described as ‘staggering’ by a US report titled *‘Bridging the quality chasm’* (Medicine., 2001). As highlighted by Glasziou and Haynes (2005), research that should change practice is often ignored for years with examples outside of rehabilitation including bed rest after lumbar puncture (compared to no bed rest) (Allen,

Glasziou, & Mar, 1999), and the appropriate prescription of anticoagulants and aspirin for people with atrial fibrillation (compared to no anticoagulants) (Brass, Krumholz, Scinto, Mathur, & Radford, 1998). In the area of cancer, Graham and colleagues (2006) highlight that outcomes could be improved by 30% if already known research was applied, and longitudinal studies have shown improved morbidity and mortality rates when clinical practice guidelines are adhered to (Komajda et al., 2005; McCullough et al., 2011). In summary, the research-practice gap is not unique to neurorehabilitation and addressing the gap could lead to not only improvements in outcomes but also cost savings.

Non-compliance with guidelines has been independently associated with poor outcomes in acute brain injury treatment (Abilleira, Ribera, Permanyer-Miralda, Tresserras, & Gallofre, 2012). Additionally, studies using data from acute stroke registries have found associations between quality of care (key performance indicators) and lower risk of death or disability post-stroke (Urimubenshi, Langhorne, Cadilhac, Kagwiza, & Wu, 2017). It would therefore be fair to suggest that implementation of research into rehabilitation practice would improve outcomes in adults after brain injury. Whilst the Australia New Zealand Trauma Registry (ATR) (National Trauma Research Institute, 2019) collects data on the prevalence, severity and outcomes of TBI, there are not yet studies of adherence to evidence-based clinical practice guidelines in TBI rehabilitation. Nonetheless, at the time this series of studies was commenced, results of a national (Australian) audit of stroke rehabilitation practices showed for the majority of stroke inpatients, evidence-based care was not provided in clinical practice (Stroke Foundation, 2016). Most alarmingly, the 2016 audit reported a low 56% adherence to guideline recommendations across the 121 rehabilitation services involved for the 3,514 audited inpatients (Stroke Foundation, 2016). Since that time, adherence has increased (Stroke Foundation, 2018) but substantial gaps persist, with only 51% of services delivering the recommended dose of therapy, 50% of inpatients with incontinence issues having no management plan, and 33% of services not assessing inpatients for depression and anxiety. To bridge these research-practice gaps, attention has moved to identifying implementation interventions or processes that may speed-up research use in practice.

The field of implementation science is dedicated to the study of *research use in practice*, with an increasing number of studies and systematic reviews emerging (Grol & Grimshaw, 2003; Ivers et al., 2012; Johnson & May, 2015). Perhaps due to the newness of the field, research to date is limited by methodological weaknesses and conflicting findings, and so substantial recommendations about effective interventions to increase

research use in practice cannot be made. Ultimately, it remains unclear which implementation interventions and methods are most effective for the uptake of research in practice, and many unanswered questions remain. Whilst government funded clinical trials in healthcare are important (to test intervention efficacy), their true impact on inpatient outcomes and economic returns can only be realised if adopted in routine practice by clinicians (Graham et al., 2006; Langhorne & Legg, 2003). This research-practice gap has likely led to research waste, funding waste and missed opportunities for people living with brain injury (Morris et al., 2011).

2.3 IMPLEMENTATION SCIENCE INTRODUCED

2.3.1 Implementation science defined

Implementation science refers to *"the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services"* (Eccles & Mittman, 2006, p.1) . The notion of implementing evidence into routine practice is not new; papers on the topic have been published since the early 1970s (Nilsen, Ståhl, Roback, & Cairney, 2013). More recently however, the shift towards implementing evidence has gained attention in healthcare systems globally due to an increasing demand from funders to see public impact for their research investment (Bauer, Damschroder, Hagedorn, Smith, & Kilbourne, 2015). Implementation science is broad in scope with transdisciplinary involvement across sociology, economics, and health service research, and often focuses on more than one system-level of healthcare (e.g. individual, organisational and political systems) (Bauer et al., 2015). Ultimately, the field of implementation science is usually associated with changing practice and behaviours, however it is the mechanisms of change, and the systems used to facilitate change that remain the central focus of contemporary implementation science.

2.3.2 The language of implementation

The field of implementation science has advanced over the years because of the important contributions by various disciplines ranging from agriculture to education (Rabin, Brownson, Haire-Joshu, Kreuter, & Weaver, 2008). Whilst this transdisciplinary approach is valuable, it has also led to a lack of standardised terminology, with new terms emerging and described interchangeably in the literature (Graham et al., 2006; Rabin et

al., 2008). Terms such as *knowledge translation, exchange, dissemination, utilisation, diffusion,* and *uptake* have all been used, with different countries preferring certain terms over others. Whilst implementation science (as defined on page 11) is the study of methods, *knowledge translation* refers to *"the exchange, synthesis and ethically sound application of knowledge – within a complex system of interactions among researchers and users"* (Graham et al, 2006, p. 11). Used throughout the body of this thesis, the term *implementation* describes an entire process that results in the use of knowledge by decision makers, and is defined as *"the execution of the adoption decision, that is, the innovation or the research is put into practice"* (Graham et al., 2006, p.15). Used commonly in the United Kingdom and Europe, the term implementation was selected over *knowledge translation* because in healthcare it tends to refer to implementation of research as opposed to other forms of knowledge, and focuses on the application or uptake of research knowledge (Graham et al., 2006). Other key terms of interest include *implementation intervention, "a single method or technique to facilitate change"* (Bauer et al., 2015, p. 4) and *implementation strategy, "an integrated set, bundle, or package of discreet implementation interventions ideally selected to address specific identified barriers to implementation success"* (Bauer et al., 2015, p.4). Henceforth in this thesis the following terms will be used: *Implementation science*, *implementation*, *implementation intervention,* and, *implementation strategy*. These terms will be defined in section 2.7.

2.4 IMPLEMENTATION MODELS AND FRAMEWORKS

Due to the complex nature of implementation, experts strongly recommend the use of a conceptual model or framework to systematically guide implementation efforts (Damschroder et al., 2009; Eccles, Grimshaw, Walker, Johnson, & Pitts, 2005; Michie, Johnston, Francis, Hardeman, & Eccles, 2008; Rycroft-Malone, 2004; Tabak, Khoong, Chambers, & Brownson, 2012). Whilst stated in the literature as one of the most important aspects of implementation (Proctor, Powell, Baumann, Hamilton, & Santens, 2012; Tabak et al., 2012), selecting a model or a framework is no simple task (Moullin, Sabater-Hernández, Fernandez-Llimos, & Benrimoj, 2015). There are a plethora of available models and frameworks in the field, which have come about in an attempt to identify theoretical factors and processes likely to lead to success (Nilsen, 2015). Neither models nor frameworks specify mechanisms for change; instead they highlight considerations relevant to implementation. Further, they contribute towards providing

explicit rationale for implementation strategies and serve to systematically guide an implementation process (Moullin et al., 2015; Nilsen, 2015).

The terms *framework*, *model* and *theory* are often incorrectly used interchangeably (Bauer et al., 2015; Field, Booth, Ilott, & Gerrish, 2014; Rabin et al., 2008). A theory refers to a proposed relationship between constructs, and may be operationalised within a model; a simplified depiction with relatively precise assumptions about cause and effect (Bauer et al., 2015) amenable to hypothesis testing (Field et al., 2014). Conceptual frameworks are broad and descriptive, do not specifying causal relationships and may provide a series of steps (Bauer et al., 2015). Many frameworks focus on different concepts, and may be described as process (for example, the Knowledge to Action (KTA) Framework), evaluative (for example, The Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) Framework) or determinant (for example, the Consolidated Framework for Implementation Research (CIFR)) (Nilsen, 2015). Variations in frameworks include classification of implementation concepts and the use of certain terms (Moullin et al., 2015). Process frameworks identify steps or stages of implementation, such as Quality Implementation Framework (QIF) (Meyers, Durlak, & Wandersman, 2012) and the Knowledge to Action Framework (Graham et al., 2006), while others focus on levels or levers of influence such as the Policy Ecology Framework (Raghavan, Bright, & Shadoin, 2008). Determinant style frameworks, such as the Theoretical Domains Framework (TDF) (Cane, O'Connor, & Michie, 2012) are mostly concerned with identifying individual determinants for change, in order to plan for applicable implementation interventions. A common criticism of many models and frameworks is that (a) they comprise of disconnected items (i.e. individual, organisational and systems level factors) that are not explicitly linked to higher-level scientific theory and (b) many have not been applied and tested in more than one study (Wensing & Grol, 2019). Robust models and frameworks are theory-informed, with many theories originating from psychology and behaviour change (Damschroder et al., 2009; Eccles, Grimshaw, Walker, Johnson, et al., 2005; Rycroft-Malone, 2004). Cane and colleagues (2012) argue that behaviour change theory is a central component of implementation, and ultimately for any level of change to occur, individual behaviour needs to first change.

Context is an integral consideration for both model and framework selection (i.e. to fit the environment for change) and for determining implementation interventions (Pfadenhauer et al., 2017). By first understanding, then incorporating, contextual factors into implementation research, the likelihood of achieving effective improvement in

clinical practice increases (Squires et al., 2019). Thus, framework or model selection is an important consideration when determining the needs of implementation efforts. Noteworthy healthcare models and frameworks have emerged and been applied in the past decade, with one systematic review identifying 49 published implementation frameworks of innovations in healthcare (Moullin et al., 2015). Just as no single theory can adequately capture implementation due to the broad range of phenomena of interest (Proctor et al., 2009), the same can be said of implementation models and frameworks. Moullin (2015) explains that different models are typically used in combination or in sections to guide an implementation process, and for decision making. Table 2.1 presents an overview of the frameworks and models that were applied to the studies of this thesis. These studies used a combination of process and determinant frameworks.

2.4.1 The Knowledge-to-Action framework

Developed in the 2000s, the Knowledge to Action (KTA) framework was created by Graham and colleagues to provide conceptual clarity and explain key features of the implementation process (Graham et al., 2006). Depicted in Figure 2.1, the KTA framework contains two prominent concepts: *knowledge creation* and an *action cycle*. These two concepts are not necessarily discrete steps (given that implementation is a dynamic and iterative) and one concept may influence the other, occur sequentially or occur simultaneously. The framework can be used as a whole to guide an implementation process or used to inform isolated phases of work at various points in time (i.e. researchers can focus on knowledge creation activities) (Graham et al., 2006). The categories within the knowledge creation *funnel* highlight that researched knowledge is conducted (*knowledge inquiry*), then aggregated with other research (*knowledge synthesis*) and refined into a useable format (*knowledge tools/products*) with tailoring for usability occurring throughout this process.

The action cycle is the process by which knowledge is implemented and applied in a healthcare setting. Based on a review of planned-action theories, models and frameworks (Graham & Tetroe, 2007a), the phases of the action cycle were created to describe the commonalities of reviewed theories. The phases of the action cycle therefore include: identifying a problem; identifying and selecting knowledge relevant to the problem; adapting the knowledge to the local context; assessing barriers to using the knowledge; selecting, tailoring and implementing interventions; monitoring knowledge use; evaluating outcomes; and sustaining knowledge use (Graham et al., 2006). The complex and fluid nature of implementation requires an iterative approach, and each

action cycle phase can be influenced by preceding phases or by feedback between phases (depicted by the two-way arrows between phases in Figure 2.1).

The KTA framework is one of the most frequently cited by implementation researchers, and most frequently used in practice, with varying levels of completeness (Field et al., 2014). In neurorehabilitation, the KTA framework has been integrated into the design of several studies to guide the process of implementation. For example, implementing clinical interventions for the management of dysphagia (Molfenter, Ammoury, Yeates, & Steele, 2009) and unilateral spatial neglect (Petzold, Korner-Bitensky, & Menon, 2010). As shown in Table 2.1, the KTA framework was applied in four of the five studies in this thesis to varying degrees. Used as both a process guide (such as in Study Four and Five) and to inform isolated phases (such as in Study One and Three), each of these studies incrementally build upon each other. They inform and support subsequent phases of the framework to ultimately implement proven interventions in neurorehabilitation. Using the framework in this flexible manner was intended by Graham and colleagues who designed the framework to accommodate phases being completed at various time points, encouraging an iterative approach in its application (Field et al., 2014; Graham et al., 2006).

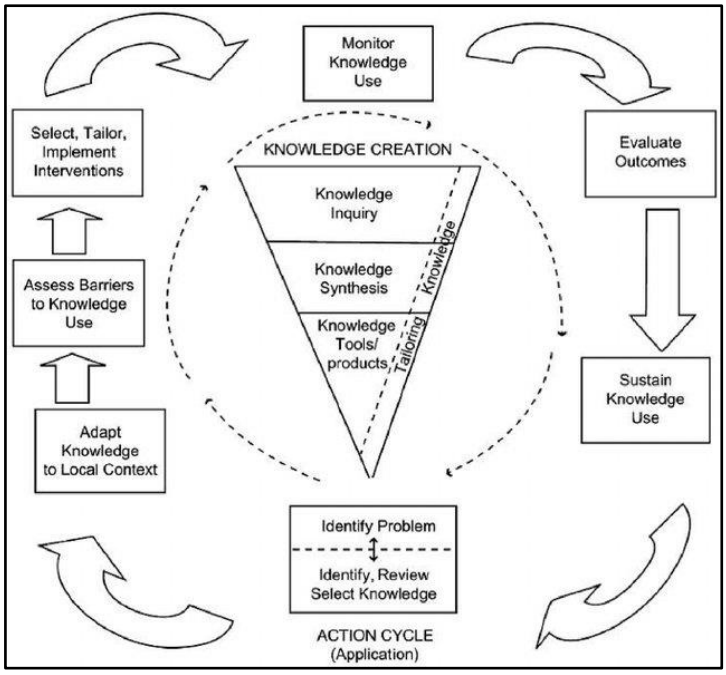

Figure 2.1. Knowledge to Action Framework (Graham, 2006, p.19)

Note: Taken from Lost in knowledge translation: time for a map? (p.19), 2006, Journal of continuing education in the health professions. Copyright 2006 by Wolters Kluwer Health, Inc. Reprinted with permission.

Table 2.1 Models and frameworks used and applied to studies contained in this thesis

	Study One: Systematic review (Chapter Three)	Study Three: Qualitative study of clinician barriers and motivators (Chapter Five)	Study Four: Before and after observational study (audit and feedback) (Chapter Six)	Study Five: Controlled cluster feasibility trial (Chapter Seven)
Knowledge To Action Framework (Graham et al., 2006)	Knowledge creation section of the framework: specifically *knowledge synthesis* and *knowledge tools/products.* Study One was conducted to explore the quality of (i) evidence to be implemented (guideline recommendations), and (ii) the tool (guideline).	Action cycle section of the framework: specifically *assess barriers / facilitators to knowledge use.* Applied in this study as a process guide.	The Action cycle section of the framework in its entirety was applied in this Study, to guide the audit and feedback process. From *identify problem* (i.e. low adherence to indicator) through to *sustain knowledge use* (i.e. embedding clinician led change into working practice).	Action cycle section of the framework: specifically (i) *select, tailor, implement interventions,* (ii) *monitor knowledge use* and (iii) *evaluate outcomes*. Study Five applied these sections of the action cycle when designing then testing the feasibility and benefit of two implementation packages.

	Study One: Systematic review (Chapter Three)	Study Three: Qualitative study of clinician barriers and motivators (Chapter Five)	Study Four: Before and after observational study (audit and feedback) (Chapter Six)	Study Five: Controlled cluster feasibility trial (Chapter Seven)
Theoretical Domains Framework (Cane et al., 2012)		The framework in its entirety was applied to categorise the identified barriers and motivators to the theoretical domains outlined within the framework. Used in this study for its determinants approach.		
Behaviour Change Wheel (Michie, Atkins, & West, 2014)				Model used to map identified barriers and motivators (informed by Study Three) to behaviour change intervention

	Study One: Systematic review (Chapter Three)	Study Three: Qualitative study of clinician barriers and motivators (Chapter Five)	Study Four: Before and after observational study (audit and feedback) (Chapter Six)	Study Five: Controlled cluster feasibility trial (Chapter Seven)
Behaviour Change Wheel continued				functions in order to select and tailor implementation interventions. Used in this study for its determinants approach.
The RE-AIM Framework (Glasgow, Vogt, & Boles, 1999)			The dimensions of *Efficacy, Adoption* and *Maintenance* from this framework were considered in the planning phase of this Study. For example, when designing for *adoption,* organisational decision-	All dimensions of the framework were considered and measured in the evaluation phase of this study. Additionally, implementation interventions designed and tested in this study were planned with future scale-

	Study One: Systematic review (Chapter Three)	Study Three: Qualitative study of clinician barriers and motivators (Chapter Five)	Study Four: Before and after observational study (audit and feedback) (Chapter Six)	Study Five: Controlled cluster feasibility trial (Chapter Seven)
The RE-AIM Framework continued.			makers were included and the Study had management support early. Intervention feedback sessions to staff were offered at various times across each fortnight to ensure staff exposure.	up in mind; informed by framework dimensions of *Implementation* and *Maintenance.*

2.4.2 The Theoretical Domains Framework and Behaviour Change Wheel

The two determinant style frameworks used in this thesis are the Theoretical Domains Framework and the Behaviour Change Wheel. Selected for their ability to categorise qualitative phenomena into discrete domains and support the theoretical linking of these domains to behaviour change interventions, these frameworks were instrumental in Studies Three and Five. Given that results of Study Three (in which the Theoretical Domains Framework was integrated) had direct implications for implementation mapping conducted in Study Five (in which the Behaviour Change Wheel was integral), both frameworks will be discussed in this section (2.4.2).

The Theoretical Domains Framework was developed by Michie and colleagues in 2005 (Michie et al., 2005) and further refined following validation in 2011 (Cane et al., 2012). The authors created the Theoretical Domains Framework as a synthesis of 33 theories and 128 theoretical constructs related to behaviour change (Michie et al., 2005). Following validation of the framework, 14 theoretical domains resulted: *knowledge*; *skills*; *professional role and identity*; *beliefs about capabilities*; *optimism*; *beliefs about consequences*; *reinforcement*; *intentions*; *goals*; *memory, attention and decision processes*; *environmental context and resources*; *social influences*; *emotions*; and *behaviour regulation*. The Theoretical Domains Framework is designed to assess implantation and or other behaviour change issues, and to inform intervention design (Cane et al., 2012). This framework was integrated into Study Three; guiding data collection (semi-structured interviews) and analysis of transcripts (into domain categories). The framework has been applied and used in previous health research in similar ways, to determine barriers and motivators (Debono et al., 2017; Duncan et al., 2012), however French and colleagues (2012) encourage researchers to take the next step and plan for behaviour change intervention functions to overcome identified barriers.

While the Theoretical Domains Framework facilitates categorising into domains, it is the Behaviour Change Wheel that allows for behaviour change intervention functions to be mapped onto these domains. The Behaviour Change Wheel created by Michie and colleagues in 2011, was developed from 19 behaviour change frameworks; synthesising common features and addressing their limitations (Michie, Van Stralen, & West, 2011). Figure 2.2 depicts the Behaviour Change Wheel. The central green circle in Figure 2.2 (i.e. the centre of the wheel) refers to *sources of behaviour*, specifically the Capability, Opportunity, Motivation- Behaviour (COM-B) model (Michie, Atkins, et al., 2014). Around this centre is a (red) layer of nine intervention functions to select from depending

on the behaviour target. The outer (grey) layer includes seven types of policy that may be used to deliver these intervention functions (Michie, Atkins, et al., 2014). In Study Five, the Behaviour Change Wheel was used to identify implementation interventions most likely to be effective at achieving the target behaviour change. For the purposes of Study Five, the COM-B model was not specific enough given the broad nature of each category. Instead, the Theoretical Domains Framework domains (which also map against the categories of the COM-B) provides refined detail about *sources of behaviour* which allow for more accurate targeting of behaviour change functions (referred to as *intervention functions* in Figure 2.2) and thus implementation interventions (referred to as *policy categories* in Figure 2.2).

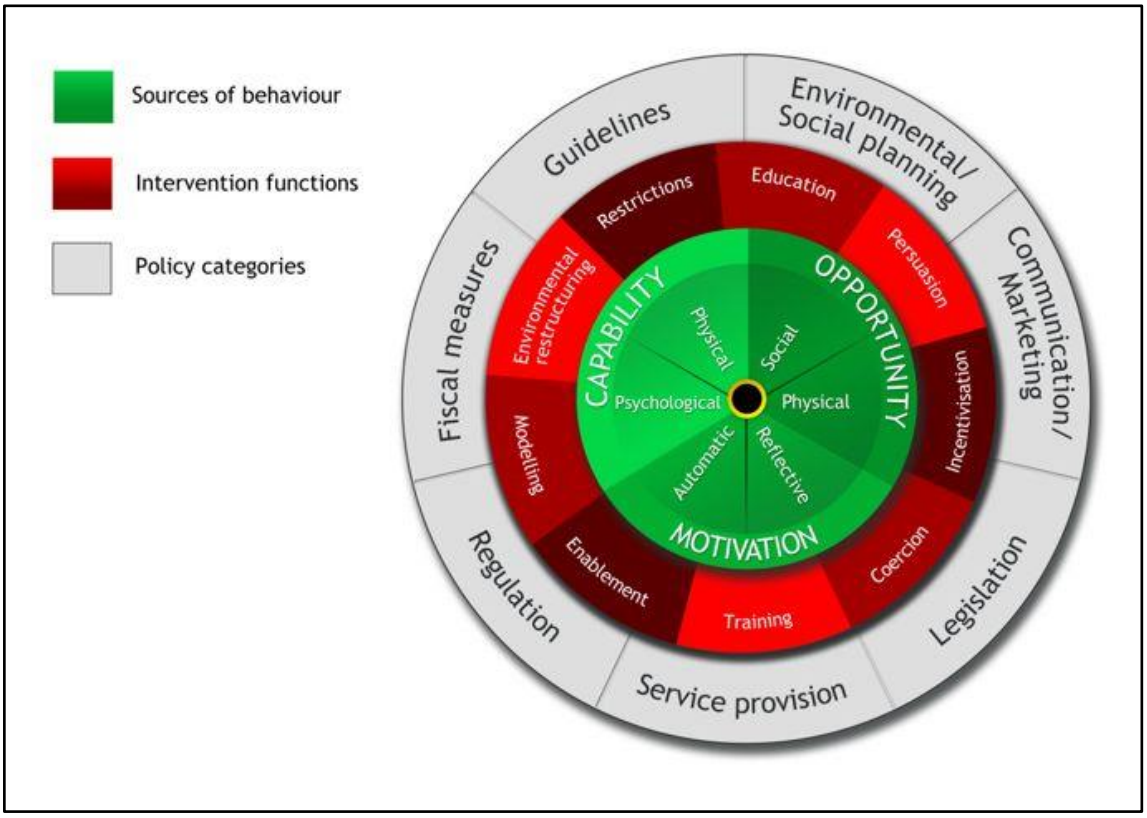

Figure 2.2. The Behaviour Change Wheel (Michie et al., 2011)

2.4.3 The Reach, Effectiveness- Adoption, Implementation and Maintenance (RE-AIM) evaluation framework

Published in 1999, the RE-AIM framework was developed to evaluate the potential translatability of interventions for public health impact (Glasgow et al., 1999). Glasgow and colleagues noted that intervention efficacy alone was not enough to translate health initiatives into practice and suggested that such initiatives (or interventions) be evaluated

across five key dimensions of: Reach, Effectiveness, Adoption, Implementation and Maintenance. The RE-AIM framework encourages health care managers, researchers, funders, policy makers and clinicians to pay attention to elements that may improve sustainable adoption of evidence based interventions (Glasgow, Lichtenstein, & Marcus, 2003). Drawing on earlier models including the diffusion of innovations theory (Rogers, 2003) and PRECEDE-PROCEED model (Green & Kreuter, 2005), RE-AIM was developed to translate research into practice, placing equal value on internal and external validity and providing specific and standard ways of measuring key factors (Glasgow, Klesges, Dzewaltowski, Estabrooks, & Vogt, 2006). Figure 2.3 presents the five dimensions of the RE-AIM Framework.

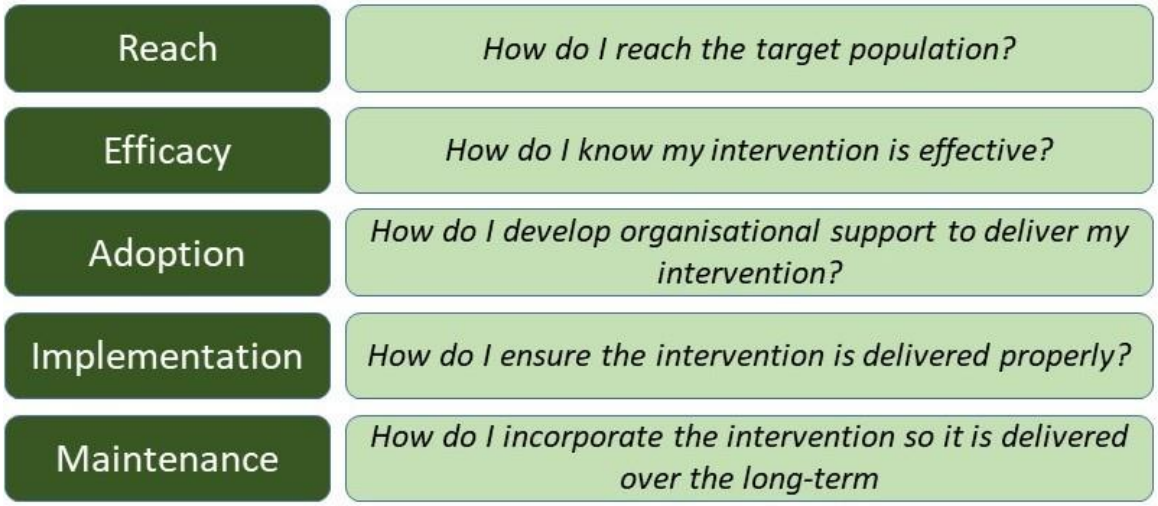

Figure 2.3. The RE-AIM Framework (Glasgow et al., 1999)

Reach within the RE-AIM framework refers to the number or proportion of individuals that participate in a given program (or intervention) (Glasgow et al., 1999). Many of the proposed approaches to improve reach include advertising (brochures, internet, word of mouth) and outreach (build relationships and recruit at target sites) (RE-AIM Workgroup, 2019). *Efficacy* refers to the impact that the intervention has on important outcomes. Strategies to increase efficacy include ensuring the intervention selected is evidence based, that available resources are used, and that documentation about program processes are kept to track consistency in delivery (RE-AIM Workgroup, 2019). *Adoption* refers to the number of staff who are prepared to offer a program, intervention or initiative. Approaches to improve adoption include understanding the local context and system (at the adoption site), involving organisational decision-makers in the

program development phase and provide information to demonstrate effectiveness and ease of delivery to staff (Harden et al., 2018). *Implementation* refers to how well the staff follow the intervention during delivery (including of consistency of delivery), and may be aided by tailoring resources and ensuring resource availability (Glasgow et al., 1999). *Maintenance* refers to the extent to which the intervention becomes part of routine practice at the setting. Approaches to facilitate maintenance include intervention support groups (or working parties), low cost and ongoing availability of resources and integration of the intervention into existing organisational infrastructure (Harden et al., 2018). In publications to date, the RE-AIM framework has been referred to and integrated in both the design phases, and well as evaluative phases of healthcare studies (Gaglio, Shoup, & Glasgow, 2013; Jilcott, Ammerman, Sommers, & Glasgow, 2007; Klesges, Estabrooks, Dzewaltowski, Bull, & Glasgow, 2005).

With a focus on the intervention setting and on staff delivery of the intervention, the RE-AIM framework places emphasis on the delivery of an intervention and assessing implementation outcomes (Harden et al., 2018). It is for these reasons that the RE-AIM framework was used in part to guide the design of Study Four and applied in the evaluation of Study Five. Whilst the framework was used in both Study Four and Five, it was not explicitly integrated within description of the studies given that other frameworks were of more prominent focus. Study Four is focused on the mechanisms underpinning the efficacy of audit and feedback and therefore the *Periodic Service Review* approach was integrated within the body of that Study. When designing Study Five, justifying the development of implementation strategies was an integral feature, and so the Behaviour Change Wheel was the more appropriate model to integrate. In Study Five, the RE-AIM framework was used to measure aspects of *Reach*, *Efficacy, Adoption, Implementation* and *Monitoring* and comment on the feasibility of implementation strategies introduced.

2.5 TERTIARY HOSPITAL CONTEXT AND CULTURE

A fundamental consideration for implementation scientists is the context (and associated culture) in which desired change is sought. The nuances of the healthcare context relevant to this series of studies therefore warrants discussion. This body of work was conducted within Victoria, Australia. Whilst one of the five Studies was conducted at a large, publicly-funded tertiary area health network (Study Four), the observational study (Study Three) and cluster trial (Study Five) recruited participants from across three health

organisations; two of these were large publicly-funded area health networks and the third was a medium sized private community neurorehabilitation service.

Unique to each organisation, culture and its relationship to implementation are of prominent interest (Aarons & Sawitzky, 2006; Jung et al., 2009; Mannion, Konteh, & Davies, 2009). Organisational culture refers to the organisational norms or expectations regarding how people behave and how things are done in an organisation (Glisson & James, 2002). Organisational culture is difficult to quantify (Jung et al., 2009) and can be challenging to change (Aarons & Sawitzky, 2006; Ogbonna, 1992; Parmelli, Flodgren, Schaafsma, et al., 2011). Within the hospital context and setting, research suggests that there are positive relationships between hospital organisational culture and measures of hospital performance (Baggs et al., 1999; Gittell et al., 2000; Lukas et al., 2007; McIntosh et al., 2014; Meterko, David, & Young, 2004). Hospitals with greater affinity towards quality of inpatient care, leadership commitment to quality, and infrastructure to support delivery of care are more likely to demonstrate desirable outcomes such as interprofessional coordination and inpatient outcomes (Lukas et al., 2007; McIntosh et al., 2014). Despite this knowledge, prospective efforts to shift organisational culture to promote research uptake in practice have been disappointing (Parmelli, Flodgren, Beyer, et al., 2011). Another important consideration for implementation is the hospital context and setting. *Context* is defined by Pfadenhauer and colleagues (2017) as reflecting *"a set of characteristics…that consist of active and unique factors, within which the implementation is embedded…Context is not a backdrop for implementation, but interacts, influences…or constrains the intervention and its implementation"* (p.6). Differing from *setting*, which refers to the specific physical location in which an intervention is to be implemented, *context* comprises of seven domains: geographical, epidemiological, socio-cultural, socio-economical, ethical, legal and, political (Pfadenhauer et al., 2017). Tertiary hospitals are often large and service an array of health conditions (e.g. trauma, general medical, oncology) across different practice areas (e.g. acute medicine, rehabilitation, community services). In the hospital context, variability of inpatient health conditions, working pace, and clinical environment exists between practice areas. For example, an emergency department is contextually different to a neurorehabilitation ward as they: treat/manage different health conditions, have differing admission times, have work force differences, potentially have socio-cultural differences, and have different physical environments. It could be assumed that due to the contextual

variability between hospital practice areas, specific factors may influence research uptake differently (McCormack et al., 2002; Nilsen & Bernhardsson, 2019; Taylor et al., 2011).

Implementation challenges presented by hospital context and culture have been explored in previous research, however most of this work has been conducted in targeted practice areas (McCluskey, Vratsistas-Curto, & Schurr, 2013; McCulloch et al., 2009; Morey et al., 2002). Few studies have compared contextual attributes across hospital contexts (Squires et al., 2019) or investigated how to improve organisational culture at an organisational (hospital) level (Curry et al., 2015). In their secondary analysis of 145 interviews across 11 studies, Squires and colleagues (2019) sought to understand barriers to, and motivators of research uptake across healthcare settings. Irrespective of setting, professional role or clinical behaviour, considerable consistency was found (Squires et al., 2019). This finding is likely to have considerable impact for implementation, as lessons learnt from targeted practice areas in healthcare may be generalised across primary healthcare with board application. Whilst heterogeneity across inpatient characteristics, professional roles, and system features were found (Squires et al., 2019), organisational culture was identified as an independent factor. Although Squires and colleagues (2019) suggest culture is individual to a healthcare setting, the work of Bradley and colleagues (2018) suggests otherwise. In a longitudinal (two-year) study to identify factors related to successful organisation culture shift, 10 hospitals participated in national (United States) *quality collaboratives* (Bradley et al., 2018). Six hospitals experienced statistically significant culture change (with associated reductions in 30-day risk-standardised mortality rate after acute myocardial infarctions) and shared three distinguishing features. These three features included distinct patterns in membership diversity (inclusion of staff from different hospital disciplines and levels), authentic participation in the collaborative and, capacity for conflict management (Bradley et al., 2018). Collectively, this body of work suggests that healthcare context and culture have large sections of overlap irrespective of practice area (or setting). Lessons learnt from implementation efforts in targeted practice areas are therefore likely to have wider applicability to healthcare organisations more broadly, including neurorehabilitation.

2.1.1 Organisational culture and promoting research uptake

Recommended approaches to improve organisational culture for research uptake in practice include: leadership commitment to quality, improvement initiatives, and infrastructure to support inpatient care (Lukas et al., 2007). In their study designed to change culture and practice patterns, William and colleagues (2015) found that physician

compliance to intensive care units (ICU) checklists increased from 67% to 90% when interventions to target accountability were introduced (interventions included bimonthly publication of compliance via division email, and, multidisciplinary case conference). Accountability for individual clinical conduct is pertinent to healthcare yet scarcely explored in implementation science. Linked to *motivation* for behaviour change (Michie, Atkins, et al., 2014), increasing clinician accountability may influence workplace culture and thus propensity for change. In Australia, there is strict behaviour monitoring of surgeons, with 100% of surgical mortalities audited (Royal Australasian College of Surgeons, 2014) and feedback provided to individual surgeons. In contrast, only 108 self-selected stroke units across Australia are audited biannually for quality (of 127 eligible stroke units) (Stroke Foundation, 2016), with audit results of little personal consequence to individual clinicians. It could be assumed that personal accountability felt by surgeons about their clinical performance is greater than that of clinicians in stroke rehabilitation. Whilst it is anticipated that culture in neurorehabilitation for participating organisations of subsequent studies (Study Three and Five) is comparable, the role of culture and especially its relationship to accountability in healthcare needs to be explored in future research. The influence of behaviour monitoring for clinician accountability is investigated in Study Three, Four and Five, and discussed in context within Chapter Eight (Discussion).

2.6 EVALUATING IMPLEMENTATION

Various aspects of implementation are typically evaluated. Aside from evaluating the effectiveness of an implementation intervention (i.e. was the intervention successful at creating behaviour change), understanding outcomes related to the method of implementation are equally important to move the science forward (Wensing & Grol, 2019). Such outcomes have already been highlighted by the RE-AIM framework (Glasgow et al., 1999) and include reach, efficacy, and adoption. Other related outcomes relevant to method include appropriateness, cost, feasibility, acceptability, fidelity, penetration, and sustainability (Lewis, Fischer, et al., 2015; Proctor et al., 2009).

Evaluating implementation receives much criticism in implementation science, in part due to poor psychometrically valid outcome measures (Lewis, Weiner, Stanick, & Fischer, 2015; Martinez, Lewis, & Weiner, 2014). Compounding this issue is an oversupply of *home-grown* or adapted instruments which further complicates

interpretation of reported findings and limits comparability across studies (Lewis, Weiner, et al., 2015; Martinez et al., 2014). The psychometric properties of most implementation outcome measures are largely unknown, due to the lack of systematic development and testing (Lewis, Fischer, et al., 2015). 420 instruments related to 38 implementation constructs were identified in a recent systematic review (Lewis, Stanick, et al., 2015). Of all these instruments, however, very few were developed using gold standard psychometric procedure (Lewis, Stanick, et al., 2015). Additionally, in a review of 104 implementation outcome measures, 96% lacked information on responsiveness, 82% on predictive validity, and 51% on reliability (Lewis, Fischer, et al., 2015). Unfortunately, this finding is not dissimilar to those reported in previous systematic reviews of implementation science-related instruments, where 48% lacked criterion validity and 49% lacked any evidence of psychometric validation (Chaudoir, Dugan, & Barr, 2013). Given these clear issues, it is unsurprising that developing and testing psychometric properties of implementation outcome measures has been highlighted as an international priority (Chaudoir et al., 2013; Lewis, Stanick, et al., 2015; Lewis, Weiner, et al., 2015).

The use of suboptimal outcome measures (Wensing & Grol, 2019) as well as measures that lack conceptual clarity (Lewis, Fischer, et al., 2015) have also been identified as problematic issues in evaluation. Pertinent to guideline implementation studies, the importance of inpatient preferences needs to be considered and the effect this may have on evaluation outcome measures reviewed. If an inpatient actively decides not to engage in or receive an evidence-based intervention (following an informed discussion with the clinician), this decision should not automatically be documented as *non-adherence* to guideline recommendations (Wensing & Grol, 2019). In Study Four, such decisions were recorded as *not applicable* during auditing. Although imperfect, inpatient preferences against recommended interventions were considered in analysis. The larger issue this poses, especially for studies of guideline uptake in practice, is the need for an optimal outcome measure that appropriately captures inpatient preferences to be developed (Wensing & Grol, 2019).

Selecting appropriate evaluation approaches has also been highlighted as a prevalent issue (Lewis, Weiner, et al., 2015; Martinez et al., 2014). Wensing and Grol (2019) encourage careful consideration of method when designing for rigorous evaluation, suggesting advanced designs (such as step-wedged designs) can only be considered if researchers involved understand and appreciate outcome evaluation. Conversely, using one method (for example self-report) or one approach (for example,

quantitative inquiry) may not be the most appropriate way to accurately answer research questions (Martinez et al., 2014). This may lead to method bias and /or limit the applicability of research findings. In an attempt to counter this issue within studies of this thesis, data were collected by various methods. For example, in Study Four, medical file notes were not solely relied on as the single measure of clinician behaviour change. To ensure accurate profiling, data were also collected and triangulated from interviews with inpatients, family members, clinical staff as well as data from ward-based observations. Furthermore, in Study Five, feasibility outcome measures were collected alongside behaviour change metrics.

Despite the aforementioned issues implementation science faces regarding evaluation, new approaches and potential ways forward are being considered by researchers. Opinion and debate papers by field experts identify potential approaches to advance the science (Martinez et al., 2014; Wensing & Grol, 2019). Evaluation of implementation has been marked as a research priority (Lewis, Stanick, et al., 2015), outcome measures of higher-quality are being validated (Weiner et al., 2017), and trials with novel designs are being conducted (Green, Coronado, Schwartz, Coury, & Baldwin, 2019).

2.7 EFFECTIVENESS OF IMPLEMENTATION INTERVENTIONS

As introduced earlier, an implementation *intervention* is a single method or technique designed to facilitate change (for example computerised reminders (Shojania et al., 2009)) (Proctor, Powell, & McMillen, 2013). An implementation *strategy* refers to an integrated package or discreet interventions selected to address specific barriers to implementation success (Graham et al., 2006). Strategies may range in complexity and target one or more stakeholder(s) (i.e. inpatients, clinicians, management teams) across single or multilevel contextual factors (individual, local, organisational, community) (Powell et al., 2019). A subject of much focus in implementation science is evaluating the effectiveness of implementation interventions. Experts in the field have developed a list of recommended interventions based on consensus (Powell et al., 2015), as few empirical studies of efficacy exist. Of the studies that have explored intervention efficacy, applicability is limited by poor methodological quality and conflicting findings. Ultimately, limited information exists about superior implementation interventions (Grimshaw, Eccles, Lavis, Hill, & Squires, 2012; Straus, Tetroe, & Graham, 2011).

To address this prominent issue, the Cochrane Collaboration's Effective Practice and Organization of Care (EPOC) group (Grimshaw, Santesso, Cumpston, Mayhew, & McGowan, 2006) led the evidence evaluation on a variety of implementation interventions including: audit and feedback (Ivers et al., 2012), educational meetings (Forsetlund, Bjørndal, et al., 2009), printed educational material (Giguère et al., 2012), local opinion leaders (Flodgren et al., 2011), educational outreach (O'Brien et al., 2007), computerised reminders (Shojania et al., 2009), and tailored implementation strategies (Baker et al., 2015). Across all these systematic reviews, the median absolute effect sizes are variable, and remain small to moderate at best (ranging from 2% (interquartile range 0 to 11%), to 12% (interquartile range 6.0 to 14.5%)).

At the commencement of this thesis research, there was only one systematic review exploring the effectiveness of implementation interventions in rehabilitation (Jones et al., 2015). No recommendations about effective interventions could be concluded from that review. Most of the 26 included studies explored the use of educational meetings in isolation (Colquhoun, Letts, Law, MacDermid, & Missiuna, 2012; Hammond & Klompenhouwer, 2005; Kerssens, Sluijs, Verhaak, Knibbe, & Hermans, 1999; Pennington, Roddam, Burton, Russell, & Russell, 2005; Tripicchio, Bykerk, Wegner, & Wegner, 2009; Vachon, Durand, & LeBlanc, 2010), and very few studies tested the efficacy of audit and feedback (Demmelmaier, Denison, Lindberg, & Åsenlöf, 2012) or opinion leaders (Gross & Lowe, 2009; Stevenson et al., 2006). On further appraisal, only five studies were in the area of stroke; two RCTs (Nikopoulou-Smyrni & Nikopoulos, 2007; Pennington et al., 2005), two before-and-after studies (Cournan, 2012; Perry & McLaren, 2000) and one qualitative study (Molfenter et al., 2009). The majority of studies have been conducted in musculoskeletal rehabilitation (Jones et al., 2015). Of the 26 studies, none satisfied all four recommendations of the Workgroup for Intervention Development and Evaluation Research (WIDER) reporting guideline; none of the quantitative studies received strong methodological ratings, and only three of the qualitative studies received a moderate rating (Jones et al., 2015). The systematic review concludes that implementation interventions and strategies used in acute care may not directly relate to the rehabilitation setting, given the different nature and structure in which rehabilitation professionals work (Jones et al., 2015). Further, the systematic review recommended future research to include effectiveness studies for audit and feedback or opinion leaders (as isolated interventions) in the rehabilitation setting (Jones et al., 2015).

Previous studies have highlighted prevalent issues related to the development and selection of interventions in implementation science. These include: the limited use of theory when selecting interventions, a lack of explicit articulation of implementation goals, limited understanding of implementation determinants prior to the development of interventions and, poor descriptions of mechanisms hypothesised to create the desired change (Fernandez et al., 2019; Powell et al., 2019; Waltz, Powell, Fernández, Abadie, & Damschroder, 2019). Within the experimental studies of this thesis, each of these key factors will be clearly reported on for transparency. Studies Three to Five all employed implementation frameworks and theoretical underpinning. Implementation goals were made explicit in experimental Studies Four and Five. Implementation determinants were methodically identified in Study Three, and interventions developed a priori to testing in Study Five. Finally, essential aspects of mechanisms thought to create desired change were clearly explained in Studies Four and Five.

Despite the aforementioned issues, systematic reviews synthesising findings of multiple studies now offer evidence-based recommendations about the effectiveness of implementation interventions. Clarity is emerging around interventions that are unlikely to be effective, such as passive dissemination interventions (Grol & Grimshaw, 2003). Interventions with small to moderate effect have also been identified, and favourable approaches to implementation postulated (Prior, Guerin, & Grimmer-Somers, 2008). Some of the most promising implementation interventions identified in systematic reviews include: audit and feedback (Ivers et al., 2014), tailored interventions (Baker et al., 2015), implementation strategies (Johnson & May, 2015) and, interactive and facilitated interventions (Rivard et al., 2010). Despite emerging evidence around efficacy, the conditions under which these respective interventions may be effective is largely unknown. In the following sections (2.7.1 to 2.7.4) each of these implementation interventions are discussed in turn, and their use in this program of research explained.

2.7.1 Audit and feedback

Audit and feedback refers to a process whereby an individual's performance is measured (audited) and compared to set targets or professional standards; results of this comparison are then fed back to the individual (Ivers et al., 2012). Audit and feedback is recommended as an intervention to promote uptake of clinical practice guideline recommendations in practice (Stroke Foundation, 2017) and is one of the most widely used interventions in implementation research (Colquhoun et al., 2013). Despite this, the reported efficacy of audit and feedback has varied across studies (Brehaut & Eva, 2012).

In a 2012 Cochrane systematic review of audit and feedback effectiveness (Ivers et al., 2012) which included 140 RCTs, intervention effects ranged from considerably positive (70% increase in behaviour) to negative (9% absolute decrease). The review concluded that modest but variable improvements to clinical practice result from the use of audit and feedback as an implementation intervention, however a lack of theory informed trials was due in part to the observed variability. Building on this, Colquhoun and colleagues (2013) found that only 20 included RCTs (14%) of the 140 audit and feedback studies in Ivers et al.'s (2012) review reported the use of theory in any aspect of the design of their intervention or strategy, measurement, implementation or interpretation. In a debate paper by Ivers and colleagues (2014) researchers were implored to stop testing for audit and feedback efficacy, and to instead focus attention to the mechanisms underpinning *how* audit and feedback works best to move the science forward. In response, research has changed in focus towards identifying and understanding key features and optimal conditions for audit and feedback interventions (as evidenced by the work of Grimshaw and colleagues (2019), Gude and colleagues (2019) and Roos-Blom and colleagues (2019)).

Published in the years after this thesis had commenced, Colquhoun and colleagues (2017) conducted 28 interviews with audit and feedback experts across a range of disciplines. They identified 313 theory-informed hypotheses, and categorised these into 30 themes related to audit and feedback *recipients*, *content*, *process of delivery*, *target behaviour*, and *other*. The authors state these testable hypotheses will inform future work, and serve to provide direction to other researchers about untested aspects of audit and feedback mechanisms (Colquhoun et al., 2017). Mechanisms of action related to audit and feedback continue to be explored and include: social interaction of audit and group feedback (Cooke et al., 2018), selection of performance comparators (Gude et al., 2019), provision of targeted solutions (Roos-Blom et al., 2019), and process of delivery (Soleymani et al., 2019). Study Four explores and tests mechanisms of action related to audit and feedback and provides insight into the conditions under which this intervention may work best.

2.7.2 Tailored interventions

A major challenge of implementation is identifying contextual barriers and motivators (henceforth termed *determinants*), and determining which implementation intervention or strategies will address them (Waltz et al., 2019; Wensing, Bosch, & Grol, 2010). Tailoring implementation interventions is frequently recommended, with the

assumption that interventions will address the most important determinants of practice for improvement (Wensing et al., 2011). A systematic review of 32 studies found that tailored interventions were more effective than no strategy, or a strategy not tailored to determinants, however the methods used to select and prioritise determinants, and to select implementation interventions, were not well described (Baker et al., 2015). Despite the availability of determinant-style frameworks (such as the Theoretical Domains Framework and Behaviour Change Wheel), methods which guide the tailoring process appear to be poorly described in published studies (Coenen, Van Royen, Michiels, & Denekens, 2004; van Gaal et al., 2009). Without a tailoring protocol, there is a risk that barriers and potential solutions could be incorrectly mapped, violating the guiding assumption of a tailored approach and resulting in a mismatch. In a review of 20 studies by Bosch and colleagues (Bosch, Van Der Weijden, Wensing, & Grol, 2007), approximately half were found to have a mismatch between determinants and the selected implementation interventions. An example of this mismatch might be that a barrier is identified on a team level, but the selected intervention is focused on a process at an individual level (and thus the selected intervention does not address the barrier) (Bosch et al., 2007).

A few initiatives have sought to improve the methods of tailoring implementation including the Tailored Implementation in Chronic Diseases project; a large European research project funded between 2011-2015 (Wensing et al., 2011). Unfortunately, the project had little impact on outcome measures, and concludes that perhaps implementation interventions need to adapt over time given determinant changes (such as contextual and political changes) (Wensing, 2017). A newly developed process called *Implementation Mapping* (Fernandez et al., 2019) has recently been published, and expands on the idea of Intervention Mapping (Bartholomew, Parcel, Kok, & Gottlieb, 2001). Whilst Intervention Mapping has been applied to a limited number of health studies (Hurley et al., 2016; Manyeh, Ibisomi, Baiden, Chirwa, & Ramaswamy, 2019; Schmid, Andersen, Kent, Williams, & Damush, 2010) it has been described as time-consuming, requires the knowledge of technical experts and remains in its infancy. Despite the theoretical support, there remains no strong evidence for the benefit of tailored implementation interventions (Powell et al., 2019; Wensing, 2017). Study Three investigates the determinants of research uptake in clinical practice. Study Five then maps identified determinants to behaviour change functions, and outlines the tailored interventions developed to promote research uptake in practice.

2.7.3 Implementation strategies

An intuitively held belief is that an implementation *strategy* (termed *multicomponent* or *multifaceted interventions* in systematic reviews; referring to more than one implementation intervention), is superior in effectiveness to a single intervention alone (Powell et al., 2019; Squires, Sullivan, Eccles, Worswick, & Grimshaw, 2014). This belief is based on the assumption that barriers to implementation are often found at various levels (i.e. individual, organisational, and political). It is thought therefore, that an implementation strategy targeting barriers across various levels are more likely to yield increased behaviour change (Squires et al., 2014). Although this theory was originally confirmed by early systematic reviews (Davis, Thomson, Oxman, & Haynes, 1995; Wensing & Grol, 1994), later reviews refuted these findings (Grimshaw et al., 2004; Hakkennes & Dodd, 2008). Complicating matters further, it appears that confusion exists about the definition of single-component interventions, as well as issues with transparent reporting of interventions selected for a strategy.

Considered more statistically robust than earlier systematic reviews (due to clear intervention component coding and explicit analytical methods), Grimshaw and colleagues (2004) found implementation strategies to not be superior to single interventions. Their finding was echoed in a subsequent systematic review (Hakkennes & Dodd, 2008), and confirmed in 2014 by Squires and colleagues (2014) in a systematic overview of 25 systematic reviews. Squires and colleagues' (2014) review concluded that there was *"no compelling evidence for [implementation strategies]…being more effective than [single interventions]"* (p.20). The work of Johnson and colleagues (2015) in their theory-led overview of systematic reviews offered an understanding as to why there have been discrepancies to date. In the Johnson review (Johnson & May, 2015), 12 systematic reviews were separately evaluated to specifically consider approaches for guideline implementation. Evidence exists for the use of implementation strategies in complex healthcare areas (Chaillet et al., 2006; Medves et al., 2010), with Johnson and colleagues (2015) concluding that bundles of interventions packaged together (i.e. an implementation strategy) appear more effective than single interventions for the uptake of guidelines in practice. The most recent systematic review to explore implementation strategies in stroke rehabilitation was Bird and colleagues (2019). In their review of 11 RCTs, it was concluded that implementation strategies that comprised of site facilitation and tailoring to local determinants were most effective for clinical practice change (Bird et al., 2019).

Difficult to establish from systematic reviews, researchers of included trials do not often clearly explain why specific implementation interventions have been included in their *strategies.* These implementation interventions ought to be mapped to contextual determinants, but instead the a priori rationale for selecting interventions for a strategy are not made transparent (Grimshaw et al., 2004). Complementing this argument, Chaillet and colleagues (2006) noted that interventions where barriers to change were prospectively identified were more likely to be effective (93.8% vs 47.1%). Perhaps, trials included in systematic reviews that have not prospectively identified barriers, bias review findings. Adding to the confusion for researchers and clinicians, it appears that even researchers cannot agree on what constitutes a single intervention versus a strategy for complex implementation interventions (such as outreach support). The poor definition of the term *strategy* potentially contributes towards the lack of clear evidence for implementation strategies (Wensing et al., 2010). Wensing and colleagues (2010) suggest that a single intervention such as outreach support does not truly comprise of one intervention but rather potentially many (i.e. instruction, motivation, technical assistance (Powell et al., 2019)). Ultimately, implementation strategies could be more effective than single interventions if they addressed various types of barriers to change.

Following review of this literature, it is not surprising that confusion and ambiguity exists about the effectiveness of implementation strategies. Nonetheless, greater clarity about the use of single interventions versus strategies will likely eventuate over time with more research. In Study Five, implementation interventions included in each of the packages tested (Group A and B) were set a priori, with the rationale for their inclusion made clear.

2.7.4 Interactive and facilitated interventions

Another area of contention, not yet settled by research, is whether passive interventions make any difference to clinicians' use of evidence-based interventions in practice. Passive interventions refer to health-promoting material continually available as part of the setting or environment (Cass, Ball, & Leveritt, 2016). They are inexpensive to provide in the clinical setting (since they are developed at the commencement of the program) and require no staffing to implement (Cass et al., 2016). Examples of passive interventions include the distribution of educational materials, conference attendance, websites and didactic lectures (Prior et al., 2008). Current evidence demonstrates that the provision of traditional one-way passive interventions is not effective for behaviour change (Grol & Grimshaw, 2003; Prior et al., 2008). However, there is emerging

evidence to suggest that interactive, yet passively delivered, interventions, such as online education or demonstration videos may be effective for the uptake of evidence-based interventions in practice (Sarkies, Maloney, Symmons, & Haines, 2019).

In contrast, interactive and facilitated interventions are more costly to deliver in the clinical setting due to their nature. Examples of these interventions include small group education sessions, workshops, and practical sessions coupled with an evaluative component (Prior et al., 2008). Interactive interventions incorporating face-to-face contact demonstrate moderate effect on research uptake in practice (Grol & Grimshaw, 2003; Lavis, Hammill, et al., 2005; Prior et al., 2008). Promising interventions for implementation underpinned by face-to-face interaction include *knowledge brokers* and *facilitators*. Reviews of facilitation have defined it as both an individual role (key activities of project management, advocacy and leadership) as well as a process (involving individuals and teams, liaising with decision makers) (Harvey et al., 2002; Kitson et al., 2008). The Promoting Action on Research Implementation in Health Services (PARiHS) framework supports the use of a facilitator and describes it as one of the active ingredients for successful implementation (Kitson et al., 2008). In a comparable approach, the concept of a knowledge broker as an implementation intervention has emerged from Canada, and has gained attention in implementation science within the past two decades (Dobbins, Robeson, et al., 2009). A knowledge broker provides a link between research producers and research users, working collaboratively with stakeholders across all levels to facilitate the identification, access, assessment, interpretation and implementation of research into local practice and policy (Dobbins, Robeson, et al., 2009).

The use of a knowledge broker has been effectively applied in fields outside of healthcare to increase the use of evidence in practice; namely business and agriculture (Sowe, Stamelos, & Angelis, 2006; von Malmborg, 2004; Zook, 2004). Limited impact studies however have been completed in healthcare (Dobbins, Hanna, et al., 2009). A recent systematic review on the effectiveness of knowledge brokerage to promote implementation (Bornbaum, Kornas, Peirson, & Rosella, 2015) found only two studies to be methodologically rigorous enough for inclusion. These studies (Dobbins, Hanna, et al., 2009; Rivard et al., 2010) yielded conflicting results and thus findings of the systematic review were deemed inconclusive (Bornbaum et al., 2015). Despite this, factors such as the physical location of the knowledge broker and whether they were internal or external to the organisation appear to be important when designing a knowledge broker

intervention (Bornbaum et al., 2015). In a clustered RCT exploring the efficacy of facilitation as an implementation intervention, the participants in the facilitation group did not implement all 18 features of a stroke rehabilitation guideline (Salbach et al., 2017). Authors hypothesise that the facilitated approach may not have adequately addressed the barriers to integrating numerous treatment recommendations simultaneously (Salbach et al., 2017). Despite the limitations of each, both the systematic review (Bornbaum et al., 2015) and RCT (Salbach et al., 2017) suggest that a person-facilitated and interactive approach (such as a facilitator or knowledge broker) may be a promising intervention to promote successful implementation. Many aspects of knowledge brokerage and facilitation remain untested. Further research is required to identify the required attributes, the dose, and the optimal location of the facilitator / knowledge broker as well as the effectiveness of this intervention on implementation. In Study Five, a facilitator is used as part of an intervention within one of the two implementation packages. The feasibility of facilitation, its impact on evidence-intervention uptake in practice, and acceptability are also further explored.

2.7.5 Summary

The aforementioned implementation interventions are among the most widely used and promising interventions in healthcare for moving research evidence into routine practice. Despite this, each intervention has elements of unknown and untested characteristics, resulting in limitations in their applicability and effectiveness. At the time this thesis research commenced, research on: exploring the methods for designing and tailoring implementation strategies, testing mechanisms of change, and, exploring the effect of tailored implementation strategies was scarce and necessary. These research gaps and the available evidence at the time, largely influenced the objectives, method and design of the subsequent studies of this thesis.

2.8 CHAPTER SUMMARY

Neurorehabilitation has high-quality evidence, is beneficial for healthcare outcomes and is cost effective. Despite advances in knowledge creation, evidence-based interventions are not routinely provided to inpatients and thus the full benefits of rehabilitation are not being achieved. Implementation science is the study of methods by

which research knowledge is applied and adopted into clinical practice. Underpinned by many theoretical constructs, models and frameworks have been developed in an attempt to integrate and guide implementation theory into research. This chapter has defined research-practice gaps, explained the language of implementation science, highlighted implementation frameworks used in healthcare (and applied to subsequent studies of this thesis) and described promising implementation interventions which if applied correctly may be effective in addressing research-practice gaps.

Chapter 3: Systematic review of clinical practice guidelines to identify recommendations for rehabilitation after stroke and other acquired brain injuries

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This study has been published as:

Jolliffe, L., Lannin, N.A., Cadilhac, D.A. & Hoffmann, T. (2018). Systematic review of clinical practice guidelines to identify recommendations for rehabilitation after stroke and other acquired brain injuries. *British Medical Journal Open, 8*(2). doi:10.1136/bmjopen-2017-018791

3.1 ABSTRACT

Objectives: Rehabilitation clinical practice guidelines (CPGs) contain recommendation statements aimed at optimising care for adults with stroke and other brain injury. The aim of this study was to determine the quality, scope and consistency of CPG recommendations for rehabilitation covering the acquired brain injury populations.

Design: Systematic review.

Interventions: Included CPGs contained recommendations for inpatient rehabilitation or community rehabilitation for adults with an acquired brain injury diagnosis (stroke, traumatic or other non-progressive acquired brain impairments). Electronic databases (n=2), guideline organisations (n=4), and websites of professional societies (n=17) were searched up to November 2017. Two independent reviewers used The Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument and textual synthesis were used to appraise and compare recommendations.

Results: From 427 papers screened, 20 guidelines met the inclusion criteria. Only three guidelines were rated high (>75%) across all domains of AGREE-II; highest rated domains were *scope and purpose* (85.1, SD 18.3) and *clarity* (76.2%, SD 20.5). Recommendations for assessment and for motor therapies were most commonly reported, however varied in the level of detail across guidelines.

Conclusion: Rehabilitation CPGs were consistent in scope, suggesting little difference in rehabilitation approaches between vascular and traumatic brain injury. There was, however, variability in included studies and methodological quality.

Trial registration: International Prospective Register of Systematic Reviews (PROSPERO) registration number CRD42016026936.

3.2 INTRODUCTION

Acquired brain injury from both vascular and traumatic causes is a major health issue, being a leading cause of disability (AIHW, 2007). Acquired brain injury (brain damage occurring after birth) is an umbrella term that encompasses many aetiologies, and includes vascular causes (stroke) and traumatic causes (SIGN, 2013). Within rehabilitation, clinicians commonly treat impairments and functional limitations rather than according to a specific diagnosis, with little observable difference in rehabilitation approaches between vascular versus traumatic brain injury. Provision of care based on evidence is known to improve inpatient outcomes (Donnellan, Sweetman, & Shelley, 2013a; Hubbard et al., 2012; Kang & Schneck, 2004; Quaglini, Cavallini, Gerzeli, & Micieli, 2004), however there are documented gaps between the generation of stroke and other health research, and its use in clinical practice (Bayley et al., 2012). For example, a recent Australian audit of stroke rehabilitation services found that only 20% of patients are discharged with a care plan (Stroke Foundation, 2016), despite strong evidence for their routine use (SIGN, 2010b; ISWP, 2016; Stroke Foundation, 2017). Clinical practice guidelines (CPGs) aim to facilitate clinicians' use of evidence (Alonso-Coello et al., 2011; Woolf et al., 1999).

In addition to supporting proven interventions, CPGs also assist to raise awareness of ineffective practices (Grimshaw et al., 2012). Whilst CPGs are developed with the aim of bridging the research-practice gap, issues regarding their use and implementation still remain. Many countries produce their own national guidelines, updates occur at varying intervals, and guideline content and scope differs with context (such country and guideline developer/sponsor). The level of evidence underpinning recommendation statements and the detail of these recommendations also differ across guidelines (Hurdowar, Graham, Bayley, Wood, & Dauphinee, 2007; Rohde, Worrall, & Le Dorze, 2013). Finally, despite rehabilitation approaches often being consistent clinically between vascular and traumatic brain injury, these diagnostic groups are separated in rehabilitation CPGs published to date. From clinicians' perspective, having multiple guidelines that are inconsistent based on differences in assessments of evidence or scope may be overwhelming and confusing.

Therefore, the research questions for this study were to:

(1) Examine the methodological quality of rehabilitation CPGs for acquired brain injury (vascular and/or traumatic);

(2) Explore the scope of CPGs (that is, what do they include in terms of target population, clinical questions, and topics covered);
(3) Examine the consistency of CPG recommendation across guidelines;
(4) Compare CPG recommendations across both diagnoses (vascular and/or traumatic); and
(5) Present synthesised recommendations of the five guidelines rated as being of highest methodological quality.

3.3 METHOD

3.3.1 Identification and selection of guidelines and their recommendations

Eligible guidelines focused on moderate to severe acquired brain injury rehabilitation (inpatient and community rehabilitation settings). The definition of acquired brain injury used *"includes traumatic brain injuries, strokes, brain illness, and any other kind of brain injury acquired after birth. However, acquired brain injury does not include degenerative brain conditions such as Alzheimer's disease or Parkinson's disease"* (Brain Injury Australia, 2016). Only recommendations pertaining to adults with a moderate or severe acquired brain injury, as defined by the source study's authors, were included (i.e. recommendations pertaining to transient ischaemic attack, mild stroke or brain injury were excluded). Guidelines not published in English were ineligible. This review was prospectively registered with the Prospective Register of Systematic Reviews (PROSPERO) (CRD42016026936).

3.3.2 Search for guidelines

Medline and EMBASE databases were searched from the earliest record until November 2017; guideline repositories including Guidelines International Network (GIN), National Guideline Clearinghouse, Scottish Intercollegiate Guidelines Network (SIGN), National Collaborating Centre for Chronic Conditions (NICE, 2013) and professional rehabilitation society websites were also searched. Search terms included words related to *brain injury, stroke, rehabilitation, guidelines, therapy,* and *practice guidelines.* Reference lists of included articles were also reviewed. Titles and abstracts were screened (LJ) and full text papers retrieved and reviewed independently by two reviewers (LJ and NAL) using predetermined criteria (Figure 3.1). Disagreements were

adjudicated by an independent reviewer (TH). In instances where guideline development groups updated their guidelines in a modular format (i.e. update of specific topic areas) and published these over separate papers, we recognise this as *one guideline* (inclusive of update) and AGREE rated both papers as one. The search strategy is available in supplementary document one (Appendix D), and list of the excluded papers with reasons for exclusion is available in supplementary document two (Appendix D).

1) Systematic literature searches and review of existing scientific evidence published in peer-reviewed journals were performed during the guideline development OR the guidelines were based on a systematic review published in the four years preceding publication of the guideline (PEDro, 2016).

2) The clinical practice guideline was produced under the support of a health professional association or society, public or private organization, health care organization or plan, or government agency (PEDro, 2016).

3) The clinical practice guideline contains systematically developed statements that include recommendations, strategies, or information to guide decisions about appropriate health care

4) Refer to inpatient rehabilitation and / or community rehabilitation of patients with acquired brain injury diagnosis.

5) Guidelines focus on more than one single component of rehabilitation (e.g. memory AND attention retraining)

6) Published in English, from 1st January 2006 onwards.

Figure 3.1. Guideline inclusion criteria

3.3.3 Appraisal of guidelines

The Appraisal of Guidelines for Research and Evaluation (AGREE) II Instrument (The AGREE Collaboration, 2002) was used to assess the methodological quality of the included guidelines across six domains: scope and purpose, stakeholder involvement, rigor of development, clarity and presentation, applicability and editorial independence. Additionally, an overall guideline assessment score was assigned by the rater and recommendation decision made (options were yes, yes with modifications or no). The 23 item AGREE-II tool uses a seven-point agreement scale from one (strongly disagree) to seven (strongly agree). Each guideline was independently rated by two authors (LJ and NAL). Major discrepancies in the scores (where assigned scores differed by more than

two points) were discussed and independently reassessed by a third author (TH). Domain scores were calculated, whereby a total quality score was obtained for each domain by summing the score of each item (Brouwers et al., 2010). The mean domain score (between the two raters) was used to standardise the domain score as a percentage. To measure inter-observer agreement across the ordinal categories of the AGREE II ratings, a weighted kappa was calculated using Statistical Package for Social Sciences (SPSS). This takes into account the degree of disagreement between assessors by assigning less weight to agreement as categories are further apart (Cohen, 1968; Viera & Garrett, 2005). An overall kappa was also calculated across all guidelines. A kappa value of <0.2 indicates poor agreement; 0.21-0.4 fair; 0.41-0.6 moderate; 0.61-0.8 good and 0.81-1.0 very good agreement (Altman, 1991).

3.3.4 Synthesis of guideline recommendations

Textual descriptive synthesis was used to analyse the scope, context, and consistency (i.e. similar or conflicting messaging) of the CPG recommendations. Initially, each guideline was read to gain an overall knowledge of content, one author (LJ) then independently coded the CPG to identify domains covered by the guidelines. Initial codes were identified and refined through constant comparison of each CPG's recommendations as data collection proceeded. For each domain, guideline recommendations were compared across CPGs to identify similarities and discrepancies. Within each theme, the recommendations were further coded into discrete categories where appropriate (for example, *motor therapy* and *inpatient / family education*).

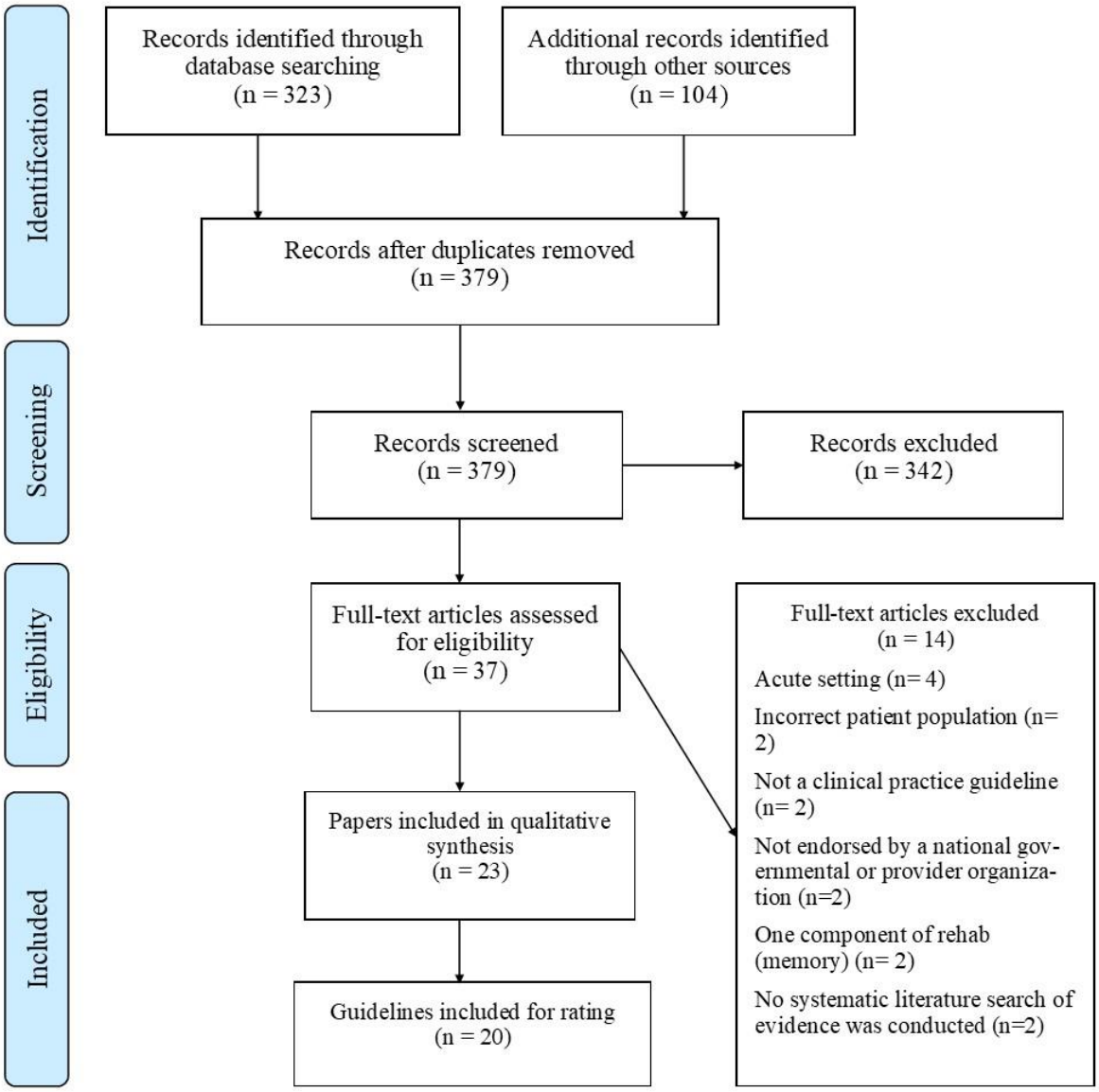
Where a guideline had a generic recommendation without providing details on timeframe, approach or assessment, or discipline responsible, i.e. *all patients should be assessed for pressure injury*, these were not included within the relevant category of the scope table. All included guidelines' levels of evidence and grades have been converted to a unified level of evidence grading of National Health and Medical Research Council (NHMRC, 2011) for ease of comparison (indicated on Table 3.1 by an asterisk). Authors (LJ and NAL) compared guidelines for consistency (congruence in content and recommendations), scope (number of different categories of recommendations) and depth (number of recommendations per category). Finally, recommendations from the guidelines rated highest in quality (AGREE II rating) were synthesised to provide an overview of all recommendations.

3.4 RESULTS

3.4.1 Search and guideline characteristics

The electronic search strategy identified 427 publications with 48 duplicates. After screening and review, 23 documents containing 20 guidelines were included in the review (Figure 3.2 shows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart) (Liberati et al., 2009). Included guidelines covered stroke (n=12) and traumatic brain injury (n=4); and some were discipline specific (occupational therapy n=2, nursing n=1, pharmacological treatment=1).

The characteristics and the development processes of each guideline are provided in Table 3.1. Guideline development groups were from Australia/New Zealand (four), Europe (six), America (six) and Canada (four). All guideline developers conducted a systematic literature search, however methods used to extract the data and synthesise the evidence varied. Some guideline developers (n=7) graded the level of study evidence included for review, whilst most graded both the level of study evidence and strength of the recommendations (n=13).



* Papers may have been excluded for failing to meet more than one inclusion criteria

Figure 3.2. Flow of papers through the review.

Table 3.1. Characteristics of the included guidelines (n=20)

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
America								
Wheeler & Acord-Vira (2016)	Occupational therapy practice guidelines for adults with TBI	2016	Occupational therapists, educators, consumers, families, caregivers, third-party payers and policy makers.	Occupational Therapists	Guideline development group	Systematic literature review	Level 1-4*	NS*
Wolf & Nilsen (2015)	Occupational therapy practice	2015	Occupational therapists, educators,	Occupational Therapists	Guideline development	Systematic literature review	Level 1-4*	A-C, I*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
	guidelines for adults with stroke		clients, families, caregivers, third-party payers and policy makers.		group review			
Department of Veterans Affairs / Department of Defense (DVA/DoD, 2010)	Management of stroke rehabilitation	2010	Healthcare professional in stroke management	Multidisciplinary	Guideline development group review	Systematic literature review	Level 1-4*	A-C, I, GPP*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
Miller et al. (2010)	Comprehensive overview of nursing and interdisciplinary rehabilitation care of the stroke patient: a scientific statement from the American Heart Association	2010	Nurses and stroke healthcare clinicians.	Multidisciplinary	NS	Systematic literature review	Level 1-4*	A-C*
Warden et al. (2006)	Guidelines for the Pharmacologic	2006	NS	Physicians	NS	Systematic literature review	Level 1-4*	NS

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
	Treatment of Neurobehavioral Sequelae of Traumatic Brain Injury							
Winstein et al. (2016)	Guidelines for adult stroke rehabilitation and recovery	2016	NS	Multidisciplinary	Internal and external peer review.	Systematic literature review	Level 1-4*	A-C*
Australia/ New Zealand								
Bayley et al. (2014)	INCOG Guidelines for Cognitive Rehabilitation Following	2014	Healthcare professionals, rehabilitation support workers, clients	Multidisciplinary	External review by journal publisher	Systematic review of published guidelines	Level 1-3.3*	A-C, GPP*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
	Traumatic Brain Injury: Methods and Overview		and their families.					
Stroke Foundation (2017)	Clinical guidelines for stroke management	2017	Administrators, funders, policy makers, health professionals.	Multidisciplinary	Public consultation, consumer consultation, peer review by international experts.	Systematic literature review	Level 1-4	A-D, GPP
New Zealand Guidelines	Traumatic Brain Injury: Diagnosis,	2006	Health practitioners, private	Multidisciplinary	External peer review,	Systematic literature review	Level 1-3*	A-C, GPP*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
Group (NZGG, 2006)	acute management and rehabilitation		providers, case managers, educationalists and funders.		expert peer review.			
Stroke Foundation of New Zealand and New Zealand Guidelines Group (SFNZ&NZGG, 2010)	Clinical Guidelines for Stroke Management	2010	Health practitioners, administrators, funders and policy makers.	Interdisciplinary	Public consultation, consumer review, stakeholder review.	Systematic literature review	Level 1-4	A-D, GPP

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
Canada								
Acquired Brain Injury Knowledge Uptake Strategy (ABIKUS) guideline development group (ABIKUS, 2007)	Evidence-Based Recommendations for Rehabilitation of Moderate to Severe Acquired Brain Injury	2007	Healthcare professionals, policy makers, funding bodies, rehabilitation support workers, clients, families.	Multidisciplinary	External individual reviewers	Systematic review of published guidelines	Level 1-4*	E*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
Hebert, Lindsay, et al. (2016)	Canadian Stroke Best Practice Recommendations : Stroke Rehabilitation Practice Guidelines, update 2015	2016	Health professionals, policy makers, planners, funders, senior managers, and administrators.	Multidisciplinary	National expert consensus meeting, external expert review.	Systematic literature review	Level 1-4*	A-C, GPP*
Blacquiere et al. (2017)	Canadian Stroke Best Practice Recommendations: Telestroke Best Practice	2017	Health professionals, policy makers, planners, funders, senior	Multidisciplinary	National expert consensus meeting, external	Systematic literature review	Level 1-4*	A-C, GPP*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
	Guidelines Update 2017		managers, and administrators.		expert review.			
Khadilkar et al. (2006)	Ottawa panel evidence based clinical practice guidelines for post stroke rehabilitation	2006	Physiotherapists, occupational therapists, physicians and clients.	Multidisciplinary	External expert review and practitioner review	Systematic literature review	Level 1-3.2*	A-D*
Registered Nurses' Association of Ontario (RNOA, 2005)	(1) Nursing best practice guideline. Stroke assessment across the	2005	Nurses, healthcare professionals and administrators.	Nursing	External stakeholder review (including clients and families)	Systematic literature review	Level 1-4*	A-B, GPP*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
	continuum of care.				SCORE Project review.			
Registered Nurses' Association of Ontario (RNAO, 2011)	(2) Stroke assessment across the continuum of care 2011 supplement.	2011	Nurses, healthcare professionals and administrators.	Nursing	Peer review	Systematic literature review of published guidelines	Level 1-4*	E*
Europe								
European Stroke Organisation (ESO) Writing	Guidelines for management of ischaemic stroke and transient	2008	NS	Multidisciplinary	NS	Systematic literature review	Level 1-4*	A-C, GPP*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
Committee (ESO, 2008)	ischaemic attack							
Quinn et al. (2009)	Evidence-based stroke rehabilitation: an expanded guidance document from the European stroke organisation (ESO) guidelines for management	2009	NS	Multidisciplinary	Editorial group review	Systematic literature review	Level 1-4*	E*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
	of ischaemic stroke and transient Ischaemic attack 2008*							
Intercollegiate Stroke Working Party (ISWP, 2016)	National Clinical Guidelines for Stroke	2012	Funders, clinical staff, managers of stroke services, patients with stroke, their families and friends.	Multidisciplinary	Internal and external peer review (national and international).	Systematic literature review	Level 1-3*	E*

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
National Institute for Health and Care Excellence (NICE, (2013)	Stroke rehabilitation: Long-term rehabilitation after stroke	2013	Healthcare professionals, educationalists, consumers.	Multidisciplinary	Public consultation	Systematic literature review	Level 1-3.2*	E*
Scottish Intercollegiate Guidelines Network (SIGN, (2013)	Brain injury rehabilitation in adults	2013	Managers of a health service, healthcare clinicians, clients, their carers, and researchers.	Multidisciplinary	National open meeting, independently expert review, SIGN	Systematic literature review	Level 1-4	A-D, GPP

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
					editorial group.			
Scottish Intercollegiate Guidelines Network (SIGN, 2010a)	Management of patients with stroke: identification and management of dysphagia (CPG 119)	2010	Healthcare clinicians, healthcare service planners, clients, their families and carers.	Multidisciplinary	Consumer review, independent expert review, public consultation, SIGN editorial group.	Systematic literature review	Level 1-4	A-D, GPP
Scottish Intercollegiate	Management of patients with stroke:	2010	Health practitioners, specialists in	Multidisciplinary	External expert review,	Systematic literature review	Level 1-4	A-D, GPP

Guideline organisation / society / authors	Guideline name/s	Year/s of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included†	NHMRC grade of recommendation‡
Guidelines Network (SIGN, 2010b)	rehabilitation, prevention and management of complications, and discharge planning (CPG 118)		public health, healthcare service planners, clients, families, and carers.		public consultation, SIGN editorial group.			

†**Level of evidence:**
Level 1: A systematic review; meta-analyses of randomised control trails; well powered RCT's.
Level 2: A randomised control trial.
Level 3-1: A pseudorandomised control trail i.e. alternate allocation
Level 3-2: A comparative study with concurrent controls: non-randomised experimental trial, cohort study, case control study, interrupted time series with a control group
Level 3-3: A comparative study without concurrent controls: historical control study, two or more single arm study, interrupted time series without a parallel control group.
Level 4: Case studies; a cross-sectional study or case series.
‡**Grade of the recommendation:**

Grade A: Body of evidence can be trusted to guide practice (Level 1 or 2 studies with low risk of bias)
Grade B: Body of evidence can be trusted to guide practice in most situations (1 or 2 level 2 studies with low risk of bias, level 1 or 2 studies with moderate risk of bias)
Grade C: Body of evidence provides some support for recommendation(s) but care should be taken in its application (level 3 studies with low risk of bias, level 1 or 2 studies with moderate risk of bias).
Grade D: Body of evidence is weak and recommendation must be applied with caution (level 4 studies or level 1-3 studies with high risk of bias).
Grade I: Insufficient information to formulate a recommendation
Grade GPP: Good practice points based on clinical experience / consensus of the guideline development group.
Grade E: Nil grade system used, alternative approach based on evidence strength and consensus of the guideline development group.
* = Level of evidence and / or grading system converted to NHMRC (2008) classification of evidence, Stroke Foundation= Stroke Foundation (Australia), NZGG=New Zealand Guideline Group, SFNZ&NZGG= Stroke Foundation of New Zealand and New Zealand Guideline Group, SIGN= Scottish Intercollegiate Guidelines Network, ISWP= Intercollegiate Stroke Working Party, ESO= European Stroke Organisation, NICE= National Institute for Health and Care Excellence, AOTA= American Occupational Therapy Association, DVA/DoD - Department of Veterans Affairs / Department of Defense, ABIKUS= Acquired Brain Injury Knowledge Uptake Strategy, CSS= Canadian Stroke Strategy, RNAO= Registered Nurses' Association of Ontario, NS= none stated, TBI= Traumatic brain injury, SCORE= Stroke Canada Optimisation of Rehabilitation by Evidence.

Table 3.2. Guideline assessment according to the Appraisal of Guidelines for Research and Evaluation (AGREE II) instrument (n = 20)

Guideline organisation / society / authors	Domain Scores (%)						Mean domain scores (%)	Agreement between appraisers
	Scope and purpose	Stakeholder involvement	Rigor of development	Clarity and presentation	Applicability	Editorial independence		Weighted kappa coefficient (κ, 95% CI)
America								
Wheeler & Acord-Vira (2016)	86.1	61.1	53.1	88.9	10.4	45.8	57.6	0.93 (0.86 to 1.0)
Wolf & Nilsen (2015)	94.4	58.3	57.3	66.7	0	29.2	51.0	0.74 (0.61 to 0.87)
DVA/DoD (2010)	86.1	63.9	62.5	75	0	0	47.9	0.75 (0.62 to 0.87)
Miller et al. (2010)	69.4	58.3	9.4	22.2	0	50	34.9	0.94 (0.88 to 1.0)

	Scope and purpose	Stakeholder involvement	Rigor of development	Clarity and presentation	Applicability	Editorial independence	Mean domain scores (%)	Weighted kappa coefficient (κ, 95% CI)
Warden et al. (2006)	80.6	13.9	30.2	50	0	0	29.1	0.67 (0.52 to 0.83)
Winstein et al. (2016)	27.8	22.2	4.2	38.9	0	79.2	28.7	0.64 (.41 to .87)
Australia/ New Zealand								
Bayley et al. (2014)	94.4	66.7	81.3	77.8	68.8	83.3	78.7	0.38 (0.11 to 0.64)
Stroke Foundation (2017)	100	100	90.6	100	83.3	100	95.7	0.90 (.72 to 1.1)
NZGG (2006)	91.7	83.3	70.8	83.3	52.1	75	76	0.73 (0.52 to 0.95)
SFNZ&NZGG (2010)	100	100	89.6	88.9	75	87.5	90.2	0.70 (0.56 to 0.83)

	Scope and purpose	Stakeholder involvement	Rigor of development	Clarity and presentation	Applicability	Editorial independence	Mean domain scores (%)	Weighted kappa coefficient (κ, 95% CI)
Canada								
ABIKUS (2007)	75	55.6	53.1	77.8	0	0	43.6	0.75 (0.59 to 0.90)
Blacquiere et al. (2017) and Hebert, Lindsay, et al. (2016)	100	91.7	87.5	94.4	66.7	100	90.0	0.91 (0.84 to 0.98)
Khadilkar et al. (2006)	88.9	52.8	70.8	75	0	0	47.9	0.80 (0.68 to 0.91)
RNAO (2005, 2011)	100	80.56	76	86.1	70.8	66.7	80.0	0.38 (0.16 to 0.60)

	Scope and purpose	Stakeholder involvement	Rigor of development	Clarity and presentation	Applicability	Editorial independence	Mean domain scores (%)	Weighted kappa coefficient (κ, 95% CI)
Europe								
ESO (2008) and Quinn et al. (2009)	52.8	30.6	45.8	66.7	0.0	100	49.3	0.86 (0.75 to 0.96)
ISWP (2016)	100	97	91	97	54	100	89.8	0.77 (0.62 to 0.91)
NICE (2013)	91.7	72.2	72.9	66.7	58.3	83.3	74.2	0.64 (0.39 to 0.89)
SIGN (2013)	75	75	56.3	75	35.4	50	61.1	0.46 (0.23 to 0.68)
SIGN (2010a)	91.7	75	89.6	94.4	56.3	25	72	0.62 (0.42 to 0.82)
SIGN (2010b)	97.2	100	87.5	100	100	83.3	94.7	0.68 (0.36 to 1.0)

Stroke Foundation= Stroke Foundation (Australia), NZGG=New Zealand Guideline Group, SFNZ&NZGG= Stroke Foundation of New Zealand and New Zealand Guideline Group, SIGN= Scottish Intercollegiate Guidelines Network, ISWP= Intercollegiate Stroke Working Party, ESO= European Stroke Organisation, NICE= National Institute for Health and Care Excellence, DVA/DoD - Department of Veterans Affairs / Department of Defense, ABIKUS= Acquired Brain Injury Knowledge Uptake Strategy, CSS= Canadian Stroke Strategy, RNAO= Registered Nurses' Association of Ontario

3.4.2 Methodological quality

The AGREE II domain scores for each guideline (n=20) are shown in Table 3.2. The mean scores (and range; standard deviation) for the domains were: scope and purpose 85.1% (53-100%; SD 18.3); stakeholder involvement 67.9% (14-100%; SD 25.2); rigour of development 64.0% (9-96%; SD 26); clarity of presentation 76.2% (22-100%; 20.5); applicability 36.6% (0-100%; SD 35.2); and editorial independence 57.9% (0-100%; 37.2). The kappa values ranged from fair κ_w= 0.38 (95% CI: 0.11 to 0.64) to very good 0.94 (95% CI: 0.88 to 1.0). The overall inter-rater agreement was ICC = 0.95 (95% CI: 0.92 to 0.97) indicating very good strength of agreement.

Fifteen (75%) guidelines were assessed as *recommended for use*, (DVA/DoD, 2010; NICE, 2013; NZGG, 2006; RNAO, 2005, 2011; SFNZ&NZGG, 2010; SIGN, 2010a, 2010b, 2013; Bayley et al., 2014; Blacquiere et al., 2017; Hebert, Lindsay, et al., 2016; ISWP, 2016; Khadilkar et al., 2006; Stroke Foundation, 2017; Wheeler & Acord-Vira, 2016; Wolf & Nilsen, 2015) since their quality scores ranged between five and seven, representing good to high quality guidelines. Four (20%) guidelines were *recommended for use after modification*, since they were given quality scores of three and four (ABIKUS, 2007; ESO, 2008; Miller et al., 2010; Quinn et al., 2009; Warden et al., 2006). One guideline with an overall score of two was *not recommended* (Winstein et al., 2016). Three of the 20 guidelines were rated as high (>75%) in all domains of AGREE-II (SFNZ&NZGG, 2010; SIGN, 2010b; Stroke Foundation, 2017). Guidelines updated more frequently were more often of higher quality (i.e. had higher AGREE II scores).

3.4.3 Synthesis of recommendations

The synthesis of clinical management themes and corresponding categories for each guideline are provided in Table 3.3. Five major clinical management themes were identified within the eligible guidelines. These were: medical management (management of depression, pain, behaviour); organisation of services (composition of therapy teams, rehabilitation processes, discharge planning); rehabilitation therapies; managing complications; and community management. The primary recommendations from the highest rated guidelines (SFNZ&NZGG, 2010; SIGN, 2010b; Blacquiere et al., 2017; Hebert, Lindsay, et al., 2016; ISWP, 2016; Stroke Foundation, 2017) are synthesised in supplementary document three (Appendix D, Appendix Table 2). Comparison of guideline recommendations between the top-rated stroke guideline and the top-rated

guideline for traumatic injury (NZGG, 2006) (i.e. where a recommendation is consistent across both aetiologies) has been made, and is displayed in supplementary document three (Appendix D, Appendix Table 2).

Table 3.3. Guideline recommendation themes and associated theme categories in brain injury rehabilitation (n=20)

Theme and Guideline Recommendation Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Medication Management Theme																				
Depression/Mood management					•	•		•	•	•	•	•			•	•				•
Aggression Management			•				•		•		•					•		•		
Psychosis					•															
Memory									•		•									
Executive Dysfunction							•				•									
Arousal and attention											•							•		
Hypertension			•																	
DVT/ Anti-coagulation therapy						•		•		•										•
Cholesterol Management																				
Pain						•		•		•		•			•	•				•
Incontinence						•		•	•	•										
Heterotopic Ossification (HO)											•									
Spasticity			•			•		•	•	•	•	•			•	•		•		•
Organisation of Services Theme																				
Carer support		•	•	•					•	•	•					•	•	•		•

Theme and Guideline Recommendation Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Peer support	•								•	•	•					•	•			
Multidisciplinary service coordination	•		•	•		•	•		•	•	•	•		•	•	•	•	•	•	•
Specialised Rehabilitation Unit			•						•	•	•	•			•	•	•			•
Processes / delivery of rehabilitation services			•			•		•	•	•	•	•		•		•	•	•		•
Rehabilitation Therapies Theme																				
Amount and Intensity	•		•	•		•		•		•		•			•	•	•	•		•
Timing						•		•		•	•	•		•		•	•		•	•
Sensation/Sensorimotor			•			•	•	•	•	•	•					•				
Communication			•	•		•		•	•	•	•	•		•	•	•	•	•		•
Visual / Perceptual Deficits	•	•	•			•		•	•	•	•	•				•	•			•
Cognition	•	•	•	•		•	•	•	•	•	•			•	•	•	•	•		•
Psychosocial	•	•	•	•		•			•	•	•			•		•	•	•	•	•
Activities of Daily Living (ADL)	•	•	•	•		•	•	•	•	•	•	•		•	•	•	•	•		•
Motor Function	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•

Theme and Guideline Recommendation Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Upper Limb Management	•	•	•	•		•	•	•		•	•	•	•		•	•	•			•
Family Participation in Therapy		•	•	•		•	•		•	•						•	•			•
Carer / Family Training			•	•		•	•	•	•	•	•	•			•	•	•		•	
Home Program / Self Practice		•	•					•	•	•	•	•				•				
Patient / Family Education		•	•	•		•	•		•	•	•	•			•	•	•	•	•	•
Goal Setting			•	•				•	•	•	•					•	•			•
Managing Complications Theme																				
Spasticity		•	•	•		•		•	•	•	•	•		•	•	•		•		•
Contracture		•				•		•		•	•	•		•		•	•	•		•
Subluxation		•				•		•		•	•	•		•		•	•			•
Pain						•		•	•	•	•	•		•	•	•	•			•
Oedema								•		•		•								
Fatigue								•		•						•				
Behavior / Mood	•					•	•	•	•		•							•		
Pressure care				•		•				•				•						•
Falls						•		•		•		•		•	•	•				
Nutrition			•	•		•		•		•	•	•		•	•	•	•		•	•

Theme and Guideline Recommendation Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Incontinence				•		•	•	•	•	•				•	•	•	•	•		•
Deep Vein Thrombosis (DVT)				•		•		•		•	•			•						•
Swallowing (Dysphagia)			•	•		•	•	•	•	•	•	•		•		•	•	•	•	•
Heterotopic Ossification (HO)											•									
Seizure Management						•					•									
Nursing Neurological Assessments														•						
Community Management Theme																				
Driving		•	•			•		•	•	•	•	•				•	•			•
Return to work / volunteer			•			•		•	•	•	•	•				•	•	•		•
Leisure		•	•	•		•		•	•	•	•	•				•				
Sexuality		•	•	•		•		•	•	•		•		•		•				•
Psychosocial rehabilitation	•	•	•					•	•	•		•				•	•	•		
Outpatient cognitive rehabilitation	•	•						•		•		•			•	•	•			•
Outpatient motor rehabilitation	•	•				•		•		•		•			•	•	•			•

1= Wheeler & Acord-Vira (2016), 2= Wolf & Nilsen (2015), 3= DVA/DoD (2010), 4= Miller et al. (2010), 5= Warden et al. (2006), 6= Winstein et al. (2016), 7= Bayley et al. (2014), 8= Stroke Foundation (2017), 9= New Zealand Guidelines Group (2006), 10= SFNZ & NZGG (2010), 11= ABIKUS

(2007), 12= Blacquiere et al. (2017) and Hebert et al. (2016), 13= Khadilkar et al. (2006), 14= RNAO (2005, 2011), 15= ESO Writing Committee (2008) and Quinn et al. (2009), 16= ISWP (2016), 17= NICE (2013), 18= SIGN (2013), 19= SIGN (2010a), 20= SIGN (2010b), DVT= Deep Vein Thrombosis, NZGG=New Zealand Guideline Group, SFNZ&NZGG= Stroke Foundation of New Zealand and New Zealand Guideline Group, SIGN= Scottish Intercollegiate Guidelines Network, ISWP= Intercollegiate Stroke Working Party, ESO= European Stroke Organisation, NICE= National Institute for Health and Care Excellence, DVA/DoD - Department of Veterans Affairs / Department of Defense, ABIKUS= Acquired Brain Injury Knowledge Uptake Strategy, CSS= Canadian Stroke Strategy, RNAO= Registered Nurses' Association of Ontario.

Medical Management

Thirteen of the 20 guidelines (65%) included recommendations for medical management (DVA/DoD, 2010; NZGG, 2006; SFNZ&NZGG, 2010; SIGN, 2010b, 2013; ABIKUS, 2007; Bayley et al., 2014; Blacquiere et al., 2017; ESO, 2008; Hebert, Lindsay, et al., 2016; ISWP, 2016; Quinn et al., 2009; Stroke Foundation, 2017; Warden et al., 2006; Winstein et al., 2016). Of these 13 guidelines, the most common category was for spasticity management (85% provided recommendations), followed by depression management (77% provided recommendations), pain management (54% provided recommendations) and aggression management (46% provided recommendations). Few guidelines had recommendations for heterotopic ossification (8.3%), psychosis (8.3%), arousal/attention (17%), and memory (17%). Consistency of guideline recommendations were noted for: the use of botulinum toxin type A for the management of spasticity, minimising the use of benzodiazepines and neuroleptic antipsychotic medications in the management of aggression, not routinely prescribing anti-depressants post stroke for the prevention of depression, and use of selective serotonin reuptake inhibitors (SSRIs) as first line of drug treatment for depression post brain injury.

Organisation of Services

Eighteen of the included guidelines (90%) contained recommendations related to the organisation of rehabilitation services, which were grouped in the following categories: carer support, peer support, multidisciplinary service delivery, specialised rehabilitation unit of care (stroke/neurological ward), and process/delivery of service (Table 3.3). Guideline recommendations within this theme were consistently reported across guidelines; with five of the 18 guidelines reporting at least one recommendation in all five categories (NICE, 2013; NZGG, 2006; SFNZ&NZGG, 2010; ABIKUS, 2007; ISWP, 2016). The most common categories of service organisation recommendations of these 18 guidelines, were use of a multidisciplinary team model (88% provided recommendations), followed by processes / delivery of rehabilitation services (67% provided recommendations) and provision of carer support (56% provided recommendations). It is noted that guidelines that have been updated more recently (i.e. Stroke Foundation (2017)) are removing recommendations related to organisation of services from the guideline; instead referring readers to a national stroke services framework.

Rehabilitation Therapies

Nineteen of the 20 guidelines (95%) had recommendations pertaining to rehabilitation therapies. There were 15 categories identified within this theme (Table 3.3). The most common category of recommendations was for *motor function* (95% of the 19 guidelines provided recommendations), *activities of daily living (ADL)* (89% provided recommendations) *cognition* (84%), *upper limb management* and *inpatient/family education* (79% each), *communication* and *psychosocial* (74% each). Few guidelines made recommendations for the categories of *sensation/sensorimotor* rehabilitation (42%) and *home program/self-practice* (42%).

The guidelines with the broadest scope (that is, had at least one recommendation in most of the 15 categories) were the Stroke Foundation of New Zealand and New Zealand Guideline Group (2010), Stroke Foundation (2017) (Australia) and Intercollegiate Stroke Working Party (2016) with recommendations in all categories (100%). Guidelines narrowest in scope, (that is, recommendations in the fewest number of categories) were Khadilkar et al. (2006), Scottish Intercollegiate Guidelines Network (2013) and Registered Nurses' Association of Ontario (2005, 2011) with recommendations in 13%, 33% and 33% of categories respectively. Guideline recommendations were less consistent across categories in rehabilitation therapies, as shown in Table 3.3.

Managing Complications

Most (n=18, 90%) guidelines had recommendations for managing complications, which were grouped into: spasticity, contracture, subluxation, pain, oedema, fatigue, behaviour, pressure care, falls, nutrition, incontinence, deep vein thrombosis (DVT), swallowing (dysphagia), heterotopic ossification (HO), seizure management and neurological nursing. The Stroke Foundation (Australia) guidelines (2017) was broadest in scope within this category, with complication recommendations in 12 of the 16 categories (75%), followed by SFNZ&NZGG (2010) and Winstein et al. (2016), both with recommendations in 11 of the 16 categories (69%). It is important to note that whilst Winstein et al. (2016) had broad scope in this category, this guideline was not recommended for use according to the AGREE-II rating.

Community Management

Sixteen guidelines (80%) included community management recommendations with the most common categories of recommendations being *driving*, *return to work/volunteer* and *sexuality* (11 of the 16 guidelines; 69% made recommendations in these categories). Recommendations in this category varied in terms of specificity; i.e. some guidelines stated more general recommendations (i.e. therapy should be provided), whereas other guidelines made specific recommendations about therapeutic interventions (i.e. task specific practice).

Overall, guidelines with the highest AGREE II ratings of mean domain score percentage (i.e. >75% in all 6 domains) were: Stroke Foundation (Australia) (2017), SIGN (2010b) and SFNZ&NZG (2010). The top four guidelines for breadth of scope and recommendation specificity were: NZGG (2006), Canadian Stroke Strategy (Blacquiere et al., 2017; Hebert, Lindsay, et al., 2016) and Intercollegiate Stroke Working Party (2016). For medical management, the ABIKUS guideline (2007) was the highest rated.

3.5 DISCUSSION

This systematic review explores the quality and the scope of published CPGs for both vascular and traumatic acquired brain injury rehabilitation in a single, comprehensive review. The quality of the reviewed guidelines, as well as the scope and breadth of recommendations contained in these guidelines varied greatly, which has implications for the clinical utility of each CPG. Research has demonstrated an association between stroke outcome and CPG compliance (Micieli, Cavallini, & Quaglini, 2002), thus, providing clinicians with this synthesised set of recommendations (from highly rated guidelines) is the first step in ensuring quality of care universally in rehabilitation, irrespective of type of acquired brain injury or of country of injury.

This review of 20 CPGs, containing more than 2088 recommendations, demonstrated differences between guidelines which could be expected to substantially influence clinical rehabilitation. The methodological quality of the reviewed guidelines varied, with only three guidelines achieving high ratings in all six AGREE II domains. Across all the guidelines, the highest AGREE II domain score was for *scope and purpose* and the lowest was for *applicability* suggesting that few guidelines provide information to clinicians for how to implement CPG recommendations into rehabilitation.

Whilst the majority of CPGs were of sufficient quality according to AGREE II ratings to be recommended, the scope of recommendations along with the depth of recommendations varied. For example, while Miller (2010) and RNAO (2005, 2011) made only one recommendation for incontinence management, NZGG (2006) provided 11 separate recommendations in the same category. Despite its recent publication (2016), one guideline was not recommended for use (Winstein et al., 2016) and contained multiple recommendation statements that were contradictory to the majority of the other guidelines. For example, in this guideline it was stated that *"routine use of prophylactic antidepressant medications is unclear"* which contradicts recommendations in all five top rated guidelines whereby *routine use of antidepressants to prevent post-stroke depression is not recommended* (SFNZ&NZGG, 2010; SIGN, 2010b; Blacquiere et al., 2017; Hebert, Lindsay, et al., 2016; ISWP, 2016; Stroke Foundation, 2017). Similarly, this guideline stated *"acupuncture may be considered as an adjunct treatment for dysphagia"* (Winstein et al., 2016) which directly contradicts the Australian Stroke Foundation's (2017) updated recommendation whereby *acupuncture should not be used for treatment of dysphagia in routine practice*. Aside from this, there were recommendations which appeared to be universally agreed to by all guideline development groups. These were those specifically pertaining to *using a multidisciplinary approach for rehabilitation, the prescription of selective serotonin reuptake inhibitors for the management of post-stroke depression*, and the use of *task specific motor retraining* for impaired movement. Recommendations in these categories were consistent in their clinical recommendations, the research evidence cited in support of the recommendations, and the breadth of content summarised. Having such consistency suggests to clinicians, that these areas of practice are universally held as representing *quality* rehabilitation.

The differing methods used by each guideline development group may explain some of the observed variation between recommendations. Other explanations may include the year of guideline development (i.e. availability of evidence for inclusion may have varied), date of search by guideline development group, or the eligibility criteria and prioritisation process used when writing the guidelines recommendation. Our findings support the importance of moving towards a universal, international guideline with pooled resources for funding adequate searching and appraisal (such as achieved by the international guidelines for the selection of lung transplant candidates) (Maurer, Frost, Estenne, Higenbottam, & Glanville, 1998).

Separating out clinical conditions (i.e. vascular from trauma) is likely inefficient in clinical practice, given that both conditions are treated consistently with common research evidence findings. Our synthesis found common recommendations across both vascular and trauma CPGs in the areas of organisation of services, rehabilitation therapies, managing complications, and community management. We do acknowledge unique guidelines for each condition in the areas of *medication* and *behaviour* management, however rehabilitation practice recommendations do not appear to differ outside these areas which suggests that a synthesised set of recommendations could substantially improve the quality of rehabilitation. Kirsner and Marston (2016) highlight that variability in guidelines and issues around applicability of recommendations to *real-life* contexts can make the selection and use of guidelines challenging. The usefulness of CPGs rests on the reasonable assumption that following the recommendations will improve care, but having multiple guidelines to apply within a single neuro-rehabilitation setting is unlikely to achieve this. Factor such as 20 available guidelines, published across 23 separate documents, with updates occurring in a modular format and varying modes of access (online, freely available, paid access) hinder clinicians behaviours regarding guideline selection and implementation.

Pragmatically, rehabilitation clinicians are likely to work with mixed acquired brain injury patient populations. Synthesising recommendations of the guidelines with higher methodological quality, as in the present review may improve the future consistency of clinical rehabilitation guidelines and in turn influence the quality of care in this field. Further to this, having direct comparison within a single document between stroke and trauma brain injury recommendations may highlight where rehabilitation practices should differ. Our study has rated all rehabilitation CPGs across both clinical conditions, and suggests that clinicians become familiar with those of both high quality and broad scope. Whilst clinicians may be more familiar with their own national/local clinical practice guidelines, findings from our systematic review suggest that these may not always be of the most methodologically rigorous.

The main limitation of the present study is, perhaps also one of its strengths. That is, the use of a standardised method and rating tool. As previously discussed, the AGREE-II instrument assesses how well a CPG development process is reported, but not the specific clinical content of the CPG recommendations. As we synthesised only the highest quality guidelines for this review, it must be acknowledged that a guideline could receive a high AGREE-II rating, yet contain low quality recommendations based on the level of

evidence accepted by the guideline development group. Our chosen review method may mean that additional and important aspects of a CPG and its ease of implementation were not rated. For example, since the rating tool selected (AGREE-II) does not rate the level of intervention detail provided in the recommendation statements, these aspects fell outside of the current systematic review findings. We have sought to capture this detail in our qualitative synthesis, however we recommend that future discussions of CPG rating tools and systematic reviews of CPGs continue to explore this issue.

3.6 CONCLUSIONS

Multiple CPGs exist to guide rehabilitation for adults after acquiring a brain injury, reporting on either vascular (stroke) or traumatic literature, which makes selecting a high quality guideline to implement overwhelming and difficult. Variability exists in guideline quality, breadth and detail of recommendations and availability of information on applicability of these guidelines. This is likely underpinned by the evidence included and method of evidence synthesis employed by each guideline development group. Clinicians need to be aware of quality differences between these guidelines and be prepared to look beyond their local guidelines to use the highest quality guidelines in the rehabilitation of adults with an acquired brain injury from stroke or traumatic causes.

Chapter 4: Implementing stroke rehabilitation research in Australia: A survey of clinical trialists

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Jolliffe, L., Hoffmann, T., Laver, K., McCluskey, A. & Lannin, N.A. (2019). Implementing stroke rehabilitation research in Australia: A survey of clinical trialists. *Submitted to Disability and Rehabilitation*, January 2020.

4.1 ABSTRACT

Objectives: The implementation of findings from stroke trials into clinical practice remains low. Little is known about planned implementation interventions from the perspective of trialists who generate the evidence. This study aims to investigate perceptions of Australian stroke clinical trialists' about the implementation of their findings into practice, and what implementation interventions they embedded into trial protocols.

Design: A descriptive cohort design and electronic survey

Participants: Three databases were searched to identify Australian stroke rehabilitation trials published between 2007 and 2017. Corresponding authors of the included trials were then invited to complete an anonymous online survey about the implementation of their trial intervention.

Measure: A survey was the primary data collection method and measure, designed and piloted for the purposes of the study

Results: Fifty-one trialists were invited to participate and 38 completed the survey (75% response rate). The majority (79%) considered their trial results to be clinically significant and 68% had pre-planned implementation interventions. The most frequently planned implementation interventions were publication (89%), conference presentation (87%), and feedback of results to target audiences (58%).

Conclusion: Mixed opinions were evident regarding *when* and *how* to design implementation interventions for inclusion in trial protocols. Stroke rehabilitation trialists rely mostly on anecdotal reports about implementation of trial interventions, with few formally measuring uptake.

4.2 INTRODUCTION

Stroke is a major health burden (World Health Organization, 2018), yet investment in stroke research has not necessarily led to improved outcomes for stroke survivors (Lynch, Chesworth, & Connell, 2018). Research waste may be addressed through greater emphasis on implementation of research findings into clinical practice (Berge et al., 2017) -an acknowledged need in stroke rehabilitation (Lynch, Chesworth, et al., 2018). The latest national audit of rehabilitation services across Australia found that adherence to best practice recommendations had decreased from the previous audit, with only 56% of guideline recommendations being met (Stroke Foundation, 2016). Bridging the research-practice gap has gained much attention in the past two decades, with increased efforts focussed on understanding ways to increase the use of evidence-based interventions in practice (LaRocca, Yost, Dobbins, Ciliska, & Butt, 2012).

Prior research has explored clinicians' perspectives of implementation, including perceived determinants to incorporating evidence-based interventions into practice (Bayley et al., 2012; Bigham et al., 2010). Common barriers include limited specificity about how to implement recommendations, intervention details missing from publications, and workplace culture (Bayley et al., 2012; McCluskey et al., 2013). It is assumed that clinicians are responsible for much of the implementation of evidence-based interventions in clinical practice, and perhaps this is why research has predominantly focused on exploring issues from the clinician perspective. Few studies have explored implementation from the perspective of trialists who create the research evidence. Little is known about how or if implementation interventions are built into RCT protocols. Greater understanding of methods used by trialists' may enable development of targeted approaches to support trialists' and facilitate research uptake. In turn, this process may alleviate some of the barriers identified by clinicians.

The aims of this study were to investigate the perceptions of Australian stroke clinical trialists' about the implementation of their findings into clinical practice, and what implementation interventions they embedded into their trial protocols.

4.3 METHOD

4.3.1 Study design and sample

This study used a descriptive cohort design and electronic survey (SurveyMonkey).

A systematic search was conducted to identify Australian-based clinical trialists who had published a stroke rehabilitation trial in the previous decade; these trialists became our survey sample. To identify trialists, CINAHL, PEDro and Scopus were searched with limits on studies conducted in Australia, published in English, between 2007 and 2017 (inclusive). Free text and Medical Subject Headings (MeSH) search terms included: stroke rehabilitation, trial, randomised controlled trial, and/or RCT. Other inclusion criteria were that studies had to report the effects of an intervention, and provide contact details for a corresponding author. Drug trials with no adjunct rehabilitation therapy were excluded. Following removal of duplicates, study titles and abstract were screened by one author (LJ) to remove ineligible studies. Potentially eligible studies identified at this stage were screened using the full text papers by two authors (LJ & NL). An email was sent to the corresponding author for included trials, inviting participation in an anonymous online survey. A reminder email was sent two weeks later.

4.3.2 Survey instrument and data collection

The survey was designed specifically for the study, contained categorical and free-text response options with 16 questions across four sections: (i) about the trial; (ii) practice and/or policy changes; (iii) stakeholder engagement, and (iv) implementation strategies. Implementation interventions were defined in the survey as *activities to support the translation of new clinical knowledge into healthcare practices* adapted from Grimshaw et al. (2012). The survey was adapted following a series of interviews (Howlett, McKinstry, & Lannin, 2018) with a pilot group of five trialists. Minor changes were made enabling easier survey completion (i.e. most likely response options listed first in response list) and to provide clarity to questions (i.e. example of *non-financial resource* provided). Additional responses (i.e. the inclusion of *other* as a response option) and free-text options were added to three questions to ensure exhaustive response options (see Appendix E for the final survey).

4.3.3 Data analysis

Descriptive statistics were used to analyse quantitative data. Open-ended responses were thematically coded by one author using content analysis. Questions that produced lengthy categorical response options were collapsed. The most frequent (top five)

responses were reported. Text-based responses to open-ended questions were analysed using a literal-level content analysis approach (Patton, 2002) to condense comments into major themes. This type of analysis was appropriate given the brevity of some text responses.

4.4 RESULTS

From database searches, 292 publications were identified and 51 trials met the inclusion criteria (see Figure 4.1). Corresponding authors were contacted, with 38 responders (response rate of 75%). The clinical discipline of trialists included physiotherapists (46%), occupational therapists (17%), speech pathologists (14%), medical doctors (9%), neuropsychologists, neurophysiologists and applied scientists (1% each respectively).

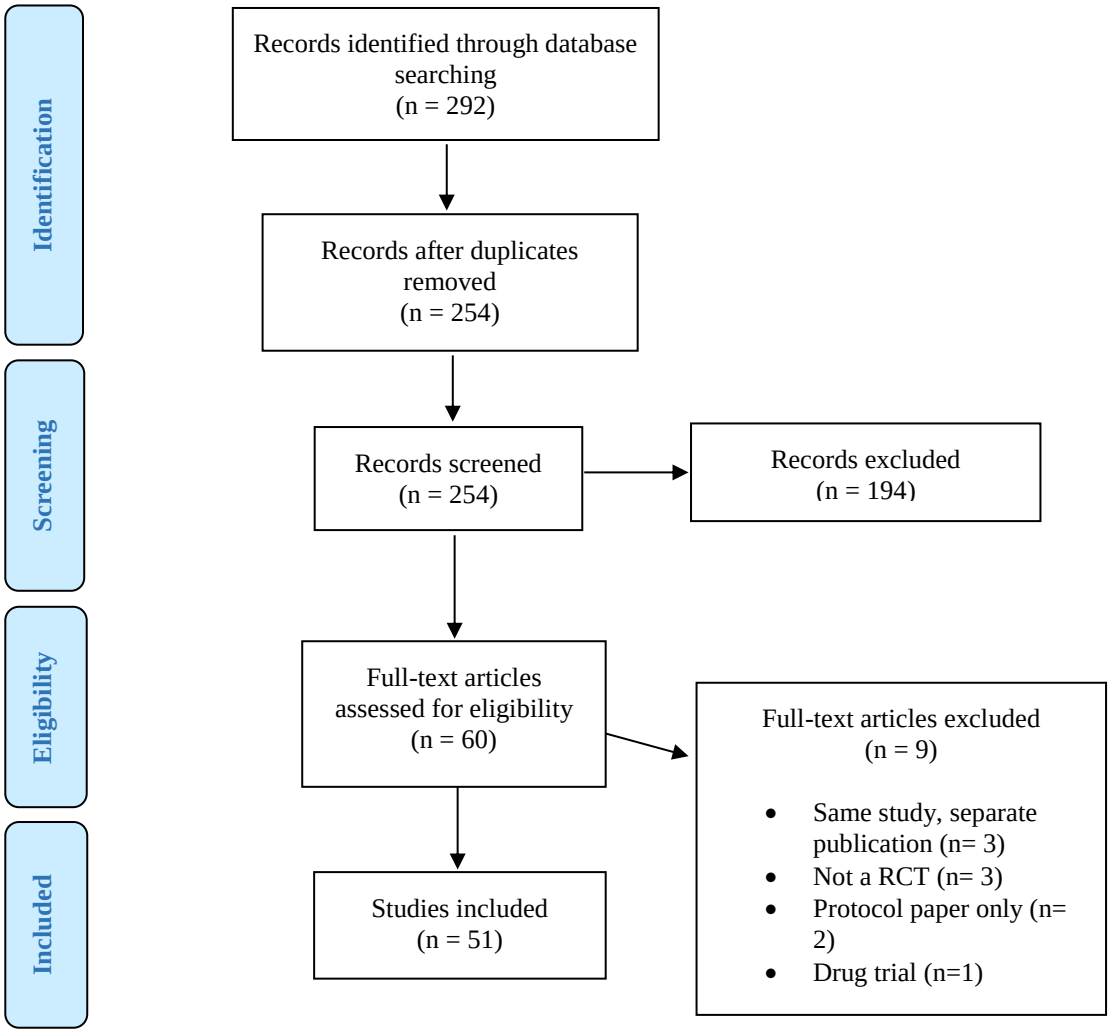

Figure 4.1. Flow of trials identified from the systematic search

The majority of trialists (81%) considered their results to be clinically meaningful based on the following reasons: they identified a service gap/s, produced novel findings, and/or answered a clinically meaningful question. Most trialists (69%) had pre-planned some type of implementation intervention, however the interventions reported mostly included publications, presentations at a conference, or to a specific target audience. About half of the trialists (49%) reported that a description of their study intervention was publicly available (protocol paper published, detail published sufficiently in results section of the paper or made available online). A further 41% of trialists stated that their study-intervention would be made available to interested readers upon request to the authors (Table 4.1).

Table 4.1. Characteristics of included trials (n=38)

Survey item	Response, n (%)
Do you consider the findings of your trial to have been clinically significant / important?	
Yes	30 (79)
No	5 (13)
Unsure	3 (8)
Are there economic implications from your trial (for example, was the study-intervention cost-effective)?	
Yes, based on economic data collected and findings produced	7 (18)
Yes, however we did not collect specific economic data	5 (13)
No, we collected health economic data but didn't find a clinically important economic finding	4 (11)
No, we did not have health economic data nor aims for this trial	19 (50)
Unsure	3 (8)
Have you undertaken any *implementation* interventions for your study	
Presented results of RCT in published paper	34 (89)
Presented findings at a conference	33 (87)
Spent time with specific target audiences presenting the research findings	22 (58)
Held informal conversations with clinicians to discuss research findings	21 (55)
Provided skill building sessions (e.g. ran a workshop) among clinicians / target audiences	18 (47)
Spent time with specific target audiences discussing ideas for possible actions	15 (39)

Survey item	Response, n (%)
Social media	11 (29)
Published study-intervention details [beyond the main publication of RCT results] (e.g. published a companion paper with intervention details, or a process evaluation paper)	9 (24)
Created a brief summary of research findings / report, either in hard copy or electronically, and made this available:	
To research participants	10 (27)
To stroke patients more widely	6 (16)
To management / administration staff	6 (16)
To relevant clinical staff (e.g. via post / email)	16 (43)
via website and/or public media	
Internally; e.g. placed on your organisational intranet/ library	8 (21)
Externally; e.g. placed on your organisational website	4 (11)
Created a full report of research findings / report, either in hard copy or electronically, and made this available:	
To research participants (via post or email)	3 (8)
To stroke patients more widely	1 (3)
To relevant clinical staff (e.g. via post / email)	6 (16)
To management / administration staff	3 (8)
Internally; e.g. placed on your organisational intranet/ library	4 (11)
Externally; e.g. placed on your organisational website	3 (8)
No, we have not undertaken any implementation interventions	2 (5)
Did you plan any of these implementation interventions before you commenced your trial, i.e. did you develop an implementation plan alongside your clinical trial protocol?	

Survey item	Response, n (%)
Yes	25 (68)
No	12 (32)
Are your study-intervention materials available to others or sufficiently detailed in the trial paper that others would be able to replicate the intervention?	
Yes, publically available	19 (50)
Yes, available on request from author	15 (39)
No	4 (11)

Most trialists reported being aware of some practice changes (either at the study site, within Australia/New Zealand, or internationally), following dissemination of their study results. Some trialists also reported a policy impact (Table 4.2). Three themes emerged from analysis of free text comments, (i) *little measurement of study-intervention uptake,* (ii) *guideline recommendations are considered practice/policy change,* and (iii) *publication is used to target clinician behaviour change.* Participants appeared to base their responses about practice and/or policy change on anecdotal feedback. For example, one respondent stated that their knowledge of study-intervention uptake was from *"Anecdotal reports primarily, as well as based on invitations to present and run workshops."* Another responder commented that *"We have had a lot of sites ask about purchasing equipment"* leading the trialist to believe that there was an uptake intention. When asked about practice and/or policy change, the most frequently reported response was that their trial results had been included in clinical practice guidelines or a systematic review, for example: *"A systematic review that included my RCT has been published recently that recommends this intervention…so this is likely to be influencing practice".* Trialists believed that sharing their findings via publications encouraged clinicians to *believe* the evidence (a motivator for intervention adoption). Responses such as *"We have published and presented the number of repetitions of reach to grasp activities achieved in our trial… this kind of communication may encourage therapists to try to achieve more practice in their therapy"* contribute to that theme. Refer to Figure 4.2 for themes and examples of the free text responses.

Table 4.2. Participants' responses about practice and/or policy changes from trial results (n=38)

Survey item	Response, n (%)				
	Yes, at study sites	Yes, within Aus. & NZ	Yes, Internationally	Unsure	No
Do you perceive that there have been any practice changes as a result of your trial?	14 (40)	10 (29)	4 (11)	11 (31)	4 (11)
Do you perceive that there have been any policy changes as a result of your trial?	8 (23)	11 (31)	1 (3)	15 (43)	8 (23)
Do you perceive that there have been any funding changes as a result of your trial?	0 (0)	0 (0)	0 (0)	12 (34)	23 (66)

Aus= Australia, NZ=New Zealand.

Theme 1: Measure of study-intervention use/uptake often not formal

- "Anecdotal reports primarily, as well as based on invitations to present and run workshops."
- "Maybe in South Africa [our study-intervention is used]"
- "We have had a lot of sites ask about purchasing [name of equipment]"

Theme 2: Trial results included in clinical practice guidelines or systematic reviews are considered practice/policy change

- "Results were included in national clinical guidelines"
- "Guidelines have picked up the trial information and many incorporate the findings in the guidelines"
- "Included in the recent update of Stroke guidelines"
- "Future international guidelines may be influenced by my study"
- "Recommendations now in stroke guidelines"
- "This research helps to support current guideline recommendations (weak) for 45-60 mins of therapy, starting as early as possible after stroke"
- "A systematic review that included my RCT has been published recently that recommends this intervention with select clients in rehabilitation settings so this is likely to be influencing practice"
- "Findings of the study have contributed to the pool of evidence around intensity and timing of treatment and have been included in a Cochrane Review"
- "Contributed to national clinical guidelines and Cochrane review"

Theme 3: Publication of results may encourage clinicians' belief about the evidence

- "We have published and presented the number of repetitions of reach to grasp activities achieved in our trial, which was 10 fold that used in the standard care control group, and this kind of communication may encourage therapists to try to achieve more practice in their therapy."
- "There is a slowly increasing ground-swell to 'believe' that the majority of people with aphasia can tolerate 45-60 minutes of direct aphasia therapy when it is provided"
- "Findings of the study have contributed to the pool of evidence around intensity and timing of treatment"

Figure 4.2. Themes and examples of free text responses regarding practice and policy change

Common categories of stakeholders targeted by trialists to facilitate implementation included clinicians, managers of organisations, other researchers, stroke survivors and their carers. The majority of trialists (74%) did not invest or allocate resources to implementation interventions. If funds were available, they were used to pay publication costs, for conference attendance or development of e-learning modules. Non-financial

resources (in-kind) allocated to implementation interventions mostly included the principal investigators' time and use of facilities (i.e. hospital meeting rooms) (see Table 4.3).

Table 4.3. Participant responses about stakeholders involved and resources allocated to implementation interventions (n=38)

Survey item	Response, n (%)
Whom did you target in your implementation interventions?	
Service providers / clinicians	30 (88)
Managers of service-providing organisations (e.g. hospitals, workplaces)	12 (35)
Other researchers	12 (35)
People living with stroke	11 (32)
Carers of people living with stroke	8 (24)
Advocacy groups (e.g. Stroke Foundation)	8 (24)
Research funders	7 (21)
Media (including social media)	6 (18)
Policy makers in federal, state or local government/s	3 (9)
General Public	2 (6)
Future clinicians	2 (6)
Did you invest financial resources specifically into implementation interventions to implement the findings of your trial?	
Yes, we dedicated part of trial budget to implementation interventions	7 (22)
Yes, we employed dedicated staff with implementation duties	1 (3)
No investment of resources in implementation interventions	24 (75)

Survey item	Response, n (%)
Did you invest non-financial resources specifically in implementation interventions to implement the findings of your trial? (e.g. volunteer support, use of equipment/facilities, access to protocols)	
Yes	16 (48)
No	17 (52)

When asked about changes they would make to the trial retrospectively, now that it had been completed, most reported that they would not change the study outcomes (76%), time points (84%) or how results had been disseminated (66%). However, almost half (41%) would consider designing their study differently with respect to feasibility, such as increasing recruitment time and number of study sites, and they would actively plan implementation interventions alongside their trial. For respondents reporting that they would disseminate findings differently (31%), their suggestions included publishing sooner, targeting policy makers, collaborating with implementation experts, and involving consumer advocacy groups (see Table 4.4).

Table 4.4. Participant responses when asked to reflect on implementation (n=38)

Survey item	Response, n (%)		
	No	Yes	Don't know/ haven't considered
Thinking about the implementation (or lack) of your study findings in the time since the trial was completed, would you design your study interventions differently?	16 (48)	13 (39)	4 (12)
Thinking about the implementation (or lack) of your study findings in the time since the trial was	26 (76)	8 (24)	0 (0)

Survey item	Response, n (%)		
completed, would you select different study outcomes?			
Thinking about the implementation (or lack) of your study findings in the time since the trial was completed, would you select different time points?	27 (84)	5 (16)	0 (0)
Thinking about the implementation (or lack) of your study findings in the time since the trial was completed, would you alter how you reported/disseminated the findings?	22 (67)	10 (30)	1 (3)
Thinking about all implementation interventions, are there additional interventions / strategies you wish you had used?	8 (44)	10 (56)	
Free text response item; If yes, please list the additional implementation interventions you wish you had used			
Invest more time in developing pre-planned implementation interventions beyond publications and conference presentations			
Consult and/or collaborate with experts in implementation research into clinical practice/policy. In this way, include implementation objectives into study design.			
Involve more consumer advocacy groups (to increase government awareness and funding needs)			
Involve different stakeholder groups in study interventions - in particular rehabilitation teams vs just acute teams			
Target policy makers more			
Develop more targeted reporting to managers who have control over budget			
Develop targeted strategies for each of our audiences / stakeholders			
Do more to disseminate results to people living with stroke			

Survey item	Response, n (%)
Publish the intervention protocol	
Produce publications sooner	
Complete audit and feedback (ie more frequent), higher dosage of education intervention (more often)	

Analysis of free text responses relating to implementation interventions / strategies revealed two themes: (i) more evidence is required before investing in an implementation plan, and (ii) the science of implementation science is relatively new. Comments included *"We need to collect more evidence for the intervention…then will definitely plan an implementation strategy"* and *"This was a phase two trial, now needs implementation work"* suggesting that respondents believed substantial evidence is required before implementation should be planned. *"I wished we knew more about translation science when we designed this study"*

4.5 DISCUSSION

A key finding from this survey of trialists' pre-planned implementation interventions was that they rely mostly on anecdotal reports of study-intervention uptake as a measure of success, believing that practice and/or policy change has occurred following their research. Without formal measurement of adoption, penetration or sustainability of study-intervention use (and impact), the true extent of study-intervention adoption from guidelines remains limited to the biennial audit conducted by peak bodies such as the Stroke Foundation. Lynch and colleagues (2018) found that only 2.5% of published stroke research evaluated study-intervention implementation, consistent with our findings. Of concern is the reliance on publication and conference presentations to disseminate findings. Without formal evaluation to measure uptake and practice change, the effect of these dissemination interventions remains unknown. Whilst there is no *gold standard* for effective implementation interventions, passive dissemination approaches such as journal publication have a limited impact on clinician behaviour (Beidas & Kendall, 2010; Fixsen, Naoom, Blase, Friedman, & Wallace, 2005).

Trialists perceived their study findings to be clinically important, however there were limited to no pre-planned implementation interventions undertaken across the decade of trials included in our study. Trialists were unsure *when* to plan for implementation interventions, although most recognised that underpowered studies provide insufficient evidence to warrant investment into implementation. When to begin planning for implementation is a decision that warrants further investigation by the research community. While delaying implementation interventions until after a study-intervention effect has been established appears reasonable, securing funding and finding time to undertake a subsequent implementation trial adds to the time-lag between phase three trials and service provision (Morris, Wooding, & Grant, 2011; Oliver, Innvar, Lorenc, Woodman, & Thomas, 2014). There is a trade-off between time needed to develop a strong body of evidence, and the need to provide inpatients with evidence-based care when evidence is still emerging. Clinicians are at the forefront of this dilemma, and many need guidance on which studies should influence inpatient care and the criteria they should use to make these decisions.

Responding trialists provided little data on *how* to plan for implementation. They reported using less effective passive implementation interventions (i.e. one-off meeting to feedback results or published a paper with results). These passive dissemination interventions do not ensure practice behaviour change (Beidas & Kendall, 2010; Fixsen et al., 2005). Active multicomponent behaviour change strategies such as practical workshops and clinical reminder systems are more likely to be effective for study-intervention implementation (LaRocca et al., 2012; Scott et al., 2012). These study-interventions are sometimes available online for use by clinicians as part of a trial publication.

In a recent Australian study exploring opinions of research implementation, clinical researchers described implementation in terms of changing clinical practice. When trialists' research findings were included and incorporated into practice guideline recommendations, participants believed this to be an example of implementation (Lynch, Ramanathan, et al., 2018). This is consistent with our study finding in which the theme *guideline recommendations are considered practice/policy change* emerged from free-text responses. Whilst the inclusion of results in guidelines and systematic reviews may influence practice, guideline recommendations do not usually lead to practice or policy changes, or service provision (Davis et al., 2003; Grol, 2001). This reliance on guideline recommendations (as an intervention for implementation) also contributes to barriers such

as the time-lag between trial completion and uptake of findings, and poor access to intervention protocols cited by policy-makers (Oliver et al., 2014). Trials which rely on publication as the primary mode of dissemination are likely to be affected most by this barrier (Glasziou, Meats, Heneghan, & Shepperd, 2008). Improving relationships and collaboration with policymakers can improve the uptake of evidence into policy (Oliver et al., 2014). Trialists responding to our survey concur with that statement. They wanted to change how they plan for dissemination, and acknowledged the need for collaboration and more engaged relationships with policymakers and advocacy groups. Some respondents that had completed more recent trials (i.e. 2012 onwards) reported investing in partnered-activities such as online learning modules for consumers or embedding results and/or interventions into university curriculum as newer initiatives. Overall, however our study found that trialists reported uncertainty about when and how to design implementation interventions alongside trial protocols. Whilst researchers are incentivised by their institutions to produce publications (Rawat & Meena, 2014), Australian funders should consider initiatives such as mandating implementation interventions (such as Canada and the UK) to encourage trialists to incorporate implementation interventions into trial protocols.

4.5.1 Study limitations

Our survey sought the perspective of Australian trialists, therefore results may not represent the views and activities of international trialists, warranting further exploration. The survey was national, and used a systematic sampling frame to limit usual biases experienced with survey methodologies. Despite the relatively high response rate (75%), our sample size was still small (31 participants) with some responses incomplete (i.e. questions skipped) which impact on the generalizability of results. The self-reporting method of survey may have limited the amount of detail we were able to capture in responses (when compared to alternative methods such as interviews or focus groups) however was most appropriate given the scope of the study. Finally, our survey did not ask for participant characteristics relating to a) research qualifications, b) years of research experience and, c) number of controlled trials conducted. We were therefore unable to analyse the impact of research experience on implementation interventions planned for.

The last two decades have seen a greater focus on the science underpinning

implementation, to help implement trial findings into clinical practice (Estabrooks et al., 2008; Tetroe et al., 2008). Our trialists were aware of, and acknowledged these advances in implementation science. Some reported an intention to consult with implementation experts when planning future trials, to enable earlier implementation. While pre-planning for implementation is a critical first step in any trial, trialists need expert methodologists (ie implementation scientists) to co-design effective implementation interventions as part of trial protocols. Initiatives such as the WIDER reporting guidelines (Albrecht, Archibald, Arseneau, & Scott, 2013) and *Trial Forge* (Treweek et al., 2015) are welcomed resources.

Overall, the study's findings provide support for the following recommendations: (a) Rehabilitation trialists would benefit from specific training in how to document their clinical protocols such that they are easily replicable, repeatable and implementable; (b) Trialists should provide information in their grant applications and protocols on how they are going to plan for implementation; (c) Australian funders should consider initiatives such as mandating implementation interventions to encourage trialists to incorporate implementation interventions into trial protocols, and; (d) Trialists should be encouraged to measure the impact of their studies objectively through not only the inclusion of their results in systematic reviews and practice guidelines, but also policy uptake and any observed practice changes that are in available in clinical registries or clinical data bases of the healthcare system.

Chapter 5: Increasing the uptake of stroke upper limb guideline recommendations with occupational therapists and physiotherapists. A qualitative study using the Theoretical Domains Framework

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5.1 ABSTRACT

Introduction: Despite the availability of stroke clinical practice guidelines and acceptance by clinicians that guidelines contain *best practice* recommendations, compliance remains low. Whilst previous studies have explored barriers associated with implementing rehabilitation guidelines in general, it is unknown if these barriers are applicable to upper limb rehabilitation specifically. To plan effective implementation interventions, key motivators and barriers to use should be identified.

Method: To investigate occupational and physiotherapists' perceptions of motivators and barriers to using upper limb clinical practice guideline recommendations in stroke rehabilitation, a mixed-method study was conducted. Using an online survey and semi-structured focus groups, physiotherapists and occupational therapists working in one of six stroke rehabilitation teams in Melbourne, Australia were invited to participate. Survey data was analysed using descriptive statistics, and thematic coding of free-text responses. Focus groups were transcribed, thematically coded and mapped against the Theoretical Domains Framework.

Results: Forty-six participants completed the survey and 29 participated in the focus groups. Key motivators to use guideline recommendations included past experience with specific interventions, availability of required resources, and an enabling workplace culture. Barriers included: limited training/skills in specific interventions, the complexity of intervention protocols, and beliefs about intervention effectiveness. Lack of accountability was highlighted and clinicians perceived they are rarely checked for quality assurance purposes regarding guideline adherence.

Conclusion: Clinicians identified that both motivators and barriers to implementing best-practice upper limb rehabilitation occur largely at the levels of the individual and the environment. As such, intervention efforts should focus at both these levels to facilitate change.

5.2 INTRODUCTION

Clinical practice guidelines are widely accepted as *best practice* (Kristensen, Ytterberg, Jones, & Lund, 2016; Munce, Graham, Salbach, Jaglal, Richards, Eng, et al., 2017; Scurlock-Evans, Upton, & Upton, 2014; Stroke Foundation, 2016; Upton, Stephens, Williams, & Scurlock-Evans, 2014). Guidelines for stroke rehabilitation were designed to improve rehabilitation practices and assist clinicians in decision-making regarding which interventions to provide when (ISWP, 2016; Jolliffe, Lannin, Cadilhac, & Hoffmann, 2018; Stroke Foundation, 2017). In the area of upper limb movement training, clinical guideline recommendations include provision of constraint-induced movement therapy and task specific motor training to increase activity and use of electrical stimulation for strengthening, however audit results suggest that these interventions are not routinely offered to stroke survivors (Stroke Foundation, 2016).

It has been established outside of stroke rehabilitation that front-line clinicians are often well-informed about clinical practice guidelines (Alonso-Coello et al., 2011; Quaglini et al.; Woolf et al., 1999), suggesting that awareness of guidelines may not be the key reason for low adoption of recommendations into practice. The presence of barriers to, and motivators of, implementation instead may explain lack of adoption. Consistent with clinical areas outside of stroke rehabilitation (Cochrane et al., 2007), most previous research has focused exclusively on barriers to guideline adherence. Stroke rehabilitation clinicians report that the lack of time (Bayley et al., 2012), staffing issues (Bayley et al., 2012; Munce, Graham, Salbach, Jaglal, Richards, Eng, et al., 2017), staff skill levels and knowledge gaps (Baatiema et al., 2017; Bayley et al., 2012; McCluskey et al., 2013; Mudge, Hart, Murugan, & Kersten, 2017), difficulty selecting or prioritising between therapies (Bayley et al., 2012), and access to resources (including protocols) (Baatiema et al., 2017; Bayley et al., 2012; McCluskey et al., 2013; Mudge et al., 2017) act as barriers to delivering stroke rehabilitation in accordance with guideline recommendations. But just as teams face barriers, so too do they possess strengths.

There is now evidence from systematic reviews outside of stroke to show that tailoring implementation strategies to address known barriers and build on known motivators identified by clinical teams increases likelihood of achieving behaviour change (Baker et al., 2010). The gap between the guideline recommendations and actual clinical rehabilitation is likely to be a result of a number of factors which together influence the clinicians' choices (behaviour). The identification of barriers and motivators

is a necessary step to develop a tailored implementation strategy. While there are many theories explaining behaviour change which may be used to guide the development of an implementation strategy (e.g. social learning theory, goal theories, and locus of control theories), the Theoretical Domains Framework condenses multiple theoretical concepts into an accessible single framework (Atkins et al., 2017). Developed using a consensus approach, the TDF is a synthesis of 128 explanatory constructs from 33 theories of behaviour change and comprises of 14 theoretical domains (Cane et al., 2012). The TDF has previously been applied in a variety of settings, including inpatient medicine (Duncan et al., 2012), community paediatrics (Seward et al., 2017) and rehabilitation (Cox, Oliveira, Lahham, & Holland, 2017). The framework has been used specifically in stroke rehabilitation to explore factors influencing the uptake of multiple stroke guideline recommendations (McCluskey et al., 2013). Despite the wide use of the TDF, no studies to date have been conducted with clinicians responsible for providing the recommended interventions to improve upper limb motor activity. Although previous studies have attempted to identify the difficulties experienced by physiotherapists and/or occupational therapists implementing upper limb rehabilitation (McHugh, Swain, & Jenkinson, 2014; Mudge et al., 2017), these have not applied a theoretical framework. Other research has attempted to address gaps in best practice upper limb rehabilitation (Connell, McMahon, Redfern, Watkins, & Eng, 2015), but again, have not sought to understand the barriers and motivators *prior* to designing their interventions, thus tailoring to the context was potentially lacking in studies to date.

It remains unknown if these general barriers apply equally to the implementation of upper limb rehabilitation guidelines in this population. To effectively plan for implementation strategies, we first need to explicitly understand the barriers and motivators as perceived by physiotherapists and occupational therapists when managing the upper limb rehabilitation of adults after stroke.

Therefore, the research question for this study was what do physiotherapists and occupational therapists perceive as motivators and barriers to delivering guideline-recommended interventions to increase upper limb activity after stroke? The intention was to subsequently use the findings to guide tailored implementation interventions for increasing the use of guideline-recommended upper limb interventions by physiotherapists and occupational therapists who work with adults who have had a stroke.

5.3 METHOD

5.3.1 Design

To understand the barriers and motivators to implementation of guideline recommendations, data should be collected from multiple perspectives (Michie, Atkins, et al., 2014). Where able, data should also be collected using a variety of methods, such as interviews and focus groups, surveys, review of local policy documents, and direct observation (Michie, Atkins, et al., 2014).

In keeping with recommendations from Michie et al (2014), a mixed-method explanatory sequential study was undertaken (February 2017), which included both open and closed-ended survey questions. Responses later shaped follow up focus group discussions about motivators and barriers to delivering guideline-recommended interventions. Participating hospital and university ethics committees approved this study prior to commencement (HREC/16/Alfred/169). Participants provided informed consent before data collection began.

5.3.2 Participants

Convenience sampling was used to recruit occupational and physiotherapists responsible for delivering upper limb rehabilitation with stroke survivors at one of the three participating organisations. Eligible clinicians (84 in total across participating organisations), as identified by management, were invited to complete the online survey, and following this, were invited to participate in one focus group (60 minutes in duration). Two of the participating organisations were large, publicly-funded area health services, providing neurorehabilitation on dedicated stroke/neurological wards as well as community neurorehabilitation services (home and centre-based contexts). The third organisation was a smaller private practice providing community neurorehabilitation (home and centre-based contexts). All organisations employed dedicated neurorehabilitation clinicians of varying experience. Characteristics of participants such as practice discipline, years of experience in neurological rehabilitation, and postgraduate qualifications were collected to describe the sample.

5.3.3 Procedure and measures

No existing survey met the specific needs of the study, so we drew on the survey questions piloted and published by Skoien et al (2016). The original 30 items, which were developed using the Theoretical Domains Framework (Michie et al., 2011) and built on previous work by Huijg et al. (2014), were expanded to understand the clinical processes of providing upper limb rehabilitation (assessment, goal setting, intervention planning and intervention delivery), the factors identified to influence stroke clinicians' use of research by previous researchers, and the upper limb guideline recommendations outlined in rehabilitation clinical practice guidelines. The specific guideline recommendations referred to in survey and focus groups included dose (to provide as much scheduled therapy as possible), strength (to use electrical stimulation in conjunction with motor training to overcome weakness), activity (to use constraint-induced movement therapy with eligible inpatients to improve arm and hand function), activity (to use mental practice in conjunction with active motor training to improve arm and hand function), and activity (to use repetitive task-specific training to improve arm and hand function). These recommendations were specifically selected from the Stroke Foundation's clinical practice guideline (Stroke Foundation, 2017) given that this was the top rated guideline from a recent systematic review and synthesis of guideline recommendations (Jolliffe et al., 2018).

This resulted in a 65-item electronic survey, which asked clinicians to rate their level of agreement with statements on a five-point scale (strongly agree to strongly disagree). Survey items asked about clinicians' knowledge of guideline recommendations, confidence and skills in delivering upper limb rehabilitation, and whether they enacted guideline recommendations. The online survey was circulated to eligible clinicians via email by their manager. A single reminder email was sent two weeks after the initial invitation. These same eligible clinicians were then invited to participate in a focus group (60 minutes in duration, both disciplines in attendance) to further explore their motivators and barriers to implementing upper limb guideline recommendations that had been highlighted in survey results. The semi-structured interview guide for the focus groups was developed based on the Theoretical Domains Framework (Cane et al., 2012; Michie et al., 2011) using the recommendations published by Atkins et al (2017) (refer to Appendix H, supplementary document three). Survey results were used to inform focus group prompt and probing questions (see data analysis for more details) and included questions such as *"what do you think about the evidence base behind upper limb*

rehabilitation" and *"what are some of the things that stop you applying upper limb clinical practice guideline recommendations?"* An example of the probing questions were *"do you have an example of that"*. The first author, an experienced occupational clinician, facilitated each focus group. The facilitator holds an Honours degree and training in qualitative interviewing, and had previously worked clinically with some of the clinicians in one of the six focus groups. Focus groups were deliberately facilitated by LJ, a peer occupational therapist (and researcher) to reduce the chance of socially bias responses from participants. The other co-investigators were deemed inappropriate to facilitate discussions given their academic positions and reputation for evidence based practice. All focus groups commenced with a discussion of confidentiality and participants reminded that Chatham House rules applied. Individual focus group content was not fed back or shared with organisation managers. Focus groups were digitally recorded and transcribed verbatim.

5.3.4 Data analysis

Responses to the survey and focus groups were triangulated to capture the multiple perspectives and limit the known tendency where clinicians focus on external rather than internal influences on behaviour (Atkins et al., 2017). Using a mixed method design, both quantitative (survey) and qualitative (focus group) analyses were performed. In analysing the quantitative data from the survey, factors raised by earlier implementation researchers (Baatiema et al., 2017; Bayley et al., 2012; McCluskey et al., 2013; Mudge et al., 2017) were tested. Then, this analysis of the quantitative data was brought into qualitative dialogue with the clinicians to build a greater understanding of the influence of different TDF domains. For survey responses, descriptive statistics were used to summarise the participants' demographic and other characteristics. To evaluate how confident participants considered themselves to be at delivering the aspects of upper limb rehabilitation, we calculated the proportion of participants who rated themselves at the level of *agree* or *strongly agree.* Responses to the open-ended questions were thematically analysed; two coders (LJ, NL) independently used thematic content analysis based on the Theoretical Domains Framework.

Transcripts from the first two focus groups were coded independently by two coders (LJ, NL) into the theoretical domains of the Theoretical Domains Framework. The coders then met to compare and discuss their results to develop a coding scheme. An iterative

process was used to clarify coding differences and to ensure consistency for subsequent analysis. Complete agreement was reached when two coders identified the same response and allocated it to the same domain, whereas partial agreement was reached when two researchers identified the same response but allocated it to different domains. When coders coded the same response differently, the response was allocated into all domains identified by both coders. Disagreements were resolved through discussion.

Sub-category themes were generated from statements describing specific underlying beliefs within each domain by the same two coders (LJ, NL) working together. A specific belief was defined as a collection of responses with similar underlying themes that suggested a problem and/or influence of the belief on the target behaviour (Atkins et al., 2017). For example, the responses "*I really don't have a lot of experience*", "*I feel rusty because it's not something we're doing all the time*" and "*I don't feel like I have had regular exposure*" were identified as the same specific belief of *I need regular caseload exposure and opportunity to practice my skills*.

5.3.5 Credibility

As recommended by Lincoln and Guba (1985), a number of steps were taken to address the issue of credibility of this research including:

- data were collected from a number of health services and across two professional groups to obtain a broad range of views
- focus group data collection continued until no new beliefs were identified (data saturation)
- all focus groups were audio recorded and transcribed verbatim with quotes from participating clinicians classified against the domains of the TDF in a code-book, and exemplar quotes used to explain the findings and presented in results
- following each focus group, data were verified and the transcript checked to ensure consistency in the facilitator's adherence to the interview guide and the probes used to elicit data.

5.4 RESULTS

Forty-six participants completed the online survey (55% response rate) and 29 of

these participated in one of the six focus groups. There was fair representation between disciplines, and across years of neurorehabilitation experience. Demographic details are provided in Table 5.1. Survey responses identified that the majority (<75%) of clinicians strongly agree or agreed to all items, and reported confidence in: knowledge of guideline recommendations, understanding research evidence for interventions, upper limb assessment skills, developing upper limb programs and delivering evidenced interventions. Table 5.2 contains the barriers and motivators to guideline implementation as identified via analysis of the free-text survey responses.

Table 5.1. Characteristics of survey and focus groups participants

Characteristic	Groups	
	Survey participants (n=45)*	Focus group participants (n=29)
Discipline, n (%)		
Occupational therapists	24 (53)	17 (59)
Physiotherapists	21 (47)	12 (41)
Years' experience in neurorehabilitation, n (%)		
< 2	10 (22)	7 (24)
2 to 5	14 (31)	8 (28)
5 to 10	12 (27)	7 (24)
>10	9 (20)	7 (24)

*n=46 however one participant did not respond to this question

Table 5.2. Most frequently identified barriers and motivators to guideline implementation in the textual synthesis of open text survey responses, n=46

Identified Barrier	Frequency in textual synthesis
Time (i.e. limited time in sessions, limited clinician availability)	19
Resources (i.e. equipment availability, access to assessments / tools)	15
Client related factors (i.e. cognition and communication ability)	10
Clinician confidence to complete intervention	9
Clinician skill level to complete intervention	9
Competing patient demands (therapy goal preferences, discharge needs take priority)	7
Limited clinician experience	6
Identified Motivator	**Frequency in textual synthesis**
Resources (i.e. equipment availability, access to assessments / tools)	20
Group programs (i.e. patient's involvement and/or access to group therapy)	11
Supportive team and/or management	9
Mentoring / supervision (i.e. access and engagement)	7
Collaborative approach to upper limb management (i.e. OT and PT working together)	7
Access to AHA and/or family members for intervention involvement	6
Motivated inpatients	6

OT= Occupational therapy, PT= physiotherapy, AHA= Allied Health Assistant

5.4.1 Motivators and barriers identified through focus groups:

The sub-category themes identified in the focus groups with Theoretical Domains Framework domain mapping are presented in Table 5.3 (for motivators) and Table 5.4 (for barriers). The majority of respondents in the survey reported sound knowledge of guideline recommendations and research evidence about intervention effectiveness. Clinicians also reported that through experience, they generally know how much recovery to expect for a stroke survivor's upper limb and 80% reported having a clear plan of action when they encounter stroke survivors with upper limb weakness. Despite this, focus group analysis revealed that clinicians had difficulty selecting interventions and grading an upper limb program. Clinicians spoke of lacking confidence to apply the evidence, and felt that *specific patient factors* (such as cognitive or language impairments) made selecting between interventions difficult. Whilst clinicians reported confidence to identify upper limb issues, decision making for developing an intervention plan was identified as challenging.

Clinicians described intervention protocols as tested in optimal and controlled settings and the difficulties of applying these same protocols in *the real world* (i.e. clinical practice settings). Environmental constraints (including ward layout, daily ward processes and structure) and inpatients not getting enough therapy were identified as barriers. Contributing factors discussed in all focus groups included competing organisational priorities, especially regarding discharge planning. Clinicians felt that their respective organisations' main priority was discharge planning rather than therapy, which therefore limited the amount of time clinicians had available for providing upper limb rehabilitation. Clinicians explained that *the real world* does not enable best practice, with all focus groups raising this issue and all participants in agreement.

A *champion* clinician with upper limb expertise and confidence was seen as able to inspire and motivate the team to deliver best practice. Conversely, without a *champion* to promote an initiative, success was seen as unlikely. From a broader perspective, clinicians identified that there is little to no behaviour regulation or monitoring in place, which can lead to individual clinicians choosing whether to implement specific interventions or not. Aside from the *supervision* structure (i.e. a senior clinician providing mentoring to a junior clinician), there is no colleague-to-colleague monitoring, regular review of practice quality, and limited accountability of clinicians.

Almost all groups expressed concern about limited access to resources; particularly

equipment (such as electrical stimulation machines or constraint-induced movement therapy mitts) and staff (i.e. allied health assistant or clinician numbers). Clinicians felt that team culture was a barrier towards improving the uptake of best practice interventions, and that the hospital policies did not always facilitate best practice (for example, a hospital policy whereby patients need to be supervised at all times in the gym does not permit "*at least 2 hours of upper limb rehabilitation a day"*, since semi-supervised or unsupervised practice was seen as necessary to meet this guideline). Participants demonstrated an awareness of guideline availability, however reported that the guideline recommendations lack specificity. Clinicians reported feeling that awareness of recommendations alone does not allow them to move forward, leaving clinicians unsure of *how* to provide specific interventions or prevent secondary complications (i.e. "*contracture should be monitored"* however how should it be monitored (what measure, how frequently, by whom).

All groups reported that regular exposure to appropriate inpatients, personal experience and access to expert colleagues facilitated learning. Access to training at a time when they would be expected to put the training into practice, and high organisational expectation to use guidelines in practice were strong motivators for change. Clinicians report that they are more likely to use or continue using an intervention if they have observed the intervention's effectiveness, irrespective of its level of research evidence. Reinforcement for using recommended interventions was discussed frequently - clinicians were more likely to use a recommended intervention if it was commonplace in their workplace (i.e. other clinicians also provided the intervention) and/or if the inpatient enjoyed and/or appeared to benefit from doing so.

Table 5.3. Motivator sub-category themes identified by clinicians mapped to the Theoretical Domains Framework domains (n=29 focus group participants)

TDF Domain	Sub-category theme	Examples
Knowledge	Resource knowledge	*"If I don't have the experience in it, I think I've got the knowledge to know what's available out there and try and seek someone who is experienced in it as a resource to support me to deliver it"*
	Awareness of clinical gaps	*"That's the focus we've chosen for this year [upper limb rehab], so I think it is a realisation that we need to improve in that area"*
	Education	*"I said can we get one of those [education] posters and out it up over this person's bed as well, because otherwise their arm was left in awful positions"*
Skills	Coaching	*"I think probably what would be of benefit is training around coaching, [how]…to be a good coach [to patients]"*
Professional role and identity	Interdisciplinary collaboration	*"As OTs [occupational therapists] it's perceived as being our role, but I think we'd get better outcomes if we can do it jointly. I think we've both got a lot to contribute and I think the patient would benefit from having joint [treatment]"*
Beliefs about consequences	Accepting the evidence	*"Well I think given how strong the evidence is around electrical stimulation, I feel like that's something we need to be doing"*

TDF Domain	Sub-category theme	Examples
	Strength of evidence	*"Certainly the ones [recommendations] with the higher level of evidence are the ones that I would prioritise over the others"*
	Seeing is believing	*I think within ABI, my experience seeing people quite a long time post-ABI is that they do seem to get more upper limb [movement] back"*
		"I'll give it a crack, if I see the evidence. But until I see…as a personal experience, of it being effective, I might not accept it"
Optimism	Optimism about recovery	*"…you read a study…you see amazing outcomes…and you think, God they did so well, we better give it a go."*
	Patient motivation	*"It depends on their motivation as well, I think, or their expectations. If it's something they prioritise or they think they're going to get quite a few gains in their function, then they're probably much happier to sit and work on their upper limb*"
Beliefs about capabilities	Confidence	*"So probably a lot more e-stim and task-specific [retraining]. It's probably what I am more confident with"*
Reinforcement	Patient progress	*"…it's enjoyable to see someone else being rewarded with [gains]"*

TDF Domain	Sub-category theme	Examples
	Intervention success	*"So yeah, [choice of intervention] is just… what you've experienced and what you've had successful experience with in the past"*
	Measuring to reinforce progress	*"But when I do remember to do [standardised outcome measurement], the patient always comments. It's really nice to compare the numbers and get that feedback…for that reason, I wish I did it more frequently".*
Goals	Patient motivation	*"…the task specific stuff that we do practice, it tends to work, because the patient is motivated because they're working towards a goal that they want."*
Environmental context and resources	Training inspires reflection	*"The course I talked about, switched my thinking a little bit, and I thought maybe the potential to improve upper limb is actually higher than I originally thought, and that motivated me to encourage and motivate my patients more than I would have before doing the course"*
	Training increases knowledge	*"I've attended another PD session around evidence-based management of the hemiplegic upper limb. So those have helped me – just sort of like remind you what you should be doing"*
	Exposure builds confidence	"*When I was in my earlier days, I'd practice on another Grade 1 or I'd get my supervisor and we'd do it in our supervision sessions, so that helps."*

TDF Domain	Sub-category theme	Examples
	Written prompts	*"...access to resources – the cheat sheets - the e-stim cheat sheets on positioning, for example...they're good."*
	Role-modelling	*"For me it's just more observing and getting support from seniors and supervisors"*
	Nursing staff are a key resource	*"I think nursing staff absolutely as well need to be involved"*
	Family are a key resource	*"Another big enabler is family. It makes such a big difference to how much [the patient] gets and what can be provided."*
	Rehabilitation assistants are a key resource	*"For us what helps is the [rehabilitation assistant] being available ... That helps us offer it more."*
	Restructuring the environment: group therapy	*"Certainly in terms of getting a high number of people together and getting the dosages done, [the group] was effective I think"*
	Environment influences clinician collaboration	*"If my patient was in the gym doing upper limb [rehab with family/AHA] I would be watching what they were doing. I'd be going over and check it out, and encouraging"*

TDF Domain	Sub-category theme	Examples
	Organisational expectation	*"The likelihood of me using an intervention is somewhat overseen by the expectation of the organisation"*
	Restructuring the environment: dedicated stroke team	*"There is a noticeable difference I think if you've worked in different teams or across different sites.... We're having that dedicated, committed team who have expertise and interest makes a phenomenal difference, compared to the team who maybe doesn't have those attributes but are still working…"*
	Restructuring the environment: culture	*"With the [upper limb] group, it has been much better because we're taking away some ward patients... If you take 15 people off the ward, that gets noticed……and supported. Whereas when we try and - I will whisper it - ask people to be ready 9:30, 10 and for whatever reason, it just doesn't happen because it's "I've got this going on already. You can't possibly add to what I'm doing".*
	Access to resources: equipment	*"By having these resources in place they enable you to implement the guidelines easier because you don't have to make them up from scratch? Yep, that's right. Yep absolutely"*
	Access to resources: staffing	*"I think we've got a really supportive team……and that's a really big enabler and the group definitely helps"*

TDF Domain	Sub-category theme	Examples
Social influences	Accountability to peers	*"I was put into a role where the project was to implement e-stim….so I learnt the ins and outs of it really….[I] had that expectation that [I] needed to know what [I] was doing, because [I] was training others. So I think that's how I became confident in e-stim myself"*
	Champion clinicians	*"I've definitely been motivated in the past…when [a new staff member] came on to work for the team…was really, really passionate about [upper limb rehab]. So we did a lot of joint sessions and I learned so much from her"*
	Motivated team	*"The culture. I think it's working with like-minded clinicians that are motivated as well – is a big factor"*
	Motivated patients	*"Yeah, that was a group where they were using - they all had the same Saebo™ devices on and were counting how many balls they could do and there was a competition. They came in every day and they all tried to beat it every day and it worked - that worked beautifully."*
Emotion	Clinicians' emotions	*"I'm a bit sadistic. I love it. I think it's fun. That sounds bad, but in a good way"*

TDF Domain	Sub-category theme	Examples
Behavioural regulation	Regular education and discussion prompts best practice	*"We've also started a journal club in physio, but yeah it's probably the first time we'll be running it this year. It's a start."*
	Professional development	*"We do know what the guidelines are, but it's just that constant reminder that you need to continue to put it into practice"*

Table 5.4. Barrier sub-category themes identified by clinicians mapped to the Theoretical Domains Framework domains (n=29 focus group participants)

TDF Domain	Sub-category Theme	Examples
Knowledge	Knowledge of intervention specifics	*"I think CIMT, there is quite a lot to learn to apply it correctly and probably the knowledge isn't there to be able to apply it to the standards that it should, to enable it to be effective."*
	Knowledge alone is not enough	*"I know what's meant to happen with the patient, but in terms of setting up parameters and really giving the encouragement and guidelines, I don't think I was, I don't think I was good enough"*
	Inaccurate knowledge influences implementation	*"The upper limb part of the brain tends to be more affected than the lower limb part [from a stroke]"*
Skills	Knowledge alone is not enough	*"So when you say believe the evidence, I believe the evidence. It's just how I put it into practice with a [patient], is where I guess I need to do that in practice to know that the evidence (intervention) is going to work with that [patient], that person, that type of impairment"*
	Skill levels vary between clinicians	*"I would say that [the provision of upper limb rehab] in very inconsistent and clinician dependent."*

TDF Domain	Sub-category Theme	Examples
	Skill deficit: Monitoring	*"...but I think there could be more monitoring". "At the moment they are set up with maybe some e-stim to do, but I don't think they are recording, they have recording sheets and things like that to record the frequency"*
	Skill Deficit: Patient progression	*"... but perhaps we need to increase our competency in how to progress"*
		"Understanding when to progress and regress became a bit of a skill."
	Exposure to an intervention builds confidence	*"For me personally - I haven't had any training in e-stim. So I don't feel confident. I wouldn't put it on someone just because I don't have that background for those, which is a barrier for using it"*
	Perceived complexity of upper limb rehabilitation	*"Legs are easier to treat than arms, so some clinicians will choose to treat those above the arm. But I think for that reason, that's perhaps why we're undertreating the arm, is because we don't know enough about it yet"*
Professional role and identity	Interdisciplinary collaboration	*"I think one big barrier is I suppose when different disciplines think of work as being – 'this is our work', 'this is your work'. Not, 'this is all, kind of our work'. That's the hard - that's one barrier that I think is really hard to break, but if you break it, it will make a big difference"*

TDF Domain	Sub-category Theme	Examples
Beliefs about capabilities	Confidence	*"I'm probably not that comfortable [doing upper limb rehab]. Purely that's through lack of experience because previous services I've worked on have been very cognitive behavioural focused and we didn't do the physical work"*
Optimism	Optimism about recovery	*"The number of times I've heard staff say to a client, oh look, there's nothing much to be done about [your hand]. That's my pet hate. Happens all the time. It's a massive barrier"*
	Patient motivation	*"If they're so far down the line and you've come in as a new therapist and you say you want to try this, and they're a bit like, 10 years down the line what are you talking about?"*
Beliefs about consequences	Strength of the evidence	*"I personally think [the evidence] is emerging. I don't think there's enough research on that as much"*
	Protocol delivery	*"But you can't follow that [research intervention protocols] to a T though…we're looking at doing this for three or four hours a day. Would love for the outcome of that… but we can't do that, so we can look at some of the principles that they talk about and dream of one day [laughs] doing it… for three or four hours a day, but it's impossible really…. to follow it to a T"*

TDF Domain	Sub-category Theme	Examples
	Accepting the evidence	*"The CIMT (Salbach et al.) is dodgy – the way its listed in the guidelines. It looks to me as if they've taken something verbatim from another clinical area, but to me it's not applicable"*
	Seeing is believing: Clinicians	*"I'll give it a crack, if I see the evidence. But until I see…as a personal experience, of it being effective, I might not accept it"*
	Seeing is believing: Clients	*"I think some get almost overly obsessed with it, and others probably disengage when they don't see results"*
Reinforcement	Homework reinforces progress	*"The other issue we have on our program, we're a home based rehab, is that often they have exercises from every discipline and then you're trying to get them to do lower-limb, upper-limb, speech and other things and they're [patients] saying, no, I'm not doing any of them"*
Goals	Priority	*"Then other goals, such around self-care and independence take over and walking take over. So I think you're sort of led by the patients a little but with their motivation and where they want to go"*
	Motivation	*"The difficulties were motivating the patients during the sessions. I think they often the repetitive tasking in itself a boring task and if they don't have*

TDF Domain	Sub-category Theme	Examples
		"Maybe the concentration of us or the understanding of why they're doing the task they would often stop performing it"
Memory, attention and decision processes	Clinical planning	*"No, [I don't feel that I am good] at setting up an upper limb training program"*
	Measuring to reinforce progress	*"I think where I fall down is not remembering to do formal assessments repeatedly through patient stays"*
	Making choices between interventions: clinical reasoning	*"It's probably my own clinical reasoning that I decide which I think are most important [recommendations] to take on"*
	Making choices between interventions: patient factors	*"Mine has been the – well not the patient, but the complexities of the patient – either behaviours that have limited us…."*
	Making choices between interventions: organizational culture	*"Definitely there are times when the pressure from the organisation is around getting people out and getting people home, they don't care if [the patient] can't use their arm to drink. As long as they can go home, that seems to be the priority"*

TDF Domain	Sub-category Theme	Examples
	Making choices between interventions: interpreting the guidelines	*"I don't know actually, whether I would be able to interpret the [Stroke Foundation guidelines] in that way [mandatory vs non-mandatory recommendations], unless its stated"*
	Making choices between interventions: competing goals	*"The therapy time is often the first thing to go, because you're ticking all these boxes. It's another thing you have to get through...."*
Environmental context and resources	Training increases knowledge	*"I've been told that I can't go to courses before because of staffing reasons, so you have patients that you potentially can't give upper limb rehab to because you haven't had the experience"*
	Access to resources: staffing	*"A hard aspect about that as well is again the 15 patients each, how long that you've got to spend to actually do it. ...because we don't have - whether it's the time, or the resources or the support to be able to do it…*"
	Access to resources: equipment	"*We only have one of everything as well, in terms of what people can use – equipment they can use for upper rehab."*
	Exposure builds confidence	*"I just think that patient experiences is what consolidates your skills, so you could go to a course but you still wouldn't be confident in providing the*

TDF Domain	Sub-category Theme	Examples
		therapy...unless I had a number of patients that I had to provide the therapy for and saw their outcomes and had feedback from other physios"
	Restructuring the environment: dedicated stroke team	*"From an admission process patients with stroke are being allocated to a lot of different wards. So I think that's a challenge for some of the staff that aren't used to doing and delivering UL rehab, so the clinicians that are more experienced are being asked to go and consult on other wards and upskill people"*
	Restructuring the environment: culture	*"I think it's - I say this all the time - but I think a large factor is culture. This is the way we've always done it, so this is the way we're always going to do it. You feel like you're bashing your head against the wall sometimes, when you try to introduce something new. You need that one person who's a real champion for it and they want to run with it, but then they're not here one day and it falls flat and you have to start fresh. So I think lots of different things we've tried to implement, whether it's timetabling, whether it's this new therapy group, all those sorts of things, It's so challenging to get buy in and to make it, well this is the way that we do it now, everyone get on board.*

TDF Domain	Sub-category Theme	Examples
		"There's always barriers and we're always coming against resistance to that change"
	Restructuring the environment: policy	*"But it's more important to try and get processes and all of that across the organisation, but that involves more staff with varied experience and confidence and varied interest and varied beliefs and staffing resources*"
	Clinical practice guideline specificity	*"We do look at these things and try to make [organisational] changes, it's just tricky when they are – as you say – a bit fuzzy"*
	Restructuring the environment: group therapy	*"The downside is - hopefully you'll back me up on this - is that I think it could be that then staff can say, ah, well that person's receiving their input in that setting…that's all that is needed"*
	Environment influences clinician collaboration	*"I think it is quite siloed at the moment in terms of rehab, that the upper limb work is done over in the OT department and there is upper limb work going on in the gym, but we don't probably see what each other is doing very much"*
	Funding models influence guideline adherence	*"It depends on funding [as to the amount of upper limb therapy] I do with a patient"*

TDF Domain	Sub-category Theme	Examples
	Training increases skill	*"From an OT perspective we have challenges with e-stims with training and competency to allow us to use them here... So that's a barrier."*
	Organisational priorities influence guideline adherence	*"There's not going to be attention paid to it [the upper limb] until somebody kicks up a stink. I mean if you had - if you sort of led clients to say, 'I'm really disappointed with the outcomes I've had with my upper-limb' and that was fed back to the [hospital] Exec or …through us to Exec. It's the only way in my opinion … the only way people respond in many organisations these days is to hear something bad."*
	Environment influences practice	*"The place where the upper limb group is on the ward is actually a dining room, so there's no other cues around that it is for upper limb or any other - it doesn't look like a gym and the table in there are from people to eat from, they're not necessarily suitable for patients in wheelchairs, if we have a few - even two or three in a wheelchair in the room it can become an entire - you have to re-arrange people to get other people in and then the tables don't work because of the arm rests. So it can be logistics - you can spend potentially up to half the session trying to actually sort everything out so that*

TDF Domain	Sub-category Theme	Examples
		people are in the right position to work, and then you've lost of a lot of your time."
Social influences	Perceptions of 'seniority'	*"One of the barriers I think as well as being perceived as an experienced clinician, you're expected to have those skills already when perhaps you don't necessarily have those skills"*
	Champion clinicians	*"You need that one person who's a real champion for it and they want to run with it, but then they're not here one day and it falls flat and you have to start fresh. So I think lots of different things we've tried to implement, whether it's timetabling, whether it's this new therapy group, all those sorts of things, It's so challenging to get buy in and to make it, well this is the way that we do it now, everyone get on board."*
Emotion	Patient emotions	*"The emotional part of it as well. I've had a few clients recently that are just so in grief over their arm that they're like, right, I don't want to work on that just now, because I will just - yeah, and just got really emotional"*
	Clinicians emotions	*"Me, I'll be honest, I want to run for the hills to be honest. It's not my passion at all, but yeah, I recognise I need to work on it, so yeah, I'm trying*

TDF Domain	Sub-category Theme	Examples
		hard and I try and be enthusiastic so my patients are enthusiastic. But yeah, I find it tedious to be honest"
	Frustration	*"Yeah. It's so demoralising, because you're running all day. You're not sitting on your bum and you think what have I done today? What have I achieved? It's horrible. It's really hard"*
Behavioural regulation	Organizational monitoring	*"Yeah, no one is checking what I am doing"*

5.5 DISCUSSION

Our findings on clinicians' attitudes towards guideline implementation suggest a number of possible explanations for the observed low adherence to recommendations for upper limb rehabilitation after stroke that is seen internationally (Kristensen et al., 2016; McHugh et al., 2014; Stroke Foundation, 2016). Barriers identified included difficulty in selecting the most appropriate intervention to use, as well as difficulty prioritising between interventions. Some participants perceived the guidelines to represent an unattainable level of best practice, one that is at odds with the available resources and training that are received by clinicians. They additionally highlighted that individual clinicians hold a large amount of power, being able to choose whether to provide best practice upper limb rehabilitation, and a perceived lack of support from the health care system for efforts to change practice to align with guidelines. Motivators to providing recommended interventions included having regular opportunity to practice skills, having access to role models with clinical expertise, and working in a well set up environment.

In contrast to the survey results, which suggested that most clinicians feel confident to deliver rehabilitation according to the guidelines, focus group discussion suggested significant barriers to providing upper limb rehabilitation exist. Social responsibility bias likely influenced clinicians' survey responses, and/or clinicians were responding about interventions they currently provide (rather than all guideline-recommended interventions). Similarly, throughout focus group discussions, clinicians were heard to avoid discussing their own personal knowledge or skill gaps as barriers, instead feeling more comfortable labelling these as *confidence* or *experience*. For example, frequent reports of *limited experience*, *limited exposure to appropriate patients* and *low confidence* were heard in focus groups. Theoretical Domains Framework mapping coded these barriers more accurately as barriers of Knowledge and Skills domains. The focus groups allowed dynamic discussions in contrast to web-based survey responses, with Theoretical Domains Framework mapping facilitating in-depth analysis of barriers and motivators. We suspect that identification of the *actual* barrier (in this case, skill) rather than *reported* barrier (in this case, exposure or experience) could have implications downstream, especially for strategy development and efficacy analysis. Previous randomised trials in which implementation strategies were tailored to target identified barriers resulted in no change in main outcomes or professional performance (Baker, Reddish, Robertson, Hearnshaw, & Jones, 2001; Flottorp, Håvelsrud, & Oxman, 2003). Given potential discrepancies between *actual* barrier and *reported* barrier as found in this study, using a

theoretical framework (such as the TDF) may facilitate a more accurate profile of barriers.

Other stroke rehabilitation researchers have suggested barriers to implementing guidelines in clinical practice. Consistent with the work of Bayley et al (2012) the clinicians involved in our study also discussed difficulties selecting interventions; and like most previous rehabilitation researchers, we also identified the barrier of insufficient resources to deliver recommended interventions (Baatiema et al., 2017; Bayley et al., 2012; McCluskey et al., 2013; Scurlock-Evans et al., 2014). Unique findings of our study were the acknowledgement that there is a lack of accountability (no monitoring of clinician decision-making) which prevented clinicians implementing the guideline interventions, and difficulty choosing between two interventions (clinical decision-making). Another Australian study (McCluskey et al., 2013) suggested that key barriers to guideline implementation were clinicians' belief about their ability to provide an intervention; their belief of consequences of providing (or not) an intervention; and limited reminders to complete interventions. Clinicians in our study did not focus on these barriers; this difference may be due in part to the difference in study design between the two qualitative studies (our study was completed across six sites, while McCluskey et al (2013) was conducted at one site with a smaller sample size).

Whilst directly meaningful for upper limb neurorehabilitation, this study is likely to have broader implications across other stroke rehabilitation practice areas (i.e. cognitive rehabilitation) and potentially across other allied health disciplines. Using a theoretic framework to guide barrier and motivator identification is supported by implementation research (Debono et al., 2017; Moore et al., 2018; Moullin et al., 2015). Barrier identification is a critical first step, however future research should include intervention mapping with its usefulness tested. From the perspectives gained by this study and echoed in similar research work (Bayley et al., 2012; McCluskey et al., 2013), there remains a clear resource and clinician skill gap in stroke rehabilitation. Perhaps sustainable solutions to this under-resourced sector need to be targeted at state and federal levels (rather than at organisational levels) with peak body organisations (such as the Stroke Foundation) and regulatory boards more involved in clinician skill development and training, and regulatory monitoring. Organisations are also encouraged to move beyond collecting episodes of care to monitor staff activity, as this appears to further contribute to the problem at hand.

Strengths of this study include having multiple sites, a representative range of experience level and targeted disciplines across participants, and use of a guiding framework (TDF) for focus group analysis. Limitations include likely social bias in the survey responses, since knowledge of the guidelines was reported as high, and the presumption that participants were responding to all current guideline recommendations throughout their responses. Given that our survey data findings contrasted with focus group finding, perhaps surveys are less appropriate to collect this type of information. The role of the researcher (i.e. a practicing occupational therapist) as a facilitator in the focus groups was a further limitation. While steps were taken to mitigate bias, there was the potential for participant-observer bias to occur.

In conclusion, clinicians working in stroke identified that motivators and barriers to implementing best-practice upper limb rehabilitation occur largely at the levels of the individual and the environment. As such, intervention efforts should focus at both these levels to improve uptake of the use of guidelines in practice. Providing skill-training to clinicians without addressing their lack of belief in the efficacy of interventions, or providing resources without addressing the significant power held by the individual clinician would thus be unlikely to improve guideline adherence in upper limb rehabilitation.

Chapter 6: Using audit and feedback to increase clinician adherence to clinical practice guidelines in brain injury rehabilitation: A before and after study

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This study has been published as:

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6.1 ABSTRACT

Objective: This study evaluated whether frequent (fortnightly) audit and feedback cycles over a sustained period of time (>12 months) increased clinician adherence to recommended guidelines in neurorehabilitation.

Design: A before and after study design

Setting: A metropolitan inpatient brain injury rehabilitation unit.

Participants: Clinicians; medical, nursing and allied health staff

Interventions: Fortnightly cycles of audit and feedback for 14 months. Each fortnight, medical file and observational audits were completed against 114 clinical indicators.

Main outcome measure: Adherence to guideline indicators before and after intervention, calculated by proportions, Mann-Whitney U and Chi square analysis.

Results: Clinical and statistically significant improvements in median clinical indicator adherence were found immediately following the audit and feedback program from 38.8% (95% CI 34.3 to 44.4) to 83.6% (95% CI 81.8 to 88.5). Three months after cessation of the intervention, median adherence had decreased from 83.6% to 76.6% (95% CI 72.7 to 83.3, $p<0.01$). Findings suggest that there are individual indicators which are more amenable to change using an audit and feedback program.

Conclusion: A fortnightly audit and feedback program increased clinicians' adherence to guideline recommendations in an inpatient neurorehabilitation setting. We propose future studies build on the evidence-based method used in the present study to determine effectiveness and develop an implementation toolkit for scale-up.

6.2 INTRODUCTION

Acquired brain injury is a leading cause of disability in adults (Australian Institute of Health and Welfare, 2007) with a large proportion of survivors requiring rehabilitation (AIHW, 2017). Consistent with other areas of health care, neurological rehabilitation has been observed to vary in quality between services (Green et al., 2012; National Stroke Foundation, 2013). Clinical practice guidelines provide recommendations to assist clinicians make evidence-informed decisions about the interventions they provide (Alonso-Coello et al., 2011; Quaglini et al.; Woolf et al., 1999). Despite the availability of such guidelines, auditing suggests that rehabilitation clinicians do not routinely provide care consistent with guideline recommendations (Stroke Foundation, 2016). Audit and feedback has been recommended as an intervention capable of increasing the uptake of evidence-based recommendations by clinicians (Hebert, Lindsay MP, et al., 2016; ISWP, 2012; Stroke Foundation, 2017).

A growing number of researchers are trialing audit and feedback interventions to promote the use of evidence in rehabilitation, however outcomes for improving clinician adherence have been mixed. The use of implementation interventions in rehabilitation is undoubtedly a positive step forward, nevertheless, critical reflection on the effectiveness of different interventions is key. Specific to audit and feedback interventions, two systematic reviews have synthesised the evidence on effectiveness; these reviews suggest limited to modest improvements occur at best (Hysong, 2009b; Ivers et al., 2012). The latest Cochrane systematic review concluded that audit and feedback generally produces small, but potentially important improvements (Ivers et al., 2012). This is consistent with a second meta-analysis, which found modest improvements on quality outcomes (Hysong, 2009b). These reviews (Aarons et al., 2014; Hysong, 2009a; Ivers et al., 2012) suggest the need for clear definitions of goal-behaviours, and triangulation of data collection to improve the effect of audit and feedback interventions. They also suggested that the characteristics of the feedback component of future studies should be identified so as to build an understanding of the causal mechanisms underpinning audit and feedback as an intervention (Foy et al., 2005; Hysong, 2009b; Ivers et al., 2012).

Prior audit and feedback interventions to increase adherence to guidelines in rehabilitation have been provided infrequently or at low *dose*. For example, to improve the implementation of transport training after stroke, McCluskey and colleagues (McCluskey et al., 2016) delivered a single audit and feedback cycle in their

implementation program, while Kristensen & Hounsgaard (2014) provided four cycles over 15 months, and Vratsistas-Curto et al (2017) provided four cycles over four years. What remains unknown is the effect of audit and feedback when it is provided at a higher dose (such as weekly or fortnightly). A further limitation of the rehabilitation studies to date is that none triangulated their audit information; triangulation occurs by gathering information from multiple sources.

Studies outside of rehabilitation also suggest that it is important to strategically plan the method of feedback delivery; for example, nurses reported feeling *exasperated* and *angry* when they received feedback they perceived as critical (Christina, Baldwin, Biron, Emed, & Lepage, 2016). Few studies have reported the use of a theoretical underpinning to their feedback delivery (Colquhoun et al., 2013; Hysong, 2009a; Ivers et al., 2012). In contrast, LaVigna and colleagues (1994) deliberately adopted a *non-aversive approach* when working with staff in quality improvement cycles, and developed a form of audit and feedback known as periodic service review (LaVigna, 1994; Lowe et al., 2010). Periodic service review has its base in both total quality management (Mawhinney, 1992) and organizational behaviour management (Deming, 1986; Sluyter, 2000), and differs from other auditing approaches used in prior rehabilitation studies, since it is undertaken at a high dose, uses positive support strategies during feedback, and actively involves staff in the process (Lowe et al., 2010). It remains unknown if this approach to audit and feedback would increase adherence to guidelines in rehabilitation, where prior audit and feedback studies have not.

Therefore, the aim of this study was to evaluate the impact of a prospective audit and feedback program on adherence to neurorehabilitation guidelines. We sought to understand whether:

1. frequent audit and feedback cycles (with positive behavioural support) increased clinician adherence to clinical practice guidelines
2. increases in adherence are maintained after the cessation of audit and feedback program
3. changes in adherence differ according to individual guideline indicators

6.3 METHOD

6.3.1 Design

A before-and-after design with a three month follow-up was used to test the effect of a 14-month audit-feedback program in an inpatient rehabilitation setting. There were eight assessments at baseline, eight assessments at end of intervention and 20 assessments at follow-up. The study design and flow is depicted in Figure 6.1. The administrative organization's Human Research Ethics Committee approved this study prior to its commencement (Alfred Health Human Research Ethics Committee 355/14); a waiver of consent for participation was approved, meaning that all inpatients and all staff were involved for the duration of the study period.

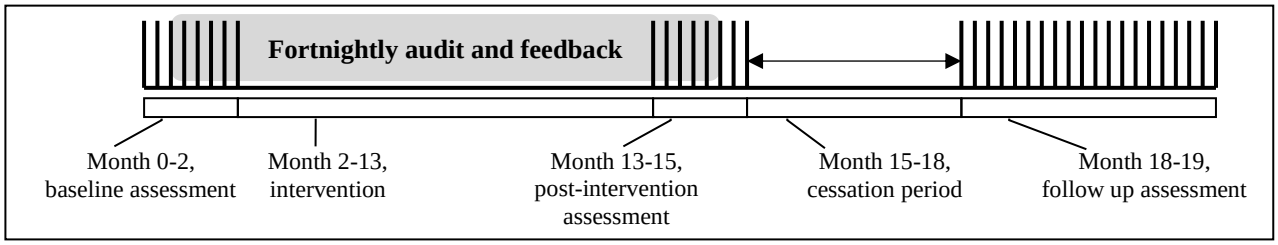

Figure 6.1. Design and flow of Study Four

6.3.2 Settings and participants

This study was conducted between September 2014 and March 2016 in a newly established 42-bed acquired brain injury rehabilitation unit in metropolitan Melbourne, Australia. All clinicians (inclusive of nursing, medical, and allied health staff) working on the unit were included in this study and expected to attend each fortnightly feedback session as part of their usual workplace meeting commitments with support of management. Staffing ratios within the unit are presented in Table 6.1. At the time of this study, other passive implementation interventions (including the availability of guidelines on each ward, and posters of best practice summaries) were also provided to clinicians.

Table 6.1. Staffing profile during intervention period

Discipline	Average staffing ratio per 10 beds	Mean occasions of service per month per 10 beds
Allied Health Assistants	1.31	380
Clinical Psychology	0.33	61
Neuropsychology	0.53	70
Occupational Therapy	1.38	259
Nutrition	0.43	42
Prosthetics and Orthotics	0.14	34
Podiatry	0.05	5
Physiotherapy	1.46	237
Speech Pathology	0.86	175
Social work	1.01	131
Nursing	9.5	-
Specialist Rehabilitation Physician	0.625	-
Junior Medical Staff	1	-

6.3.3 Intervention

A 14-month audit and feedback program was developed. Audit criteria were developed by two authors (NL, LJ) *a priori* from recommendations with high-quality (Grading of Recommendations Assessment, Development and Evaluation (GRADE) level one) evidence cited in stroke and traumatic brain injury clinical practice guidelines (ABIKUS, 2007; Stroke Foundation, 2010) as well as the organization's model of care and practice standards (Australian commission on safety and quality in health care, 2018). The resultant 114 observable criteria were mapped to 16 overarching guideline indicator areas for ease of communication with staff regarding performance. These guideline indicator areas included: behavioural support plans, care plans, continuity of care, discharge planning, equipment use, family education, goal setting, medical issues management, medical records, minimally conscious care, patient safety, personal care regimes, post traumatic amnesia management, roles and responsibilities, therapy interventions, and ward rounds. The organization set the target for staff to adhere to a minimum of 75% of applicable guideline indicators per inpatient prior to commencing the

study.

Our audit and feedback program was based on the periodic service review method developed by LeVigna and colleagues (1994). By acknowledging that the clinical team are key to delivery of evidence-based rehabilitation, we aimed to improve and then maintain the quality of the service using positive behavioural approaches to staff management (Lowe et al., 2010). We adopted a non-aversive approach to working with clinicians during the feedback session, making the clinicians the leaders of the change solutions (Deming, 1986; Lowe et al., 2010; Sluyter, 2000). The audit-feedback cycles were regular and frequent throughout the study period. Each fortnight, a research assistant randomly selected two inpatients on the rehabilitation unit (one from each of the two medical teams) and completed a) medical file audit; b) on ward observations; c) clinical staff interviews of three disciplines (allied health, nursing and medical); d) inpatient interview; and e) family / friend interviews. At the completion of both audits, descriptive statistics (proportion of criteria adherence) were calculated and prepared for the clinician feedback meeting. Feedback sessions were offered twice within each fortnight period to enable shift-working staff to attend. These 15-minute sessions provided the audit results to clinicians, and were delivered by the senior author (NL) an accepted member of staff. Following the feedback sessions, data were made available to all staff via a shared drive on the organization's computer network. These audit-feedback cycles were repeated every two weeks for 14 months. The intervention is summarized in Table 6.2; please refer to Figure 6.2 for the flow of the fortnightly intervention and supplementary document one (Appendix G, Appendix Table 4) for the Standards for Reporting Implementation Studies (StaRI) checklist.

Table 6.2. Intervention summary based on TIDieR, delivered by researchers.

Intervention components	Rationale	Mode of Delivery	Delivered to	When/how often
Evidence introductory education session, including target setting of 75% adherence	To familiarise staff with the audit/feedback intervention and increase awareness of guideline indicators	Face-to-face (group)	Doctors, nurses, allied health staff, inpatient support staff, reception staff	Each staff member attended one session, and once at each new staff induction to the ward
Point of care access to clinical practice guideline evidence	To educate staff about the guidelines and ensure access to the evidence underpinning guideline indicators	Documents loaded onto an e-reader device	Doctors, nurses, allied health staff, inpatient support staff	Ongoing
Educational summary of guideline indicators	To provide education about single guideline indicators and promote self-monitoring	Small summarised poster mailed participants, and poster documents placed on wall	Doctors, nurses, allied health staff, inpatient support staff, reception staff	Small summarised poster mailed fortnightly to all clinicians; A3 summarised poster placed on wall ongoing

Intervention components	Rationale	Mode of Delivery	Delivered to	When/how often
Audit and group feedback	To focus staff on targets and progress, group discussion aided in process of care changes to increase adherence rates	Feedback presentation displayed rates graphically, feedback delivered face-to-face (group)	All available staff on shift at time of feedback presentation	Fortnightly auditing of cases, feedback delivered bi-weekly
Feedback to staff outside of scheduled feedback sessions	To update staff on progress and targets	Feedback provided one-on-one or email copy of feedback presentation. Fortnightly feedback was made available on the organisation's share drive.	Staff who missed all the biweekly feedback sessions and requested an update	Adhoc, ~1 staff per fortnight

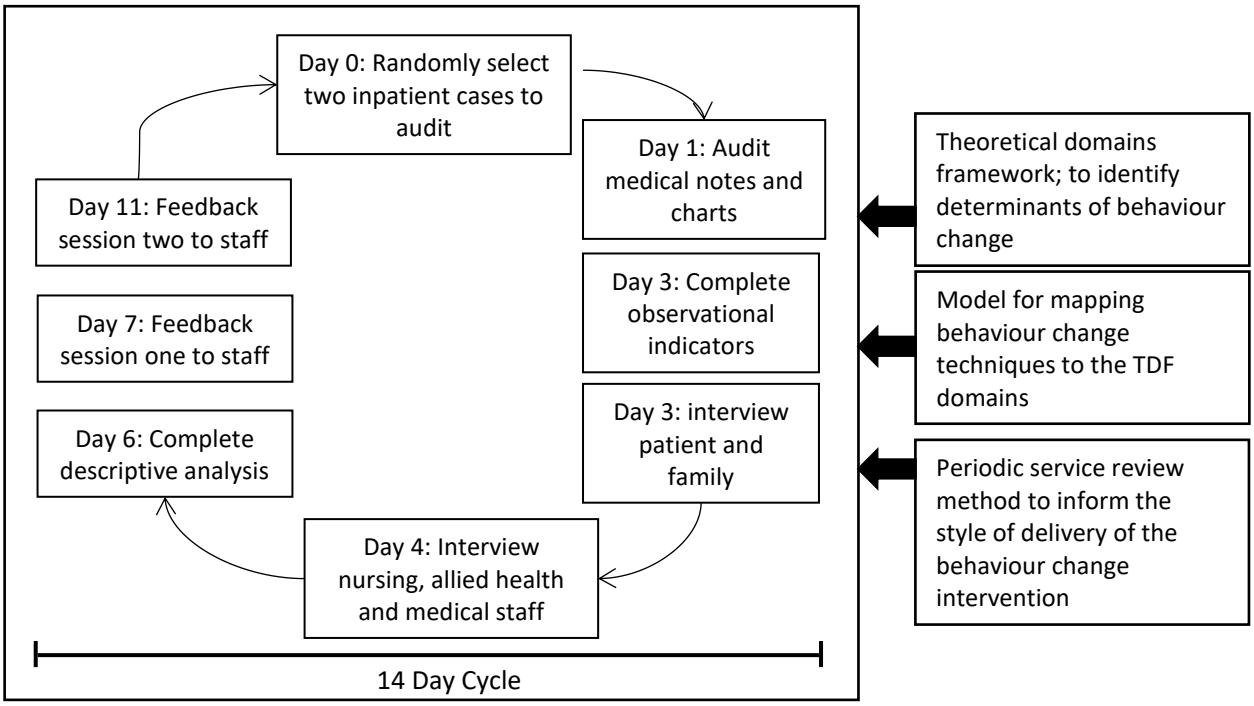

Figure 6.2. Flow of fortnightly intervention for Study Four

Audit data were triangulated, involving a medical file audit, interviews with clinicians, and interviews with the inpatient and/or family. An example of an interview question with a clinical staff member is *"Can you identify the inpatient's primary rehabilitation goals consistent with the documented goals from the interdisciplinary family meeting?"*. If the clinician responded correctly, this item was deemed met and scored *yes* on the audit form. An example of a medical file audit indicator was *Does the inpatient receive 4.5-5 hours of therapy daily?* To score *yes* for this item, on ward observations as well as review of the inpatient's therapy timetable was completed. An example of an interview question with the inpatient and or family member is *"Did someone provide you with a tour of the unit when you first arrived on the ward?"* The responses to these interviews (yes or no) were recorded on the audit form. The data dictionary of audit criteria is available from author on request.

A cessation period of three months then ensued, in which no auditing or feedback occurred. In March 2016, n=20 randomly selected inpatient cases were audited (consistent with the main audit method) to investigate guideline adherence following intervention cessation.

6.3.4 Organisational context

The intervention was tailored to the organization, and designed to be multicomponent (to increase the likelihood of uptake) and frequent (to lower the fidelity gap). The core of the intervention (i.e. audit and feedback) was held consistent throughout the study (no adaptations); instead, the passive implementation interventions (in particular, the education components) were tailored to address highlighted fidelity gaps each fortnight. For example, if auditing revealed low adherence to a guideline indicator, an evidence summary was created to increase staff awareness of the expected behaviour. To understand the intervention *dose delivered* and *dose received,* we collected data on both number of staff employed (who would have received all passive implementation components) and number of staff who attended the feedback sessions (referring to exposure to and uptake of the core intervention).

Our implementation intervention targeted behaviour changes within both the individual (i.e., staff) and the organization. While the feedback was provided to staff, behaviour change discussions held within feedback sessions took into consideration the context of the organization, the inpatient / family dyads and the national healthcare system). With staff leading the behaviour changes, they held in-depth knowledge of the processes that controlled adoption of the guidelines within their organization, maximizing effect (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). Our implementation targets were individual clinicians who worked within the rehabilitation unit, however, buy-in and support from management was an obvious factor impacting on implementation effectiveness. The Director of Rehabilitation, Director of Nursing Services and the Service Manager were asked to communicate support for guideline implementation to staff during orientation, at staff meetings, and via email throughout the intervention period.

6.3.5 Outcome measures

The primary outcome was adherence to guideline indicators as measured by the audits. Consistent with the auditing which formed part of the intervention, this included triangulation of data from the medical file audits, unit based observations, and inpatient, staff, and family interviews.

6.3.6 Data analysis

Each fortnight, dichotomous data were recorded in an excel spreadsheet, and later imported into SPSS V24 for analysis. The mean adherence from audit data of month 0-2 was calculated to represent *baseline* adherence. Mean adherence audit data from month 13-15 were calculated to represent *end of intervention* adherence comparisons. Following intervention cessation (months 15-18), 20 randomly selected cases were audited (month 18-19) to calculate average (mean) adherence to assess if adherence was maintained or reduced. Where an audit item was not applicable to the selected case (i.e., if the selected case was not minimally conscious and therefore the minimally conscious care item(s) were not applicable), this item(s) was removed from the analysis for that period.

Median (95% confidence intervals) and Mann-Whitney U analyses were used to describe comparisons across all data due to the small sample size at each timepoint (n=8, n=8, n=20 respectively) producing non-normally distributed data. Confidence intervals were calculated to highlight statistical significance where it existed, along with measures of variance around median differences (IQR). Chi square analyses for individual guideline indicator items were conducted to compare adherence across comparison points (given data was binary) with Fisher exact test statistic additionally reported due to small sample size (Larntz, 1978). To describe the data, mean (95% confidence intervals) and difference between means (95% confidence intervals) were also calculated and are presented in supplementary document two (Appendix G, Appendix Table 5). The Bonferroni correction was applied to adjust the alpha level for all tests since multiple comparisons were made (with tests run for 230 comparisons, the alpha level was lowered to 0.0002). Refer to Figure 6.2 for diagrammatic representation of analysis points.

Following quantitative analysis, narrative synthesis was undertaken to synthesise findings from our study with recommendations relating to conducting audit and feedback projects drawn from previously conducted systematic reviews (Hysong, 2009b; Ivers et al., 2012). Two authors (NL, LJ) extracted contributing factors which led to the success of the audit and feedback program into categories highlighted by these previous systematic reviews. All authors then reviewed and refined the list of factors.

6.4 RESULTS

During the study period, 58 clinical staff were employed with strong representation at fortnightly feedback sessions, mean of 67% (SD 8) attendance. Clinical profiles of

inpatients audited at all time-points are presented in Table 6.3.

Table 6.3. Demographic characteristics of randomly selected inpatients included at each audit time point

Characteristic	**Time points**		
	0-2 months (n=8)	13-15 months; post intervention *(n=8)*	18-19 months; follow-up *(n=20)*
Diagnosis			
TBI, n (%)	3 (38)	4 (50)	7 (35)
Stroke, n (%)	4 (50)	3 (28)	7 (35)
Other*, n (%)	1 (12)	1 (12)	6 (30)
Gender			
Male, n (%)	6 (75)	6 (75)	16 (80)
Age, *mean years (sd)*	42 (16)	38 (17)	47 (15)
Length of stay *mean days, (min - max)*	193 (23 – 423)	106 (13 – 452)	147 (37 – 362)
Total FIM score at admission (possible scores18-126), *median (IQR)*	27 (18.5, 42.5)	28 (20, 50.5)	33 (19,70.5)
FIM Cognitive score at admission (possible scores 5-35) , *median (IQR)*	7.5 (5.5, 16.5)	8.5 (5, 16)	10 (5, 16)
FIM Motor score at admission (possible scores 13-91), *median (IQR)*	17.5 (13, 25)	18 (13.5, 37.5)	16 (61,13)

TBI=Traumatic Brain Injury, FIM= Functional Independence Measure, IQR=Interquartile Range, *Tumour and/or hypoxic brain injury.

The sustained audit and feedback program significantly increased clinician's adherence to guideline recommendation from median 38.8% (95% CI 34.3 to 44.4) at baseline to 83.6% (95% CI 81.8 to 88.5) at the end of the intervention. Table 6.4 shows median total adherence at each time point. Following cessation of the audit and feedback program, clinician adherence levels decreased by 7% (95% CI .51 to 14.0) from the end of the intervention to follow up, however adherence to guideline indicators was maintained above the organization's goal of 75% adherence.

Adherence differed across guideline indicators, with some indicators more susceptible to change with the audit and feedback program, and others that were not. For example, indicators related to *goal setting*, *therapy* and *roles and responsibilities* increased significantly during the intervention period, but this increase was not sustained at follow up. Conversely, adherence to most of the *ward round* indicators did not improve during the intervention period. Refer to Table 6.5 (and supplementary document two; Appendix G, Appendix Table 5) for full indicator change results.

Table 6.4. Median (IQR) of clinical practice guideline indicator adherence across measurement points, median differences between time points (95% Confidence Interval) and significance of the between group difference

Adherence	Percent (%) of clinical practice adherence obtained at three time points (IQR)			Difference between groups; Mann-Whitney U, p-value*	
	0-2 months (baseline)	13-15 months (post intervention)	18-19 months (follow-up)	13-15 months minus 0-2 months	18-19 months minus 13-15 months
Total adherence (%)	38.8 (32.8, 65.1)	83.6 (78.4, 89.4)	76.6 (60.4, 88.6)	45.2 (95% CI 38.5 to 50.3) .000, *p*=0.0001*	-7.0 (95% CI -0.5 to -14.0) 125, *p*=0.0102

CPG= clinical practice guideline, CI= Confidence Interval, IQR= Interquartile Range, * statistically significant at the Bonferroni adjusted p-value 0.000217

Table 6.5. Adherence to audited indictors (n=114) at three audit time points and difference (Chi square) between time points

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
Behavioural support plan							
1: Inpatient behavioural support plan is known to the family and informal carers [Model of care recommendation]	3	1	5	*	*	1.0	.289
2: An admission screen of behavioural support requirements has taken place (ABIKUS, 2007)	3	8	19	.026	.674‡	1.0	.122

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
3: Patient behavioural support plan is in place (ABIKUS, 2007)	2	3	12	.196	.600‡	*	*
4: The implementation of strategies documented in the patient behavioural support plan occurs (ABIKUS, 2007)	2	3	12	.429	.548‡	*	*
5: Patient behavioural support plan is known to staff (ABIKUS, 2007)	7	8	18	*	*	*	*
6: Antecedent behaviours are known to staff (ABIKUS, 2007)	2	1	10	1.0	.333‡	.154	.452‡

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
Care plan							
1: Family are able to identify primary rehabilitation goals consistent with documented goals from interdisciplinary family meeting [Model of care recommendation]	3	4	8	.444	.478‡	.516	.333‡
2: Inpatient centred goals are displayed appropriately in the patient's room [Model of care recommendation]	1	7	12	.010	.732‡	.214	.266

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
3: Inpatient is able to identify primary rehabilitation goals consistent with documented goals from interdisciplinary family meeting [Model of care recommendation]	4	6	5	1.0	.076	.569	.262
4: Up-to-date treatment plan is in place (ABIKUS, 2007)	5	6	17	1.0	.135	.606	.118
5: Documented goals guide and inform therapy and treatment (SIGN, 2010b)	2	8	14	.007	.775‡	.141	.330‡

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
6: Staff are able to identify primary rehabilitation goals consistent with documented goals from interdisciplinary family meeting [Model of care recommendation]	7	8	13	1.0	.258	.142	.365‡
Continuity of care							
1: Engagement with visitors is evident throughout a clear welcoming process [Model of care recommendation]	1	6	13	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
2: An inpatient centred care approach is used on the unit throughout the entire inpatient journey (NICE, 2013; SFNZ&NZGG, 2010; SIGN, 2010b, 2013; Hetts et al., 2014; ISWP, 2012; Stroke Foundation, 2010)	2	8	18	.015	.730‡	.577	.175
3: Continuity of care is in place for nursing [Model of care recommendation]	0	8	14	.0001§	1.0‡	.141	.330‡
4: Continuity of care is in place for allied health [Model of care recommendation]	1	8	16	*	*	.295	.258

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
5: Continuity of care is in place for medicine [Model of care recommendation]	1	8	20	*	*	*	*
6: Inpatient/ family/informal caregivers are involved in the care planning meeting on the unit. (ISWP, 2012; NICE, 2013; SIGN, 2013; Hetts et al., 2014)	1	7	18	.005	.854‡	1.0	.121

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
7: Escalation of inpatient issues or concerns has been documented appropriately [Model of care recommendation]	1	6	13	*	*	*	*
8: Engagement with family/informal caregiver is evident throughout every stage of recovery (Hebert, Lindsay, et al., 2016; Hetts et al., 2014). [Audit: medical notes]	5	8	20	.200	.480‡	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
9: Engagement with family/informal caregiver is evident throughout every stage of recovery (Hebert, Lindsay, et al., 2016; Hetts et al., 2014). [Audit: family response].	2	5	10	.021	.732‡	.559	.236
Discharge planning							
1: Interdisciplinary and inpatient (and family) directed discharge plan is in place (SFNZ&NZGG, 2010; SIGN, 2010b, 2013; Stroke Foundation, 2010)	5	6	7	1.0	.174	.165	.370‡

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
2: Training of family/ informal caregivers occurs prior to discharge: including safe use of equipment and management of the inpatient to ensure inpatient & caregiver safety in the home environment (SFNZ&NZGG, 2010; Stroke Foundation, 2010) (a minimum of four weeks) [Audit: medical notes]	1	2	0	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
3: Assessment of discharge destination environment and available support occurs prior to discharge (SIGN, 2010b; Stroke Foundation, 2010b) (a minimum of four weeks).	0	5	4	.167	1.0‡	.455	.430‡
4: All required equipment and adaptations are provided prior to discharge (Stroke Foundation, 2010)	*	1	0	*	*	1.0	1.0‡

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
5: Training of family/ informal caregivers occurs prior to discharge: including safe use of equipment and management of the inpatient to ensure inpatient & caregiver safety in the home environment [Audit: family report] (SIGN, 2010b; Stroke Foundation, 2010) (a minimum of four weeks prior)	1	1	1	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
6: Educating inpatients and family/informal caregivers about relevant formal and informal resources and how to access these resources including voluntary services and groups occurs prior to discharge (SIGN, 2010b; ABIKUS, 2007)	0	1	1	1.0	.333‡	1.0	.577‡
7: Minimum of two weeks (before discharge) are spent in the transitional living space (ABIKUS, 2007)	3	3	1	*	*	1.0	.250

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
Equipment use							
1: Instructions for the inpatient's individualised equipment use is in place (SIGN, 2010b)	7	8	14	1.0	.258	1.0	.156
2: If prescribed, ceiling track hoist is used for every transfer within the past week [Model of care recommendation]	1	4	3	.333	.632‡±	1.0	.378†

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
3: All staff are aware of the inpatient's individualised equipment needs [Audit: medical notes] [Model of care recommendation]	7	6	20	1.0	.277	.259	.331‡
4: All staff are aware of the inpatient's individualised equipment needs [Audit: ask staff] [Model of care recommendation]	7	8	20	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
Inpatient/family education (ISWP, 2012)							
1: Ward orientation	3	7	16	.119	.516‡	1.0	.020
2: Diet/nutrition	2	0	1	.487	.337‡	1.0	.141
3: Psychosocial changes after ABI	1	7	15	.010	.750‡	1.0	.101
4: Wounds/lines/drains/airways	0	2	2	1.0	.316‡	.547	.234
5: Tracheostomy care	*	1	1	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
6: Goal setting and rehabilitation importance	3	8	16	.026	.674‡	.532	.229
7: Discharge planning	1	7	11	.010	.750‡	.201	.287
8: Inpatient/family centred care	2	8	17	.007	.775‡	.567	.184
9: Diagnosis/illness/injury	1	6	16	.041	.630‡	.616	.108
10: Medical procedures/treatments	1	1	7	1.0	1.0‡	.364	.243
11: Safety	1	8	10	.001	.882‡	.026	.459†
12: Activity/mobility	0	7	8	.001	.882‡	.043	.417†

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
13: Self-care ADLs within the ward	1	7	6	.010	.750‡	.030	.500‡
14: Pain management	0	3	1	.200	.480‡	.091	.395‡
15: Medication management	0	0	5	*	*	.280	.309‡
16: Equipment use	1	8	9	.001	.882‡	.115	.410‡
Goal setting							
1: Inpatient has commenced goals setting within 48 hours of admission (ISWP, 2012)	8	8	14	*	*	.277	.287

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
2: Goal-based planning meeting has taken place (ABIKUS, 2007; ISWP, 2012) (within two weeks of admission)	0	8	13	.0001[§]	1.0[‡]	.142	.365[‡]
Medical management							
1: Family / caregivers trained in the medical management plans for paretic upper limbs during transfers, hypersensitivity, and neurogenic pain are in place (ABIKUS, 2007)	1	4	2	.143	.730[‡]	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
2: Benzodiazepines and Neuroleptic antipsychotics use minimised (ISWP, 2012)	4	6	14	.608	.189	1.0	.030
3: Medication for Executive Dysfunction follows recommended guidelines (ABIKUS, 2007)	*	*	0	*	*	*	*
4: Medication for management of memory is in place (ABIKUS, 2007)	*	*	0	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
5: Stimulants are prescribed for management of memory as appropriate (ABIKUS, 2007)	*	*	0	*	*	*	*
6: Medication for Arousal and Attention is prescribed appropriately (SIGN, 2013; ABIKUS, 2007)	2	2	0	*	*	*	*
7: Pain management plans are regularly reviewed (ABIKUS, 2007)	7	8	19	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
8: Medical management plans for paretic upper limbs during transfers, hypersensitivity, and neurogenic pain are in place (ABIKUS, 2007)	2	4	6	.429	.471[†]	1.0	.239
9: Appropriate medication management of agitation/ aggression is in place (SIGN, 2013; ABIKUS, 2007)	3	3	4	*	*	.500	.378[†]
10: Appropriate medication management of spasticity is in place (SFNZ&NZGG, 2010; SIGN, 2013; ISWP, 2012)	0	3	5	.100	1.0[‡]	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
11: Appropriate medication management of mood and seizures is in place (ABIKUS, 2007)	1	3	18	.400	.612‡	*	*
Medical records							
1: All invasive procedures are documented in accordance with hospital policies [Hospital policy]	1	8	20	.001	.882‡	*	*
2: Records only contain accurate statements of fact or clinical judgement (Royal College of Physicians, 2012)	7	8	20	1.0	.258	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
3: Records only contain abbreviations which are accepted and commonly known [Hospital policy]	4	8	20	.077	.577‡	*	*
Minimally conscious care							
1: Inpatient in a Coma, Vegetative and Minimal Conscious State are screened using a consistent assessment of recovery (SIGN, 2013)	*	1	1	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
2: The Coma Recovery Scale -Revised has been administered consistently (SIGN, 2013)	*	1	1	*	*	*	*
3: Multisensory stimulation for inpatient in a coma or vegetative state is not carried out as an intervention (SIGN, 2013)	*	1	1	*	*	*	*
Safety							
1: During the past week, patient was sitting out of bed before 8am [Model of care recommendation]	0	4	13	.467	.408‡	.359	.265

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
2: Safe diet strategies are in place [Model of care recommendation]	7	8	19	1.0	.258	*	*
3: Safe diet strategies are followed [Model of care recommendation]	7	8	19	1.0	.258	*	*
4: During the past week, the inpatient was sitting out of bed for all meals [Model of care recommendation]	2	4	14	1.0	.333‡	.576	.167
5: All inpatients are screened for their fall risk as soon as practicable after admission [hospital policy]	*	8	20	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
6: All inpatients are screened for their pressure injury/sore risk as soon as practicable after admission [hospital policy]	*	8	20	*	*	*	*
7: All staff working with inpatients can identify safe transferring strategies (SIGN, 2010b)	8	8	20	*	*	*	*
Personal care regime							

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
1: Maximum privacy during use of the toilet at all times [Model of care recommendation]	*	4	10	*	*	*	*
2: All inpatients will have showers at a regular time each day consistent with their pre-injury showering time [Model of care recommendation] [Audit: medical notes]	0	4	10	.200	1.0‡	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
3: Inpatient personal care regimes are documented to ensure consistency between staff & with the aim of maximising independence [Model of care recommendation]	6	6	15	*	*	1.0	.000
4: All inpatients have a personalised toileting regime in place, at a regular time each day [Model of care recommendation]	1	0	2	1.0	.189	1.0	.222

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
5: All inpatients will have showers at a regular time each day consistent with their pre-injury showering time [Model of care recommendation] [Audit: ask patient]	1	5	14	.103	.577‡	.557	.195
Post traumatic amnesia management							
1: The Westmead PTA Scale (WPTAS) is commenced within 24 hours of emerging from coma and used to assess all inpatients following closed TBI (Bayley et al., 2014)	2	2	1	*	*	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
2: The Orientation Log (O-Log) is commenced within 24 hours of emerging from coma for all other neurological inpatients (open TBI, stroke, hypoxic brain injury) (Bayley et al., 2014)	*	*	1	*	*	1.0	1.0‡
3: The WPTAS /O-Log is administered by a consistent member of appropriately trained staff. (Clinical guidelines) (Bayley et al., 2014)	1	4	8	.333	.632‡	.516	.333‡

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
4: The WPTAS/O-Log is administered at a consistent time each day [Model of care recommendation]	0	4	10	.067	1.0‡	1.0	.218
5: Inpatient in PTA receive goal-oriented and procedural therapy (no new learning) (Bayley et al., 2014)	4	5	4	*	*	1.0	.333‡
Roles and responsibilities							

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
1: Roles and responsibilities for the implementation of the inpatient's care are in place for family/caregivers and have been discussed with family [Model of care recommendation]	0	5	8	.008	1.0‡	.261	.358‡
2: Roles and responsibilities for the implementation of the inpatient's care are followed by the family/informal caregivers [Model of care recommendation]	4	5	9	*	*	.542	.255

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
3: Inpatient and/or their families/ informal caregivers are involved in the provision of inpatient care [Model of care recommendation]	5	6	11	*	*	1.0	.171
4: Roles and responsibilities for the implementation of the inpatient's care are in place for family/informal caregivers [Model of care recommendation]	0	7	12	.001	.882‡	.214	.266

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
5: Roles and responsibilities for the implementation of the inpatient's care are followed by the family [Model of care recommendation]	0	7	12	.0001[§]	1.0[‡]	.273	.303[‡]
6: Inpatient and/or their families are involved in the provision of inpatient care as much as they wish (ABIKUS, 2007)	5	8	19	.200	.480[‡]	1.0	.122

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
Therapy							
1: All appropriate inpatients are screened by a speech and language clinician within 48 hours of admission (ABIKUS, 2007)	7	8	18	*	*	.577	.175
2: Seating plans are communicated with the family/informal caregivers [Model of care recommendation]	1	4	5	*	*	*	*
3: A therapy timetable is in place for each inpatient [Model of care recommendation]	7	8	18	1.0	.258	1.0	.127

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
4: Therapy is provided in the appropriate context for the individual [Model of care recommendation]	1	8	20	.200	.667‡	*	*
5: Learning and memory aids are in place in inpatient's room [Model of care recommendation]	5	8	19	.200	.419‡	1.0	.122

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
6: Management of motor function and control is in place and follows evidenced based guidelines (ABIKUS, 2007; Hebert, Lindsay, et al., 2016; ISWP, 2012; Stroke Foundation, 2010)	0	7	14	.001	.882‡	1.0	.000
7: Therapy is provided in the appropriate context for the individual (NICE, 2013; ABIKUS, 2007)	1	8	20	.003	.861‡	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
8: Leisure and recreation activities are included in the inpatient's weekly program (NICE, 2013; ABIKUS, 2007)	4	2	10	.608	.258	.236	.254
9: Seating needs are assessed within the required timeframe [Model of care recommendation]	4	8	20	.077	.535‡	*	*
10: Seating plans are followed by all staff. [Model of care recommendation]	1	7	12	.010	.837‡	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
11: Inpatients with a visual impairment have been assessed as per guidelines (Hebert, Lindsay, et al., 2016; ISWP, 2012; Stroke Foundation, 2010; ABIKUS, 2007; SFNZ&NZGG, 2010; SIGN, 2010b, 2013)	0	4	6	.167	.632‡	1.0	.000
12: Inpatients received a minimum of four hours of therapy per day at least five days a week in the past week [Model of care recommendation]	0	2	3	.467	.378‡	1.0	.098

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
13: There is documented evidence that inpatients have received therapy from at least three different professions during the past week [Model of care recommendation]	6	8	19	.467	.378‡	1.0	.122
14: Effective treatment approaches for rehabilitation are in place and embedded in daily life activities (ISWP, 2012)	4	7	10	.282	.405‡	.190	.330‡

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
15: Learning and memory aids are in place and documented (NICE, 2013; Bayley et al., 2014)	3	7	20	.070	.632‡	*	*
16: If '15' Is Yes: Inpatient is trained in the use of one, single external aid to compensate for memory impairments [Model of care recommendation]	2	6	18	.103	.537‡	1.0	.150
17: Errorless learning approach / scripts are documented [Model of care recommendation]	0	2	8	.091	.632‡	1.0	.060

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
18: Interventions addressing poor executive functioning are in place (Bayley et al., 2014)	1	1	0	.250	.655‡	.167	1.0‡
19: Repetition of computer based tasks are not carried out unless additional cognitive rehabilitation strategies are used (Bayley et al., 2014)	3	2	7	*	*	*	*
20: Staff are aware of seating plan [Model of care recommendation]	4	7	19	.192	.461‡	*	*

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
Ward round							
1: Documented evidence of that the weekly ward round includes ANUM and the inpatient nurse in addition to RMO/Resident and rehabilitation physician (Royal College of Physicians, 2012)	2	0	0	.467	.378‡	*	*
2: Documented evidence of the weekly ward round records nursing dependency data [Model of care recommendation]	*	*	1	*	*	1.0	.122

	Adherence to audit criteria			Differences in adherence measured between time points			
	0-2 months (n=8)	13-15 months; post intervention (n=8)	18-19 months; follow-up (n=20)	13-15 months minus 0-2 months		18-19 months minus 13-15 months	
Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	n	n	n	*p-value* (Fisher exact statistic)	Cramer's V	*p-value* (Fisher exact statistic)	Cramer's V
3: Documented evidence that ward rounds are taken to each inpatient (inclusive of therapy spaces) [Model of care recommendation]	0	8	20	.0001[§]	1.0[‡]	*	*
4: Documented evidence that weekly ward rounds include discussion of: basic care needs, specialised nursing needs, dependency on nursing time for common tasks, and influences on dependency (Royal College of Physicians, 2012)	*	*	1	*	*	1.0	.122

O-Log= Orientation Log, WPTAS= Westmead Post Traumatic Amnesia Scale, PTA=Post Traumatic Amnesia, ANUM= Associate Nurse Unit Manager, RMO= Resident Medical Officer, PTA= Post Traumatic Amnesia, * = Unable to compute as some items responses are ‘not applicable’

† = medium effect size(Cohen, 1988)

‡ = large effect size(Cohen, 1988)

§ statistically significant at the Bonferroni adjusted p-value 0.000217

6.5 DISCUSSION

Our sustained fortnightly audit and feedback program led to a significant increase in adherence to clinical practice guideline recommendations. Following the three-month cessation period during which no audit and feedback was provided, adherence to guideline recommendations decreased (but remained above the organization's benchmark of ≥75% adherence). The positive results of our study contrast to other audit and feedback studies conducted in rehabilitation (Kristensen & Hounsgaard, 2014; McCluskey et al., 2016; Vratsistas-Curto et al., 2017). Our program had strong support from senior management and the organization, as well as external funding. This external context supported higher frequency audit and feedback cycles, and our feedback was grounded in social cognitive modelling. The adherence improvements following intervention were likely due to a combination of the following attributes of our program: a) high level of managerial support, b) feedback delivered using a non-aversive and clinician-led approach, c) high frequency of audit and feedback cycles, d) 12-month duration of the program, and e) shared goal of working towards a target of ≥75% adherence. By describing these attributes, future studies can build on our program's success.

We do acknowledge that when the audit and feedback program was ceased, adherence rates decreased, although they did not return to baseline levels. This decrease was not unexpected, and while we did not investigate the reasons why, we anticipate that the loss of accountability (knowledge that auditing was not occurring) as well as no longer having formal opportunities to reflect on practice gaps contributed to the lower rates of adherence. Interestingly, there were some audit indicators that increased in adherence after the program was ceased which suggests that comprehensive processes developed and established during the study period carried over beyond the period of audit and feedback.

Our results support many findings from audit and feedback studies conducted outside of rehabilitation. Indicators that had high adherence at baseline in our study were also less likely to improve with regular audit and feedback (Hysong, 2009a; Ivers et al., 2012; Ivers et al., 2014; Jamtvedt, Young, Kristoffersen, O'Brien, & Oxman, 2006); the benefits of audit and feedback programs are likely greatest when baseline performance is low. The use of positive support while delivering feedback (i.e. employing a *no blame* ethos and highlighting discipline *achievements*) is also consistent with other studies (Christina et al., 2016; D'Lima et al., 2015; Larson, Patel, Evans, & Saiman, 2013) which

suggest that feedback which is perceived as supportive rather than punitive, it is more likely to positively influence clinician behaviour. Finally, our study provided feedback in both written and verbal formats by a respected internal senior member of staff. These characteristics are described in systematic reviews as effective strategies to increase audit and feedback effectiveness (Hysong, 2009a; Ivers et al., 2012). Future studies testing audit and feedback interventions should continue to investigate models of providing feedback.

Setting targets (or goals) has been proposed as increasing the effectiveness of feedback, however, this remains uncertain (Locke & Latham, 2002; Nasser M, 2007) . In contrast to Garner and colleagues (Gardner, Whittington, McAteer, Eccles, & Michie, 2010), our results suggest that setting goals and developing action plans during feedback sessions was an effective strategy. With positive support, the facilitator guided clinician discussions towards solutions and encouraged the clinicians to create changes that may lead to increased guideline adherence for the following fortnight. The use of a cognitive model, in combination with high frequency (i.e., fortnightly) and solution-focused feedback is a novel addition to the evaluative studies in this field and supported in theory by the work of Hysong (2009a) and Ivers (2012; 2014). Figure 6.5 outlines the potential factors which may have contributed to the success of the audit and feedback program.

- Strong management and organizational support for the audit and feedback program.
- Complete auditing with clear pre-determined indicators and specific criteria for measurement (i.e., what is considered *indicator met* vs *indicator unmet*)
- Audit against latest clinical practice guideline recommendations
- Complete audit and feedback cycles frequently (fortnightly – monthly)
- Complete audit and feedback cycles over a sustained period of time (>12 months)
- Deliver verbal feedback in the form of face to face meetings from a respected internal senior staff member
- Use positive behavioural support (from social cognitive modelling) during feedback meetings and facilitate the group to come to the correct solution
- Encourage and empower clinical staff to be responsible for modifying processes that might increase adherence for the following audit and feedback cycle.
- Provide strong emphasis on a no blame ethos, and acknowledge department/s (i.e., occupational therapy, nursing, physiotherapy) who demonstrate excellent achievement (for that cycle).
- Provide access to each cycle's feedback on a shared system (e.g. shared network computer drive) to all relevant clinical staff.

Figure 6.3. Factors that contribute to the success of the audit and feedback program as indicated by Study Four

Organizational expectation of clinician participation was likely to contribute to the high level of staff engagement achieved in the present study. Current behaviour change models focus predominantly on individual level or local change characteristics (i.e. the Behaviour Change Wheel (Michie et al., 2011) and Theoretical Domains Framework (Cane et al., 2012)). Research around behaviour change interventions have explored staff motivation for and perceptions of audit and feedback on an individual level (Christina et al., 2016). Less discussed is how organizational expectations drive behaviour change in clinicians. The revisited Promoting Action on Research Implementation (PARiHS) framework aptly encompasses the construct of environment and context; separating out micro (local) and meso (organizational) from macro (political, policy) levels (Harvey & Kitson, 2016). In this framework, organizational systems and culture are a key consideration for behaviour change. Given the organizational expectation of staff involvement in our current study, as well as the intervention frequency (i.e. fortnightly) and paid staff time release for feedback, the strong contribution of organization and culture to our positive findings cannot be overlooked.

6.5.1 Study limitations

Like all pragmatic studies in the clinical setting, our study is not without limitations. Not all staff attended each fortnight's feedback session. While this reflects the practical reality of a ward environment and the shift work nature of hospital staffing, it did mean that not all clinicians received regular feedback. This study sought to investigate the effectiveness of a sustained program, and so this was an accepted limitation within the design of the study. We also acknowledge that the use of only one site may limit the generalisability of the results. The use of only one site also limits our ability to predict whether scaling up will achieve similar rates of adoption and delivery across multiple organizations. Furthermore, contextual factors may have positively affected the uptake at our study site (since it was newly established with newly employed staff) which may not directly translate to other sites. Our program also sought to improve adherence to n=114 indicators of best-practice rehabilitation. While effective at the single site, scaling up our complex audit and feedback intervention may not be straightforward and future programs may choose a smaller number of indicators to implement. Finally, this was a funded study, so sustainable infrastructure needs to be established to enable scaling up. We recommend that future studies include a controlled comparison, consider using both publically and privately funded rehabilitation hospitals, and include a cost/benefit analysis

alongside any evaluation of efficacy.

6.6 CONCLUSION

Our study demonstrated that a frequent and sustained audit and feedback program is an effective implementation intervention to increase adherence to brain injury rehabilitation guidelines. Findings also highlighted that some guideline recommendation indicators that are less likely to change with audit and feedback, suggesting that alternative implementation strategies may be more appropriate to achieve behaviour change for these items. Our program has the potential to inform both local and larger initiatives to improve the quality of rehabilitation received, and more significantly beyond rehabilitation, in the field of implementation science and the knowledge base underpinning audit and feedback.

Chapter 7: What is the feasibility and observed effect of two implementation packages for stroke rehabilitation clinicians implementing upper limb guidelines? A cluster controlled feasibility study

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Jolliffe, L., Hoffmann, T., Churilov, L. & Lannin, N.A (2019). What is the feasibility and observed effect of two implementation packages for stroke rehabilitation clinicians implementing upper limb guidelines? A cluster controlled feasibility study. *Submitted to BMJ Open Quality*, Accepted 4 May 2020.

7.1 ABSTRACT

Background: Hand and arm activity after stroke improves with evidence-based upper limb rehabilitation. Clinicians face known barriers when providing evidence-based rehabilitation and require support to implement clinical practice guidelines. The aim of this study was to investigate the feasibility of two implementation packages on guideline adherence by occupational therapists and physiotherapists, and explore effect on patient upper limb outcomes.

Method: This was a non-randomised clustered feasibility study of occupational and physiotherapy rehabilitation services (n=3 inpatient and n=3 outpatient services). Services were allocated to one of three groups: (Group A) Facilitator-mediated implementation package, (Group B) Self-directed implementation package, or (Group C) Usual care (control); we recruited n=1 inpatient and n=1 outpatient service per Group. Outcomes of feasibility, adherence to guidelines (medical file audits), and patient upper limb impairment (Fugl-Meyer Upper Extremity Assessment), activity (Box and Block Test), and practice (minutes/week) were collected at baseline and after 3-months of intervention.

Results: 29 clinicians (8 in Group A, 13 in Group B and 8 in Group C) and 55 patients participated. Both the facilitator-mediated and the self-directed implementation packages were feasible to deliver in the rehabilitation setting. Clinicians in Group A improved with respect to guideline adherence (medical file audits)(median within-group proportion difference of 0.29 (95% CI 0.22 to 0.36, $p<.0001$) pre to post intervention). No significant within-group differences from baseline to post-intervention were found in Group B or Group C, and no between-group differences were found for upper limb outcomes.

Conclusion: A facilitator-mediated package was acceptable to clinicians working in stroke rehabilitation, and feasibility data suggest increased guideline uptake following implementation. An adequately powered study is needed to understand how to support clinicians to provide evidence-based upper limb rehabilitation after stroke.

Trial Registration: Australian New Zealand Clinical Trials Registry (ANZCTR), ACTRN12619000596101. Registration date: 17/04/2019

7.2 INTRODUCTION

In stroke rehabilitation, implementable evidence exists for arm and hand interventions, (Stroke Foundation, 2017) synthesized in clinical practice guidelines (Jolliffe et al., 2018). Guidelines provide *"systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances"* (Institute of Medicine, 1990, p.38). Despite this, research indicates that such guidelines in stroke rehabilitation are often not followed (Smaha, 2004; Stroke Foundation, 2017). This variability in adherence suggests a problematic gap between what is known (as cited in the guidelines) and clinician decision-making in stroke rehabilitation practice. To support clinicians to deliver evidence-based care and thus improve adherence to clinical practice guidelines in practice, an active implementation approach is often required (Grimshaw et al., 2004).

Implementation science seeks to understand the science behind implementation models and intervention efforts, so as to improve the likelihood of successful implementation of research into clinical practice. In fact, Powell and colleagues (Powell et al., 2015) identified 71 different implementation interventions in their Delphi study conducted with implementation experts. We acknowledge that no *gold standard* implementation interventions have been identified (Grimshaw et al., 2012; Grol & Grimshaw, 2003), however it has been suggested that active and multicomponent interventions are likely to work best (Bird et al., 2019; Menon et al., 2009; Prior et al., 2008), and that passive interventions (such as providing guidelines or attending an educational meeting) are less likely to change clinician behaviour (LaRocca et al., 2012; Prior et al., 2008; Scott et al., 2012). There are many theories, models and frameworks in the implementation literature to guide efforts (Michie, West, Campbell, Brown, & Gainforth, 2014; Moullin et al., 2015) and all encourage researchers and end users to employ a structured and theoretical approach (Damschroder et al., 2009; Grol, Bosch, Hulscher, Eccles, & Wensing, 2007). Despite the availability of these theories, it is estimated that only 10% of guideline implementation studies describe their theoretical rationale for selecting implementation interventions (Michie & Abraham, 2004). In an effort to understand clinicians' behaviour, previous studies have mapped the perceived barriers and motivators of clinicians to frameworks such as the Theoretical Domains Framework (Craig et al., 2016; Lawton et al., 2015; Sakzewski, Ziviani, & Boyd, 2014), however few subsequently develop behaviour change interventions. One can conclude from existing research, that to change behaviour, understanding perceived barriers to

address is important, but mapping these barriers to a model or framework to identify implementation interventions, and developing a multicomponent package of active interventions' maximizes the likelihood of improving clinician adherence to guideline recommendations.

In stroke rehabilitation there is a now a good understanding of the issues faced by clinicians who seek to implement upper limb guideline recommendations (Donnellan, Sweetman, & Shelley, 2013b; McCluskey et al., 2013). Much work is still needed, to develop and test the effectiveness of behaviour change interventions. Organisations however, seeking to implement clinical guidelines do not yet know *what* interventions to fund and *how* they should be delivered so as to improve clinician adherence. Active and multicomponent approaches that are grounded in theory are suggested as most likely to achieve behaviour change (Bird et al., 2019; LaRocca et al., 2012). In a recent systematic review that explored the benefit of implementation strategies in stroke rehabilitation, Bird and colleagues (2019), included 11 RCTs. According to GRADE criteria, the quality of included studies was low, and no studies explored the difference between *high resource investment* (financial and non-financial) and *low resource investment* implementation package of interventions (compared to no implementation interventions) for achieving behaviour change. Understanding the feasibility and effectiveness of high and low resource-investment for implementation strategies (underpinned by behaviour change intervention mapping) would inform clinical trialists, service providers, funding bodies and clinicians (Davies, Walker, & Grimshaw, 2010). To improve adherence to upper limb rehabilitation guidelines (Stroke Foundation, 2017), we developed implementation strategies to specifically target the knowledge, belief in consequences, and skill barriers identified in Australian stroke rehabilitation clinicians. The aim of this study was to test the feasibility and potential efficacy of two tailored implementation packages for improving adherence to upper limb stroke rehabilitation guidelines, and to understand the acceptance from the clinicians' perspective. The following research questions were therefore addressed:

1. ***Feasibility:*** What numbers of eligible clinicians (i.e., the occupational therapists and physiotherapists; target users of guidelines) consent to participate in the study? Is it feasible and acceptable to recruit patients (i.e., recipients of guideline interventions) during their rehabilitation? How feasible is it to deliver the two packages (i.e facilitator-mediated implementation package and the self-directed implementation package)? Were both packages delivered per-protocol?

2. ***Efficacy:*** What is the observed effect of the two implementation packages (facilitator-mediated or self-directed) implementation packages on i) adherence to stroke rehabilitation guidelines for upper limb rehabilitation; and ii) patient upper limb recovery? In addition, the study will provide estimates to inform future power calculations, including estimates of variability of proposed outcomes and confidence intervals around observed treatment effects.

3. ***Acceptance:*** What was the experience of receiving the allocated package from the perspective of the clinicians?

7.3 METHOD

7.3.1 Design

This was a non-randomised three-arm cluster controlled longitudinal feasibility study, with assessment at three time-points. Participating health care services provided neurological rehabilitation within inpatient (i.e. hospital ward based) and/or outpatient (i.e community based) contexts in Melbourne, Australia. Given the scope and nature of this study (i.e. feasibility), sample size calculations were not conducted. Power calculations for future trials will be informed by the results generated from this work. Three organisations were approached (and agreed) to take part in this study. Of the three participating organisations, six sites (three inpatient and three outpatient) took part. Sites were pragmatically allocated (ratio 1:1:1) to one of three intervention groups:

Group A: facilitator-mediated implementation package;

Group B: self-directed implementation package, or

Group C: usual care.

This study recruited both clinician and patient participants. To address the feasibility research questions, we purposively recruited one inpatient and one outpatient team per Group (A, B, C), with five or more clinicians per Group. Together, these purposive site recruitment decisions influenced our patient participant recruitment (i.e., recipients of guideline interventions); patient participant recruitment was open throughout the three-month intervention period (such that new admissions who were being seen by an enrolled clinician would be invited to participate in the study). Figure 7.1 outlines the flow of participants through the study. Ethics approval was sought and granted prior to

the commencement of this study by participating health care services (see Appendix C).

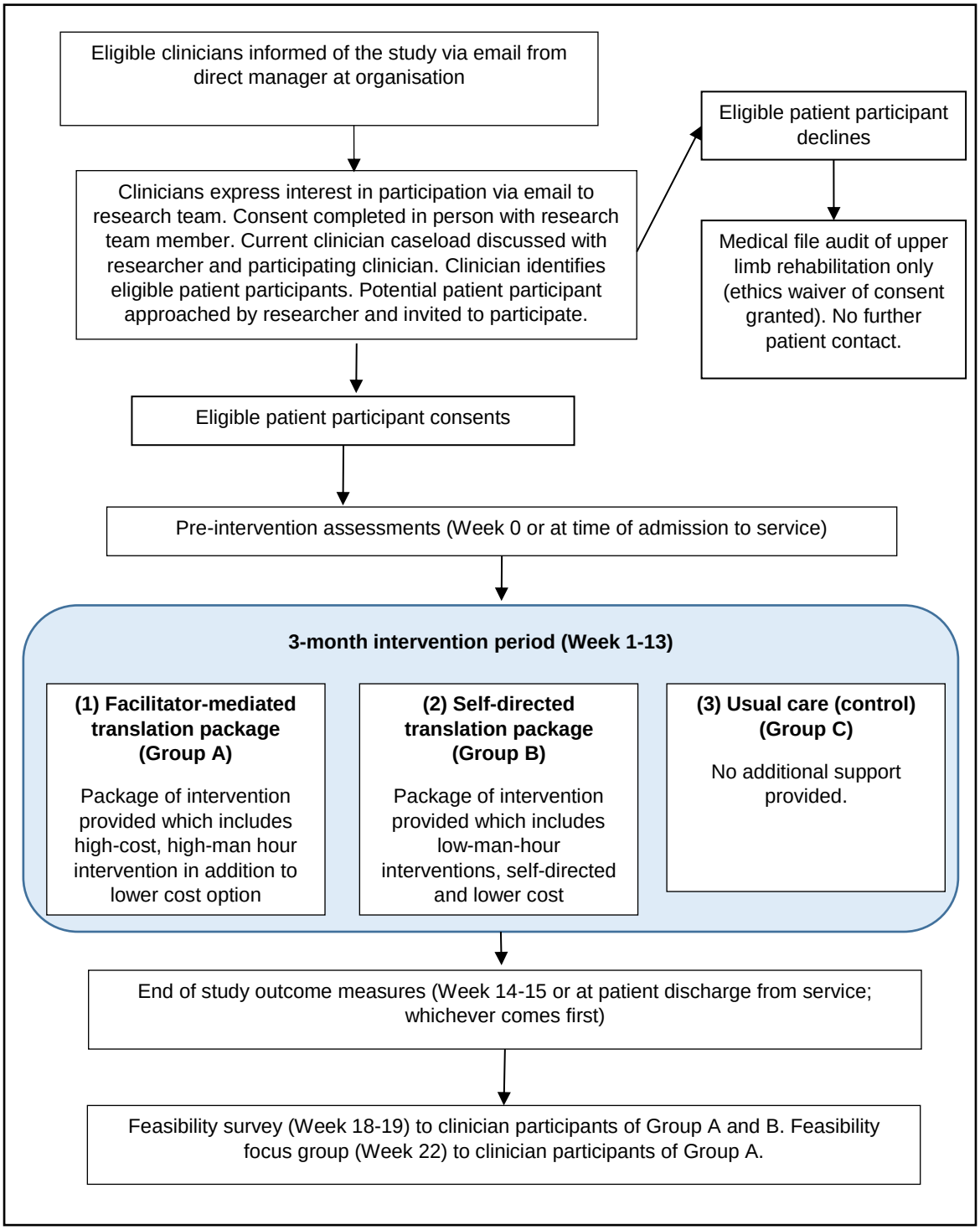

Figure 7.1. Flow of participants through Study Five (clinician and patient participants

The following inclusion criteria were applied to the selection of clinician participants:

- Registered occupational (OT) or physiotherapist (PT) working at one or two of the six recruitment sites (e.g. an OT may have a split caseload between

inpatient and outpatient services; this was acceptable if they are within the same employing organisation and intervention arm); and

- Working in neurorehabilitation, and treating adults with an acquired brain injury (of any type).

The following inclusion criteria were applied to the selection of patient participants:

- The treating clinician had consented to participating in the study;
- The patient was currently receiving therapy for the upper limb due to an acquired brain injury;
- The patient has documented upper limb goals; and
- The patient (or their proxy) was able to provide to participate in the study.

For the purposes of this study, an acquired brain injury included stroke, traumatic brain injury, intracerebral haemorrhage, and any other kind of brain injury acquired after birth. It did not include degenerative brain conditions such as Alzheimer's type dementia, Multiple Sclerosis or Parkinson's disease (Toronto ABI Network, 2018).

7.3.2 Intervention

Using data collected from prior focus groups completed with clinicians from participating organisations on the barriers and motivators for implementing best practice arm and hand interventions, behaviour change intervention mapping was undertaken using the Theoretical Domains Framework (Cane et al., 2012), Behaviour Change Wheel (Michie, Atkins, et al., 2014) and method outlined by French and colleagues (French et al., 2012). Table 7.1 outlines the planned implementation interventions that contributed towards the *implementation package* for each of the intervention groups. Strategies in the self-directed group were designed to be low-cost, and implementable with distance (i.e. no direct intermediary contact by the research team). This was the primary difference between Group A (facilitator-mediated) and Group B (self-directed). Intervention content for Group B therefore, was delivered via *Trello*; an online, closed-group share point. Over the 12-week intervention period, implementation packages covering six key topics related to upper limb rehabilitation guidelines were delivered fortnightly (i.e. one topic, each fortnight) to participants in Groups A and B. Topics areas were selected based on the knowledge and skill gaps identified in focus groups, and included: task specific motor training, setting up patient practice, functional electrical stimulation, whole upper limb program, modified constraint-induced movement therapy, and behaviour monitoring. Two

of the study investigators (LJ and NL) were responsible for delivering the face to face interventions to Group A, and LJ was responsible for ensuring intervention delivery via *Trello* for Group B.

7.3.3 Outcome measures

Feasibility

1. Study recruitment of occupational therapists and physiotherapists (i.e. target users of the guidelines), assessed by determining the proportion of consented/those approached.
2. Study recruitment of patient participants, assessed by calculating the total number of patients who consented.
3. Time commitment for study participation, assessed by calculating the total time reportedly spent on implementation interventions per Group.
4. Clinicians perspectives on intervention feasibility, assessed via a survey of participating clinicians at completion of study.
5. Protocol adjustments, assessed by logging the numbers and description of changes.

Efficacy

1. Guideline adherence by clinicians, assessed using medical file audits pre- and post-intervention
2. Upper limb outcomes of participating patients, assessed pre- and post-intervention (administered by a researcher) using the Box and Block Test (BBT) (Platz et al., 2005), Fugl-Meyer Upper Extremity Assessment (Fugl-Meyer, Jääskö, Leyman, Olsson, & Steglind, 1975), assessed by a research assistant. Self-reported minutes of weekly therapy (patient reported and clinician reported) was also collected.

Acceptance

1. Clinician participants' acceptance of the intervention, assessed by survey and a focus group. Clinician participants in Groups A and B were invited by email to complete an anonymous online survey. A focus group with clinicians in Group A (allocated to receive the facilitator-mediated implementation package) was then conducted to further explore intervention acceptance (given this group had more time-intensive commitment to the study).

Table 7.1. Implementation interventions included in each of the three group packages, mapped against COM-B model, the TDF and behaviour change intervention function.

COM-B Domain	TDF Domain	Behaviour change intervention function	Implementation strategies used in the intervention package	Facilitator-mediated implementation package	Self-directed implementation package	Usual care package
Physical capability	Physical skills	Training	Point-of-care videos demonstrating clinical practice	✓	✓	
Psychological capability	Knowledge	Education	Usual EBP support and in-services	✓	✓	✓
	Knowledge	Education	Fortnightly / Monthly supervision with senior peer-clinician	✓	✓	✓
	Knowledge	Education	Face-to-Face education sessions	✓		
	Knowledge	Education	Online Modules	✓	✓	
	Knowledge	Education	Evidence Summary Postcards	✓	✓	
	Knowledge	Education	Posters of each clinical practice guideline recommendation	✓	✓	
	Knowledge	Education	Written Manuals	✓	✓	

COM-B Domain	TDF Domain	Behaviour change intervention function	Implementation strategies used in the intervention package	Facilitator-mediated implementation package	Self-directed implementation package	Usual care package
	Memory, attention and decision processes	Modelling	Coaching and mentoring from senior clinician	✓		
	Cognitive and interpersonal skills	Persuasion	Strategy provision for patient coaching and motivational interviewing.	✓		
	Behaviour regulation	Incentivisation	Auditing of files and patient timetable to provide real-time feedback on the amount and type of therapy provided	✓		
Physical opportunity	Environmental context and resources	Environmental restructuring	Access to essential resources (e-stims, GRASP kits, assessments)	✓	✓	
	Environmental context and resources	Environmental restructuring	Access to intervention resources (portable upper limb kits, assessments, CIMT mitts, treatment tables)	✓		

COM-B Domain	TDF Domain	Behaviour change intervention function	Implementation strategies used in the intervention package	Facilitator-mediated implementation package	Self-directed implementation package	Usual care package
	Environmental context and resources	Environmental restructuring	Care pathway to simplify clinical reasoning to adhere to amount / intensity CPG	✓	✓	
	Environmental context and resources	Environmental restructuring	Space created for self-practice	✓		
	Environmental context and resources	Environmental restructuring	Time Management: Group sessions to support one another to deliver an hour/day upper limb rehabilitation	✓		
	Environmental context and resources	Environmental restructuring	Time Management: posters for how to increase the amount of therapy without increasing clinician one-on-one time	✓	✓	
Reflective Motivation	Goals	Environmental restructuring	Pre-planned treatment plans based on patient goals	✓	✓	
Social opportunity	Social influences	Coercion	Consumer information: Evidence based therapy and CPG Posters/Brochures	✓	✓	

COM-B Domain	TDF Domain	Behaviour change intervention function	Implementation strategies used in the intervention package	Facilitator-mediated implementation package	Self-directed implementation package	Usual care package
	Social influences	Coercion	Consumer information: Seminars for consumers	✓		

COM-B= Capability, Opportunity, Motivation- Behaviour, TDF= Theoretical Domains Framework, EBP= Evidence Based Practice, CPG= Clinical Practice Guideline, UL= Upper Limb, CIMT= Constraint-Induced Movement Therapy, GRASP= Graded Repetitive Arm Supplementary Program.

7.3.4 Data analysis

Descriptive statistics were used to describe participant characteristics, recruitment rates and responses to multiple choice survey items. Focus group data (tape-recorded and transcribed verbatim) and free-text survey responses were thematically coded (10% double coded by second reviewer to establish coding reliability) and themes generated. Free-text survey responses with the highest frequency were reported in results. Summary statistics for patient outcome measures and medical file audits, broken down by group, were analysed for medians (IQR), within group proportion differences (medians with 95% confidence intervals) and between group proportion differences (median and 95% confidence intervals) using Wilcoxon's signed rank tests. Estimates of variability of proposed outcomes and confidence intervals around treatment effects were reported to permit future sample size calculations. Given our patient recruitment method (ongoing recruitment throughout intervention period), patient participants enrolled after day 35 and allocated to Group A and Group B were removed from the analysis of *baseline* adherence audits in an attempt to control for intervention contamination.

7.4 RESULTS

7.4.1 Feasibility

A total of 29 clinicians participated (8 in facilitator-mediated, 13 in self-directed, and 8 in usual care groups). Of these, 11 (38%) clinicians primarily worked in the outpatient setting and 18 (62%) within the inpatient setting. The majority of clinician participants were occupational therapists (87% across all groups).

Feasibility: Study recruitment of occupational and physiotherapists (target users of the guidelines)

There was excellent participation by therapy teams, 50% of invited clinicians consented to Group A (facilitator-mediated), 41% consented to Group B (self-directed), and 47% consented to Group C (usual care).

Feasibility: Study recruitment of patient participants

A total of 55 patient participants were recruited (20 in Group A, 17 in Group B, and 18 in Group C). Of these, 19 (35%) were recruited from the outpatient setting, and 36 (65%) from the inpatient setting. Table 7.2 shows clinician and patient characteristics.

Table 7.2. Characteristics of clinician participants (n=29) and patient participants (n=55) in each of the three groups

Clinician Characteristic	Groups		
	A (n=8)	B (n=13)	C (n=8)
Discipline, Occupational Therapy, *number (%)*	8 (100)	11 (85)	6 (75)
Female, *number (%)*	8 (100)	11 (85)	6 (75)
Days on study, *number (SD)*	87 (0)	78 (18)	75 (24)
Neurological experience (yrs) *number (%)*			
<2	1 (13)	8 (62)	4 (50)
2 to 5	3 (38)	2 (15)	2 (25)
5 to 10	2 (25)	3 (23)	1 (13)
10+	2 (25)	0 (0)	1 (13)
Patient Characteristics	**A (n=20)**	**B (n=17)**	**C (n=18)**
Age *(yr)* mean (SD)	43 (15)	60 (22)	66 (13)
Female, *number (%)*	7 (35)	6 (35)	6 (33)
Side of hemiplegia, *number right side (%)*	13 (65)	8 (47)	9 (50)
Days on study, *number (SD)*	75 (28)	51 (34)	43 (26)

Clinician Characteristic	Groups		
	A (n=8)	B (n=13)	C (n=8)
Time between injury date and study recruitment date, *months* (SD)			
Inpatient rehabilitation	5.9 (4)	1.3 (0.77)	1.2 (1.8)
Outpatient rehabilitation	18.6 (7.9)	41.5 (48.9)	7.0 (4.0)
Injury type, number (%)			
Stroke	11 (55)	13 (76)	18 (100)
Brain injury	9 (45)	4 (24)	0 (0)

Feasibility: Time commitment for study participation

Clinicians in Groups A and B reported that intervention participation was time-feasible within their work schedule. Group A dedicated 94 minutes per week on average (range 20 to 120) to intervention content. Group B dedicated 49 minutes per week on average (range 0-180) to intervention content. The majority (71%) of clinicians reported the interventions to be time-feasible, and did not perceive activities to take up too much of their time. Clinicians' preferences were to spend more time on the topic areas of constraint-induced movement therapy and functional electrical stimulation than other topic areas. In the free-text section of the survey, one clinician commented on their selection of CIMT and FES, saying *"[these] were areas that I could improve upon in terms of knowledge and practical application".*

Feasibility: Clinicians perspectives on intervention feasibility

Most active intervention clinician participants (Groups A and B) completed the post-intervention survey (completion rate 78%). The majority (responses of *always* and *most times*) of clinicians from both groups reported that interventions made available to them were used (54%), helpful (80%), relevant (86%), and assisted them to provide evidence-based practice (72%). Group B participants reported the use of *Trello Boards* (share point for intervention content) was easy to access and navigate. Table 7.3 shows additional survey results and free-text responses.

Table 7.3. Feasibility survey to clinician participants (n=15 respondents) in both facilitator-mediated and self-directed implementation package groups

Survey Item	Survey response, mean (range)
Since commencing this project, how many of your patients needed upper limb rehabilitation?	4 (1 to 10)
Since commencing this project, how many of your patients were you able to enrol into the study?	2 (1 to 6)
What is the average number of hours of face-to-face upper limb rehabilitation that patients received from allied health (OT/PT/AHA) per week?	6 (1-10)
What is the average therapy time per session for these face-to-face sessions (mins)?	53.4 (15-75)
Please estimate how many minutes per week you were taking part in the implementation interventions (please average from the last study fortnight)	80 (10 to 180)
Survey Items	**Percentage**
Did you use the implementation interventions made available to you?	
Seldom	13
Sometimes	33
Most times	33

Always	20
Did you find the implementation interventions helpful?	
Seldom	20
Most times	20
Always	60
Did you have the resources to implement recommendations from the implementation strategies?	
Sometimes	15
Most times	54
Always	31
Do you think the implementation interventions were relevant to your needs?	
Sometimes	14
Most times	36
Always	50
Were there any implementation interventions that were offered but that you did NOT take part in?	

Yes	17
No	83
Do you believe that the implementation interventions you participated in assisted you to provide the guideline recommended upper limb interventions to patients?	
No	7
Seldom	0
Sometimes	21
Most times	29
Always	43
Do you believe that the implementation interventions you participated in increased your confidence to provide the guideline recommended upper limb interventions to patients?	
No	7
Seldom	0
Sometimes	21
Most times	29

Always	43
Did you perceive that the implementation interventions took up too much of your time?	
No	71
Seldom	7
Sometimes	21
Knowing what you know about your use of guidelines in your practice now, do you think using these implementation interventions were an appropriate time trade off?	
Sometimes	14
Most times	29
Always	57

Free text response items	**Most frequent responses; top three**
Out of all the implementation interventions provided, which did you find the most helpful?	• Patient handouts/ready-to-use resources • CIMT training materials • Functional electrical stimulation materials
Out of all the implementation interventions provided, which did you find the least helpful?	• Background reading/ journal articles • Functional electrical stimulation (already confident with this)

Which implementation interventions were most time consuming? Which implementation interventions were more acceptable to you personally from a time perspective, and why?	• Tips for communicating with people with aphasia • Functional electrical stimulation • Constraint-induced movement therapy • Background reading/journal articles • Patient handouts; '*direct use with patients'* • CIMT; *'because they were areas that I could improve upon in terms of knowledge and practical application'* • E-stim • Audit feedback • Practical skill and resource training; *'it's time well spent as there is a resource that can be used and you know how to use it effectively immediately after attending'*

Free text comments from self-directed group participants

- *Personally [I] could have spent more time [engaging in the study]. I would have been more likely to fully engage in materials in a more structured learning environment*
- *I did not have enough time to look at all the resources in detail but have saved them all for future use*
- *It was excellent to have the opportunity to access online resources, however more structured training and face to face sessions may have also assisted in the greater uptake of guidelines and recommendations*

Free text comments from facilitator-mediated group participants
• *The implementation of regular audit review & education, with the additional resources that were developed throughout this project have been invaluable in terms of time efficiency with setting up programs for patients & prioritising UL interventions for patients. The project has stimulated a lot more discussion amongst the OT team re: how we can implement best practice in this area & make best use of resources (& also additional resources we may need to source).*
• *I thought it was really good and I liked the auditing of the notes because it made me realise how much documenting interventions and time spent on exercises is important. Also trello was a helpful tool and I am still using it*
• *Thank-you, it was great to be part of a study that is so important to improving upper limb function after stroke of brain injury.*

Feasibility: Protocol adjustments, assessed by logging the numbers and description of changes.

Group B (self-directed) and Group C (control) had no protocol adjustments. Group A required more time from the facilitator than expected and/or planned for in the protocol. The protocol adjustments were all related to requests for tailored resources (i.e. development of five additional/unplanned patient handouts) and/or additional modelling/demonstration sessions with patient participants (6 in total, each of 60 minute duration). No harm or unintended effects were evident in any group throughout the study.

7.4.2 Efficacy

Efficacy: Guideline adherence by clinician participants

Significant behaviour change was observed between pre- and post-intervention audits in Group A (facilitator-mediated), with a median within-group proportion increase to guideline adherence of 0.29 (95% CI 0.22 to 0.26, $p<.0001$). No observed effects for within-group differences were found in Group B or Group C between pre- and post-intervention audits. Group A adhered to guidelines significantly more than and Group B, with a median between-group difference of 0.26 (95% CI 0.16 to 0.34, $p<.0001$). Effect estimates in adherence to guidelines were also found between Group A (facilitator-mediated) and Group C (usual care), with a median difference of 0.29 (95% CI 0.21 to 0.37, $p<.0001$). No observed effects for between group differences were found between Group B (self-directed) and Group C (usual care).

Efficacy: Upper limb outcomes of participating patients

Mean improvement (105, 95% CI -20 to 345) in minutes of practice of upper limb activities for patient participants was observed from pre-to post-intervention (ie within group changes) in Group A (facilitator-mediated) and Group C (usual care) (87.5 95% CI -5 to 177.5). No increase in minutes of practice was observed in Group B participants (self-directed). There were also no between-group observed effects. Overall, patient participants' box and block test score in all groups improved pre-intervention to post-intervention, with no observed effects found between groups. Observed effect for within-group improvements on the Fugl-Meyer Upper Extremity Assessment were found for Groups A (facilitator-mediated) and C (usual care). Refer to Table 7.4 for full results.

Table 7.4. Median (IQR) of groups, median within group change (95% CI), and median difference between change scores (95% CI; p-value)

Outcome	Groups (median and IQR)						Within-group change (median differences and 95% CI)			Difference between change scores (median differences, 95% CI and *p-value*s)		
	Baseline			End of intervention			End of intervention minus baseline			Difference between within group changes		
	A (n = 18)	B (n = 17)	C (n=18)	A (n = 20)	B (n = 17)	C (n=18)	A (n = 20)	B (n = 17)	C (n=18)	A minus B	A minus C	B minus C
Adherence to guideline recommendation, *%, (IQR)*	40^ (13)	59 (42)	47 (19)	73 (22)	64 (27)	48 (26)	0.29 (0.22 to 0.36)	0.03 (-0.02 to 0.08)	0 (-0.03 to 0.02)	0.26 (0.16 to 0.34) p<0.0001	0.29 (0.21 to 0.37) p<0.0001	0.03 (-0.03 to 0.07) p=0.318
Minutes of practice per week *n, (SD)*	225 (347.5)	360 (560)	180 (198.8)	347.5 (421.3)	300 (505)	285 (222.5)	105 (-20 to 345)	0 (-112.5 to 35)	87.5 (-5 to 177.5)	90 (-10 to 315) p=0.136	10 (-150 to 165) p=0.857	-92.5 (-225 to 10) p=0.132

Outcome	Groups (median and IQR)						Within-group change (median differences and 95% CI)			Difference between change scores (median differences, 95% CI and *p-value*s)		
	Baseline			End of intervention			End of intervention minus baseline			Difference between within group changes		
	A (n = 20)	B (n = 17)	C (n=16)	A (n = 20)	B (n = 17)	C (n=16)	A (n = 20)	B (n = 17)	C (n=16)	A minus B	A minus C	B minus C
Box and Block assessment *blocks per s, (SD)*	0.00 (0.16)	0.05 (0.52)	0.00 (0.40)	0.02 (0.49)	0.10 (0.63)	0.17 (0.52)	0.085 (0 to 0.24)	0.059 (0.01 to 0.24)	0.073 (0.002 to 0.21)	0 (-0.07 to 0.07) p=0.839	0 (-0.07 to 0.07) p=0.901	0 (-0.08 to 0.07) p=0.986
Fugl-Meyer Assessment score (*0-66), n, (SD)*	16 (45.5)	37 (50)	10.5 (42.75)	29 (49.5)	40 (50.5)	32.0 (46.25)	2 (0 to 9.5)	1 (-0.5 to 5)	8.5 (3 to 14.5)	0 (-3 to 1) p=0.751	2 (0 to 10) p=0.073	-4 (-11 to 0) p=0.027

CI= Confidence Intervals, IQR= Interquartile ranges, A= Facilitator-mediated implementation package group, B= self-directed implementation package group, C= usual care group, ^=Two outliers removed

7.4.3 Acceptance

Acceptance of implementation packages (Group A and B)

Both Groups A and B reported the implementation packages to be helpful and used, however free-text comments in survey responses suggest that clinicians allocated to Group B (self-directed) would have found the intervention more beneficial if additional structure in the form of face-to-face sessions with hands on demonstration were provided. The free-text comments from participants in Group A (facilitator-mediated) positively reflected on the benefit of face-to-face sessions and audit and feedback, and expressed gratitude for their involvement. There was a high attendance to Group A's (facilitator mediated) post-intervention focus group (75%). Five themes emerged from the focus group: provision of tailored and accessible resources was valuable; equipment and resource availability allowed timely intervention provision; skilled behaviour monitoring incentivized evidence based practice (EBP); direct modelling prioritised and facilitated optimal learning; and study participation increased skill, knowledge and confidence. Clinicians from Group A spoke positively about the usefulness of tailored resources (such as patient handouts and/or clinician workbooks) which they felt saved them time in the longer term. Audit and feedback sessions were reported to be motivating, with clinicians commenting that "*The [facilitator] broke it down really well*" and feedback described as *"very encouraging…I think that's what helped that motivation"*. Clinicians from Group A reported that modelling of interventions by the facilitator promoted learning and confidence; *"It means you can have a go, like hands-on, someone there to support you. Rather than just watching [a video]. Because sometimes with patients, there are those slight [differences], so you can problem solve with the [facilitator]".* Overall, clinicians felt their involvement in the study had changed their practice; *"It's 100 per cent changed my practice, and the study is still very much at the forefront of my mind when I'm doing [upper limb rehabilitation]. It's absolutely had a flow-on effect and a really positive one"* and *"I have changed what I do with a patient's upper limb. I think I am more efficient in time as well".* Figure 7.2 outlines themes and sub-category themes, supplementary document two (Appendix H, Appendix Table 7) provides focus group example quotes.

Provision of tailored and accessible resources was valuable

- Materials provided were frequently used
- Tailored resources (i.e. patient handouts) were useful
- The method of resource provision is important (readily available i.e. email preferred)

Equipment and resource availability allowed timely best-practice intervention provision

- Availability of equipment facilitated best practice
- Availability of equipment increased patient motivation in therapy
- Resource availability saved time
- Upper limb therapy was provided faster to the patient

Skilled behaviour monitoring incentivised EBP

- Audit and feedback was helpful to monitor behaviour
- Positive behavioural support method of audit and feedback is important for acceptance
- Providing guided solutions in feedback sessions is important

Direct mentorship and modelling prioritized and facilitated optimal learning

- Mentor-led joint patient sessions increased confidence and skill
- In person training/education sessions are the preferred learning method
- In person training prioritizes new learning and time is made for the activity

Study participation increased clinician's skills, knowledge and confidence

- Clinicians believe participating in the study was time-feasible
- Clinician participants would recommend this study to others.
- Clinicians believed that their patients' upper limb recovered better during the study (from their changed ways of practice)
- Clinicians believe they are now providing best practice interventions
- Clinicians believe they complete upper limb rehabilitation differently post study
- Clinicians felt their behaviour did change despite not always having the caseload to *practice on*.

Figure 7.2. Feasibility focus group themes and sub-categories from facilitator-mediated implementation group clinician participants, Group A (n=6)

7.5 DISCUSSION

This main finding from this study is that providing a facilitator-mediated implementation package to occupational and physiotherapists was feasible and

acceptable. Observed improvements in guideline adherence by clinicians who received the facilitator-mediated package, inclusive of multicomponent implementation interventions, suggest it may also lead to clinician behaviour change in provision of upper limb rehabilitation after stroke. No changes in clinician behaviour change were found in either the self-directed implementation package or usual care groups, suggesting that providing a low-resource implementation package may be no more effective than usual care in terms of delivering guideline-based upper limb rehabilitation after stroke. While significant improvements in patient upper limb outcomes were found within all groups, there were no between-group differences on any measure.

Our study was able to recruit well within each site, with around half of eligible clinicians individually consenting to be active participants in the study (and 100% of eligible occupational clinicians taking part at three of the six sites). This high recruitment rate may indicate clinicians' self-identified need to improve their knowledge and skills in upper limb therapy provision after stroke. The large representation of occupational therapy clinicians in our study is not surprising given that the role of upper limb rehabilitation is an occupational therapy domain of practice (The American Occupational Therapy Association, 2018; Wolf et al., 2006). We do however, acknowledge that this representation may be contextually different in countries outside of Australia. The possible differences in entry-level training between occupational therapists and physiotherapists may influence the content of the knowledge and skill packages within similar implementation programs if not conducted with a mix of occupational and physiotherapists, and thus, future studies should therefore include a needs analysis of the context prior to commencing (French et al., 2012).

Findings also provide guidance for the development of other rehabilitation implementation interventions beyond upper limb therapy. Discussions and themes generated from the focus group held with participants of the facilitator-mediated group suggest that: (1) use of a facilitator (2) interactive and regular education sessions; (3) targeted and tailored resources; (4) role modelling; and (5) behaviour monitoring (fortnightly audit and feedback) were interventions perceived by participants to contribute to their own changes in behaviour. Whilst the self-directed group also received targeted resources (i.e. Graded Repetitive Arm Supplementary Program (GRASP) kits, electrical stimulation machines, tailored patient handouts) and regular written education packs with online video demonstrations, the key differences were regular interactions with a facilitator and behaviour monitoring. This finding has important implications for future

implementation efforts. Both intervention groups required financial and non-financial resources (e.g. equipment and facilitator time), however the facilitator-mediated group required significantly more investment than the self-directed group. Given that the self-directed implementation package was no more effective in achieving clinician behaviour change than our usual care group, investment in implementation interventions without facilitation and audit-feedback (as provided to the self-directed group) may not yield behaviour change. More time commitment was also required by clinicians in the facilitator-mediated group, yet despite this, clinicians reported interventions to be time-feasible and perceived it to save them time in other ways (e.g. establishing patient programs). This perceived *time tradeoff* is likely to also contribute to the positive acceptance of the study intervention, with clinicians reporting personal and clinical benefits (increased skill and confidence, and clinical changes observed in their patients). Clinicians in the self-directed group also reported their involvement to be time feasible (although they spent less time engaged in study interventions), however they were not as satisfied with the time investment tradeoff for perceived increased skill and confidence.

Due to the small sample and lack of randomisation, no conclusion can be reached about differences in patient upper limb outcomes between the three clusters (no estimate of effect of between-group differences were found). Patients in the facilitator-mediated inpatient group were on average 176 days post-injury at the time of recruitment, compared to an average of 40 and 36 days in the self-directed and usual care groups respectively. This difference may be a contributing factor to the limited between-group differences in upper limb outcome measures. Few implementation studies measure patient outcomes, and future studies should incorporate this into their protocol design.

Previous allied health studies investigating the effectiveness of implementation interventions have reported little to no effect (Scott et al., 2012), which may be due in part to lack of explicit rationale for a) intervention choice and b) inappropriate methods to design implementation interventions (Davies et al., 2010; The Improved Clinical Effectiveness through Behavioural Research, 2006). Our study interventions were informed by the Theoretical Domains Framework (Cane et al., 2012) and Behaviour Change Wheel theory (Michie, Atkins, et al., 2014). Employing the four-step method outlined by French and colleagues (2012), behaviour change intervention mapping guided the design of both implementation packages. This was considered the most appropriate behaviour change theory to use, given our study population of individual clinicians (Michie et al., 2005). In this way, our implementation interventions were theoretically

developed (explicitly) as opposed to pragmatically developed (Rothman, 2004) or conceptually-based, and this may have contributed towards our successful study findings. As indicated by Davis and colleagues (2010) greater use of explicit theories in understanding barriers and designing interventions is required to advance the science of implementation. In addition to this theoretical underpinning, promising implementation interventions reported in previous research or recommended for use in systematic reviews (i.e. active and multicomponent interventions) were considered. For example, learnings from successful behaviour change trials such as Bekkering and colleagues (2005) and Martin and colleagues (2010) suggested the use of interactive education sessions, role modelling, rehearsal and performance feedback interventions, and so were incorporated into our intervention design. Newer approaches were also employed such as the use of a facilitator (or *knowledge broker* as described by Dobbins and colleagues (2009)) to establish a relationship between research producers and end users via interactive and face-to-face contact.

Two recent and notable behaviour change studies in stroke, the *out and about trial* (McCluskey et al., 2016) and *implementation of the Assessment for Rehabilitation Tool (ART)* (Lynch, Cadilhac, Luker, & Hillier, 2016) did not lead to behaviour change of clinicians. In their cluster randomised controlled study, Lynch and colleagues (2016) delivered active, multicomponent implementation interventions (informed by conceptual theory) over two weeks, followed by phone call reminders in the month following intervention. Whilst they conducted a barrier and motivator workshop and facilitated the development of *action plans*, they relied on site-based opinion leaders to implement and enact the action plans. In contrast, our study developed implementation interventions explicitly informed by theory, and supported implementation within the workplace context using a facilitator (knowledge broker). Additionally, we conducted fortnightly audit and feedback to clinicians (12 rounds in total) about their compliance to guideline recommendations, whereas Lynch and colleagues (2016) and McCluskey and colleagues (McCluskey et al., 2016) completed audit and feedback on one occasion respectively. Strategies employed by both studies, whilst active and multicomponent in approach, were not delivered with the same frequency (i.e. interaction *dose*) and did not contain the same type of face-to-face interventions (i.e. modelling and rehearsal) as our study did (in the facilitator-mediated group). This is likely to be a contributing factor to the differences in behaviour change outcomes. Interventions used in our self-directed implementation package group also contained active and multicomponent interventions, yet were less

interactive than interventions used in Lynch et al. (2016) and McCluskey and colleagues (McCluskey et al., 2016) trials. As concluded by Bird and colleagues (2019), the use of a facilitator appears to be a successful implementation intervention component within an implementation strategy. This finding is consistent with the findings of our study. The use of a facilitator (or knowledge broker) often removes *championing* tasks from busy clinicians, and as identified in this study may lead to time saved in other work tasks (Simms, 2010). Frequency and dose of face-to-face interaction may be an important factor in successful behaviour change. Whilst the use of opinion leaders is thought to promote evidence based practice (Flodgren et al., 2011), asking clinicians to *champion* change on top of their current workload is not ideal.

Strengths of this study include behaviour change intervention mapping (with explicit theory use), the use of a cluster controlled design and recruiting from multiple sites across private and public healthcare sectors. There are some limitations of this study. Firstly, the sample size is small and caution needs to be taken when interpreting results. Grimshaw and colleagues (2000) suggest that a randomised cluster controlled trial is the ideal design for implementation allowing head to head comparisons of interventions, however multiple arm groups are compromised by a loss of statistical power. Secondly, given the scope of this study (feasibility), we were unable to randomise the clusters, which would have greatly strengthened the design. Thirdly, our method of recruitment (ongoing patient recruitment during the three-month intervention period) meant that some patients were enrolled mid-way through the study, so given that the treating clinician was receiving study interventions, the *baseline* medical file audit for that patient may not be a true reflection of the clinician *pre-intervention* behaviour. We attempted to control for this by removing *baseline* audits of patient participants enrolled after day 35 in the facilitator-mediated and self-directed implementation groups. Finally, the majority of clinician participants were occupational therapists, which may reduce generalisability of the results to physiotherapists.

7.6 CONCLUSIONS

This study provides novel findings about high and low resource investment in implementation packages. Low resource investment into implementation interventions was found to be no more effective than usual care for producing behaviour change with rehabilitation clinicians working with stroke survivors. Given the results of this feasibility

study, a randomised trial is warranted to test effectiveness of these intervention packages on clinician behaviour change and patient upper limb outcomes. Future trials should also include follow-up assessment to better understand the sustainability of changes, and if significant changes are found, health economic analyses to determine cost-benefit given the proportionally higher investment of time by clinicians.

Chapter 8: Discussion

8.1 INTRODUCTION

This program of research has explored increasing the use of guideline recommendations in neurorehabilitation, contributing new knowledge to the fields of implementation science and rehabilitation. Studies Three and Five were narrower in scope, focusing on the uptake of guideline recommendations specific to upper limb rehabilitation following brain injury. Despite this, the lessons learnt from these studies have broader applicability to neurorehabilitation. Taken together, studies in this thesis investigated the current state of evidence, implementation planning, determinants of guideline recommendation uptake, and effectiveness of implementation interventions in rehabilitation.

The literature review in Chapter Two introduced implementation science and discussed the prevalent implementation and behaviour change frameworks used in healthcare. The effectiveness of known implementation interventions was discussed, with various interventions explored in detail, including audit / feedback and tailored interventions. The systematic review (Study One) synthesised the five highest quality brain injury rehabilitation clinical practice guidelines. Recommendations from these international guidelines were compared, showing that high quality and consistent research is available to guide practice. Unfortunately, this collective evidence has not led to routine use of evidence-based rehabilitation.

Following on from the systematic review, four studies were conducted, each building incrementally upon one another. First, to understand the deliberate planning for implementation within clinical trials, an Australia-wide survey of rehabilitation clinical trialists explored a) their awareness about the implementation of their study intervention in practice, and b) the implementation interventions included in their trial protocols. Second, surveys and focus groups were conducted with occupational therapists and physiotherapists to explore barriers and motivators to adhering to guideline recommendations. After establishing the importance of a behaviour monitoring system, and in an effort to determine the effectiveness of audit and feedback as an implementation intervention, a before-and-after observational study was conducted. Informed by the

preceding studies, two implementation packages (high vs low resource investment) were developed and tested. Finally, a non-randomised cluster controlled feasibility study was conducted to test the effectiveness of changing clinicians' behaviour using these two packages. Taken together, the studies reported in this thesis contribute new knowledge for clinicians, implementation scientists and organisations about the effectiveness of implementation interventions on neurorehabilitation practice.

This discussion chapter reviews key findings from this series of studies in the context of existing literature, along with their contribution to the existing body of knowledge. Limitations of the studies are acknowledged and implications for practice, education, and research discussed.

8.2 KEY FINDINGS

As discussed in earlier chapters, each study makes an important contribution to the disciplines of neurorehabilitation or implementation science in their own right. The thesis as a whole, makes a novel contribution across both disciplines by presenting and integrating these key research studies in a manner which enables a thorough assessment of key barriers to the uptake of guideline recommendations, as well as outlining effective implementation interventions. Consequently, this thesis has advanced understanding about how to best support clinicians to use evidence-based interventions in brain injury rehabilitation. Additionally, by drawing together these research findings, areas for improvement in both the conduct of implementation science research as well as rehabilitation practice have been identified.

8.2.1 Major findings and their significance

At the beginning of this program of research, six questions were posed. Five studies were conducted with six major findings to answer these questions. First, the systematic review identified the top-rated clinical practice guidelines for brain injury rehabilitation internationally, then synthesised recommendations across stroke and brain injury populations. Second, the survey of Australian clinical trialists found that research findings were mostly disseminated as publications, and trialists were largely unsure *when* or *how* to design implementation interventions alongside their effectiveness trials. Third, focus groups with clinicians (occupational and physiotherapists) revealed that barriers to implementing guideline recommendations were present at both the individual and

environmental levels. Fourth, findings from a before-and-after observational study showed that sustained audit and feedback was an effective behaviour change intervention, which increased clinician adherence to rehabilitation guideline recommendations. Finally, the cluster trial found that achieving clinician behaviour change was possible if resource-intensive implementation interventions are used and underpinned by theoretical behaviour mapping, but less-resource intensive interventions did not lead to the same outcomes. These key findings are now discussed, with implications and recommendations for practice, research and policy proposed.

The literature review defined implementation, the role of implementation science within the Australian healthcare system, and outlined the key models and frameworks commonly applied in health research. The review also highlighted research-practice gaps evident in neurorehabilitation and emphasised the problem of limited evidence to guide effective implementation efforts. The systematic review (Study One) confirmed that no published clinical practice guidelines provide health professionals with readily applicable implementation interventions for the clinical setting. Clinicians and organisations have to establish their own processes for implementing individual guideline recommendations, which the latest national audit for stroke rehabilitation has shown is a problem (Stroke Foundation, 2018). For example, despite constraint-induced movement therapy being a *strongly recommended* intervention for people with upper limb weakness following stroke (Stroke Foundation, 2017), only 12% of inpatients received this therapy in rehabilitation (Stroke Foundation, 2018). One domain of the Agree-II tool concerned with quality of implementation planning (Domain Five, Applicability) was the lowest rated of all domains, across all guidelines in the systematic review. This finding suggests that greater detail is required for implementing recommendations and that intervention uptake should be measured and monitored.

In Study Two, planning for implementation and measuring intervention uptake were explored from the perspectives of Australian clinical trialists. Results show that the primary method of planned implementation is academic publication, followed by conference presentations. Both methods are isolated activities that were acknowledged to take place at the end of a trial. As suggested by Gagnon (2011) and confirmed in this study, trialists should be encouraged to engage novel approaches to research dissemination to plan for more impactful research uptake, which may not necessarily take place at the end of a trial. Similarly, Graham and Tetroe (2007b) encourage trialists that employ a traditional end-of-trial dissemination approach to use more intense, interactive and targeted methods. Examples of these methods include interactive education sessions

with policy-makers, media engagement or the use of knowledge brokers to disseminate research findings (Graham & Tetroe, 2007b). Most surveyed trialists considered practice and policy change to have occurred if their trial was included in clinical practice guidelines, despite no formal measurement of intervention adoption and/or use by the trialists themselves. Clinical trialists appeared unsure about when and how to plan for implementation interventions, often perceiving that smaller studies were not significantly powered to warrant implementation planning. This finding is consistent with those of Lynch and colleagues (2018) who suggested that education and skill development are needed for trialists to apply broader implementation interventions. Ultimately, Study Two suggests that further research is required to identify effective components of implementation interventions, to support trialists in planning for implementation. Furthermore, findings indicate that perhaps novel approaches such as collaborative research design (i.e. partnering with research-users in research) (Walter, Davies, & Nutley, 2003) or incentives (such as mandating implementation in funded trials) need to be piloted to encourage trialists to use broader dissemination designs for implementation.

For the purposes of this program of research, a subset of guideline recommendations were selected; this exemplar set was drawn from the Stroke Foundation's rehabilitation clinical practice guidelines (Stroke Foundation, 2017) specifically in upper limb management (Section 10.6 recommendations). To understand the barriers and motivators (i.e. determinants) of using these guideline recommendations in practice, Study Three outlined the perspectives of clinicians (occupational and physiotherapists). Applying the Theoretical Domains Framework (discussed in the literature review) allowed barriers and motivators to be qualified and categorised from the perspectives of the clinicians. This study generated three key findings. Firstly, using a framework to map statements of perceived barriers to domain categories enabled accurate identification of need. This process later increased the precision of the implementation intervention developed to address identified needs. Secondly, the majority of barriers were at the level of the individual (i.e. skill, knowledge, belief about consequences) with a clinically important finding that very little (if any) behaviour regulation or monitoring occurred in everyday clinical practice. Thirdly, environmental factors (such as organisational priority and access to resources) contributed significantly to the use of specific guideline recommendations. As highlighted in the literature review, identifying determinants appears to be a critical step in identifying, selecting and tailoring appropriate implementation interventions (Dobbins, Hanna, et al., 2009; Fernandez et al., 2019; LaRocca et al., 2012). If this step is missed or miscalculated, the implementation process

may not lead to success; a hypothesised cause of inconclusive findings in previous implementation research (Dobbins, Hanna, et al., 2009; Wensing, 2017).

The literature review highlighted that many implementation models and frameworks exist, but there are not yet effective methods (i.e. implementation interventions) to facilitate the efficient uptake of guideline recommendations into clinical practice. Study Two revealed that clinical trialists rely mostly on anecdotal feedback about their intervention uptake, and rarely measure clinical uptake of their trial findings in practice. Study Three highlighted that little or no regulation (behaviour monitoring) of clinical practice occurs and accountability for clinical performance may influence the implementation of research in practice. There is a strong move towards auditing, to establish if guideline recommendations are being used in clinical care (Stroke Foundation, 2018). Furthermore, it has been suggested that regular cycles of audit and feedback may be used as a regulatory intervention to promote behaviour monitoring in the clinical context (Hysong, Best, & Pugh, 2006; Michie, Atkins, et al., 2014). Ivers (2014) argued that audit and feedback is an effective implementation intervention, yet what remains unknown is the mechanisms associated with its effectiveness. Therefore, Study Four, which used a before-and-after design, investigated constructs related to method and dose of audit and feedback to determine the effectiveness of its use as an implementation intervention within a neurorehabilitation setting.

Building on the hypotheses of Grimshaw and colleagues (2013), findings of Study Four revealed that frequent cycles, use of theory, and clinician involvement for solution generation were important features to the effectiveness of the audit and feedback intervention. Study Four supports the content of the literature review, and details how the correct application and use of implementation theory to interventions is essential to obtain targeted behaviour change and thus research uptake in practice. Findings also support the work of Guldberg and colleagues (2009) where targeting behaviour for change was associated with adherence effectiveness. Additionally findings concur with characteristics outlined by Hysong (2009b) where feedback that was not punitive, presented in written and verbal formats, and directed attention towards acceptable and familiar tasks were effective for producing behaviour change. The frequency of audit and feedback cycles are also likely to be an important mechanism for efficacy (Berman & Simon, 1998; Wahlstrom et al., 2003), consistent with findings from a meta-analysis by Hysong (2009b) and the systematic review by Ivers and colleagues (2012).

Whilst sustainability of implementation was beyond the scope of this thesis, learnings from Study Four (given its three-month intervention withdrawal period) suggest

that behaviour change is more likely to be sustained if process and system changes are made and receive ongoing support from management / organisation. Although limited evidence exists about the efficacy of sustainability interventions (Chambers, Glasgow, & Stange, 2013; Hailemariam et al., 2019; Proctor et al., 2015), change in organisational policy and practice has been identified as a potential method (Gruen et al., 2008; Swerissen & Crisp, 2004), as have regulatory interventions that monitor performance (Michie et al., 2011).

Given the learnings from the aforementioned studies, implementation theories were applied to determine effective and feasible strategies for use in clinical practice. Insights gained from Study Three were instrumental in designing the implementation packages used and explained in Study Five. Using the Behaviour Change Wheel (Michie et al., 2011), barriers identified in Study Three were mapped to a behaviour change intervention function, and aligned to the implementation intervention. Study Five, a cluster feasibility trial, was designed to test the feasibility and effectiveness of two implementation packages on clinician adherence to upper limb guideline recommendations. Findings show that clinicians in Group A (resource-intensive group) that received a facilitator-mediated implementation strategy, changed their behaviour (as measured by medical file audits) in both within-group and between-group analyses. Clinicians in Group A reported the implementation package to be time-feasible, acceptable in the clinical context and increase their skills at delivering upper limb interventions. Clinicians allocated to Group B (low-resource group) were no more effective than the control group in adhering to guideline recommendations. Whilst this exemplar in upper limb rehabilitation has demonstrated that the investment required for successful implementation is more substantial than anticipated, the results are likely to have implications for implementation in rehabilitation more broadly. The findings of Study Five concur with those of Riis and colleagues et al (2016) for the use of multimodal interventions, Russell et al (2010) for the use of a facilitator, Prior et al (2008) for the use of active and interactive interventions and Ivers et al (2012) for behaviour monitoring (audit and feedback).

In summary, the systematic review of rehabilitation guidelines (Study One) and nationwide survey of trialists (Study Two) highlight the availability of high quality interventions for use in neurorehabilitation, and substantiate the need for effective implementation interventions. Findings from the mixed methods study (Study Three), before-and-after observational study (Study Four), and cluster trial (Study Five) highlight the importance of using implementation models and frameworks to accurately categorise

areas of need and guide implementation efforts. Further, results from the before-and-after observational study (Study Four) and the cluster trial (Study Five) suggest that implementation interventions can be effective in clinical practice to increase recommendation adherence if they:

- are informed by implementation models or frameworks
- are tailored to meet the needs of health professionals
- are actively invested in (i.e. facilitator-mediated)
- employ a multi-faceted approach (i.e. implementation strategy)
- incorporate a behaviour monitoring system (i.e. audit and feedback)
- become embedded in routine process
- are frequently delivered in a deliberate and dedicated manner
- are supported by health service management.

Thesis findings highlight areas in need of further research for implementation science. These areas of need include investigating the *active* components of implementation interventions (i.e. within implementation strategies) to determine which interventions or key features are necessary for greatest behaviour change. Rigorous research is also required into the effectiveness of knowledge brokers in the context of implementation and the constraints under which their impact is optimised. There is a strong need to establish optimal methods for achieving intervention sustainability post implementation, as well as identifying an optimal method for measuring intervention penetration and uptake. Finally, exploring how to maintain clinical intervention fidelity whist allowing for acceptable adaptation to context would be of great benefit to the field.

8.3 STRENGTHS AND LIMITATIONS

Each individual study in this thesis has limitations as well as strengths which have already been discussed in the preceding chapters. A summary of these strengths and limitations is listed below:

Table 8.1: Strengths and limitations of individual studies in this thesis

Study Number	Study Strengths	Study Limitations
Study One	• Broad search strategy and inclusion criteria	• Only included guidelines published in English

Study Number	Study Strengths	Study Limitations
		• Potentially not representative of middle to low income countries
Study Two	• High response rate • Representation from various disciplines • Employed rigorous (systematic) method to source participants	• Only used email to contact authors • Only searched databases that could be limited to country of authorship
Study Three	• Strong geographical representation of participants • Theoretically informed design	• Social bias in survey responses likely
Study Four	• Long (<12 months) duration of intervention • Broad representation of health care professional • Theoretically informed design	• Potentially contaminated with intervention effect over commencement and end of intervention time points • Unable to observe behaviour change on an individual clinician level
Study Five	• Control group comparison • Representation from both in and outpatient settings • Representation from both private and public sectors of healthcare. • Theoretically informed design	• Cluster sites were not randomised • Small sample size. • Smaller representation of physiotherapists than occupational therapists. • Self-directed implementation interventions potentially did not contain adequate content for skill development.

The broad and inclusive nature of data collection processes (e.g. publication searching and participant recruitment) and the theoretically informed design are strengths across individual studies (Nilsen, 2015; Slade, Philip, & Morris, 2018). Consequently,

this thesis has the key strength of providing a broad and comprehensive profile of the current state of evidence, clinical guidance, pertinent implementation issues and new knowledge regarding implementation interventions for neurorehabilitation. Additionally, using implementation frameworks and models has enabled the continuous connection of implementation theory across key areas of evidence-based practice. By doing so, this thesis makes a valuable contribution to the field by highlighting clinical and health service needs, as well as the implementation interventions required to deliver guideline-recommended healthcare.

Limitations inherently imposed by study design need to be acknowledged, particularly for Studies Two, Four, and Five. Under ideal conditions (i.e. with funding and increased time) additional design elements to increase rigour would have been incorporated. For example, international recruitment could be added to Study Two, longitudinal follow-up (12-months post intervention) added to Study Four, and, randomisation and national recruitment added to Study Five. The main limitation in interpreting the findings of this thesis thus derive namely from small study sample sizes which impact on generalisability (Altman, 1991) and certainty of findings. Whilst every effort was made within the scope of a PhD to increase participants in each study, the choice of design for Study Five (non-randomised cluster design) limits the certainty of findings and the overall conclusions that can be made (Campbell, Elbourne, & Altman, 2004).

8.4 IMPLICATIONS AND RECOMMENDATIONS

The key implications and recommendations arising from this thesis have been derived from issues raised in one or more of the studies undertaken. While guideline recommendations were specific to upper limb rehabilitation in Studies Three and Five, lessons learnt may be applied more broadly across rehabilitation. As established in the literature review, the rehabilitation context is considered complex with implementation research in its infancy (Jones et al., 2015; Morris et al., 2019). Morris and colleagues (2019) recently encouraged implementation researchers to learn from four presented case studies of successful projects across rehabilitation. Despite each of these included case studies narrowing in on specific areas within rehabilitation (i.e. upper limb interventions, early supported discharge) (Bernhardsson et al., 2014; Connell et al., 2015; Fisher et al., 2016; Sezier et al., 2018), learnings about implementation science can be taken from each (Morris et al., 2019). It is this consistency in the rehabilitation context and practices that

enables studies which ought to implement various guidelines (in practice areas such as chronic pain, aged care, neurology) to be synthesised in systematic reviews of implementation interventions (Jones et al., 2015). Implications and recommendations from this series of studies (Studies One - Five) for clinical care, research, and policy are discussed in detail below.

What recommendations can be made from the findings of this thesis to improve the implementation of guideline recommendations and close research-practice gaps in rehabilitation?

1. **A globally endorsed and regularly updated single clinical practice guideline for neurorehabilitation that does not separate vascular from traumatic causes should be considered.**

Clinical practice guidelines are defined by the National Health and Medical Research Council as being *"evidence based statements that include recommendations intended to optimise patient care and assist health care practitioners to make decisions about appropriate health care for specific clinical circumstances"* (NHMRC, 2017). The systematic review (Study One) found 19 published and endorsed guidelines for stroke and traumatic brain injury. When assessed for quality, much variation was found, particularly in older guidelines. This issue of having multiple guidelines for users to select from, with varying degrees of quality is a problem for implementation and recommendation uptake (Graham et al., 2001; Harrison et al., 2013). When the high quality guidelines were synthesised, very little difference between recommendations was found (Jolliffe et al., 2018) suggesting that (1) separating out clinical conditions (vascular from traumatic) is inefficient when rehabilitation interventions are the same (with the exception of medical management and behaviour regulation) and, (2) much resource waste occurs when each country produces its own guideline with similar, if not the same, recommendation outcomes. In terms of implementation and adoption from the perspective of users, having a globally endorsed guideline, with pooled resources and consistent messaging may influence the quality of care in neurorehabilitation, and minimise the challenges regarding guideline selection and implementation.

Founded in 2002, the introduction of the Guidelines International Network, a central repository for health clinical practice guidelines, in combination with the movement towards international standards for guideline development (AGREE

collaboration established in 2001) (Qaseem et al., 2012) has strengthened collaborative guideline development (Guidelines International Network, 2019). Through collaboration, further reduction in quality variability, duplication and conflicts can be made, by pooling resources and regularly updating international guidelines for brain injury (encompassing vascular and non-vascular causes). Other areas of health have successfully introduced international guidelines, including: selection of lung transplant clients (Orens et al., 2006), provision of allergy immunotherapy (Jutel et al., 2015) and diagnosis and management of early psychosis (2018). Given the volume of nationally-produced guidelines around the world for stroke and traumatic brain injury, international guidelines for neurorehabilitation should strongly be considered.

2. **Guideline development groups should improve the reporting of recommended interventions in guidelines and/or signpost where clinicians can access specific protocols. This may facilitate improved intervention understanding and uptake by guideline users.**

Poor intervention reporting is one of the known barriers clinicians face for implementing evidence-based interventions in practice (Wilson et al., 2017) with detailed intervention reporting (sufficient for reproducibility) highlighted as a priority (Simera et al., 2010). Over recent decades, improved effort has been made by researchers, scientific journals, and trial registries to improve the completeness of research reporting (i.e. Consolidated Standards of Reporting Trials (CONSORT) and Standards for Reporting Implementation Studies (STarI) checklists) and access to intervention-based protocols. Despite the introduction of the TIDieR checklist (Hoffmann et al., 2014) and the collective movement towards greater transparency and complete reporting, issues of incomplete intervention reporting remain. Poor intervention reporting in trials has downstream consequences for evidence-based intervention uptake in practice. For example, incomplete reporting in trial publications are then synthesised into systematic reviews, which later influence guideline recommendations (Hoffmann et al., 2015). This issue (poor intervention reporting) has been highlighted in a study exploring intervention descriptions within systematic reviews of non-pharmacological stroke interventions (Hoffmann et al., 2015). Hoffmann and colleagues found that most systematic reviews were missing adequate intervention descriptions for the majority of items on the TIDieR checklist. Furthermore, the authors highlight the compounding effect that missing intervention detail has on intervention conduct, interpretation and usability (Hoffmann et

al., 2015). It is therefore unsurprising that clinicians continue to identify a lack of complete intervention reporting as a barrier to guideline recommendation uptake in practice (Study Three). Whilst clinical trialists believe their publications provide sufficient detail about intervention protocols (Study Two), research suggests that sufficient detail to replicate an intervention is typically absent (Glasziou et al., 2014; Hoffmann et al., 2015). It has been estimated that only 39% of clinical trial reports provide adequate information about interventions however details vary between clinical areas, thus impacting on reproducibility for clinicians (Hoffmann, Erueti, & Glasziou, 2013). Alongside poor intervention reporting, Hoffmann and colleagues (2017) demonstrate that actual access to intervention protocols remains an issue. This may be an opportunity for guideline development groups to assist clinicians and evidence uptake by signposting or directing readers to detailed intervention protocols within guidelines.

The creation of clinical practice guidelines is a huge undertaking for development groups, and involves a committed, collaborative effort from a range of stakeholders (Shekelle, Woolf, Eccles, & Grimshaw, 1999). Whilst guideline development is a necessary step towards bringing research into clinical practice (Woolf et al., 1999), producing high quality, accessible guidelines is no guarantee that recommendations will be implemented (Harrison et al., 2013). Guideline recommendations are however, often the first point of reference for many clinicians seeking to review evidence-based practice and / or looking to select an appropriate intervention (Study Three). Although the primary intent of guidelines is to collect, appraise, and synthesise latest evidence (Grol & Grimshaw, 2003), it has become apparent that users (in this case, clinicians) want a *one-stop-shop* experience; looking to guidelines to provide specific details about *how* to provide recommended interventions (Study Three). Harrison and colleagues (2013) argue that the emphasis needs to shift from guideline development to guideline use; suggesting that available evidence housed in guidelines is part of the solution, but adapting recommendations for practical use is the initial step towards creating change. The AGREE-II is not only an evaluation tool, but can be used as a framework to inform guideline development and reporting (Collaboration). With a whole domain dedicated to *applicability* and points assigned to guidelines that include tools to monitor recommendation uptake (such as audit criteria), there is some onus on development groups to guide implementation efforts. Given that guideline development members are well informed about topic areas (having appraised and synthesised relevant publications) (Shekelle et al., 1999), they are well positioned to provide direction to readers about high quality publications and other resources/locations that detail intervention specifics. This

need for complete intervention detail or signposting in guidelines is only one part of a broader implementation strategy and raises an interrelated issue of where these protocols and intervention materials should be housed for access. There is the potential for trial registries to be a repository for intervention and trial protocols.

In light of this emerging shift (guideline users wanting details about how to implement interventions) perhaps guideline working groups need to consider how they can address this increasing need. In Gagliardi and Brouwer's (2012) analysis of guideline development manual instructions, it was found that guideline writing groups have limited instruction when incorporating implementation advice. Gagliardi and Brouwers (2012) recommend guideline-manual content be expanded for domains related to implementation, and encourages new approaches be adopted for guideline development. Recommendations from guideline users have been made to writing groups in the past, in an attempt to address the need to increase the applicability and implementation of guidelines (Sabharwal, Patel, Gauher, Holloway, & Athansiou, 2014). Suggestions include pilot testing and adapting guidelines based on user feedback, adding a barrier analysis tool, and holding an annual open dialogue between writing groups and users, with steps to manage difficulties that arise in practice (Sabharwal et al., 2014). Some of these suggestions have been adopted and trialled with limited success, for example adapting guidelines for local use (Silagy et al., 2002). Perhaps therefore, novel approaches could include the use of online media (e.g. videos) to role model and demonstrate specific interventions. Other approaches include partnering with peak body organisations or advocacy groups to provide accessible online learning modules or resources.

3. **An open dialogue in the stroke community should begin, to discuss who is best placed to advise about the uptake of research in practice, and where this advice can be accessed. Perhaps implementation advice is beyond the scope of clinical practice guideline developers.**

Implementation is defined as the process of integrating proven (evidenced based) interventions (i.e. programs, practices, guideline recommendations and policies) within a specific context (Bauer et al., 2015; Rabin et al., 2008). Implementation is a critical step to ensuring the full benefits of an evidence-based intervention is realised for its intended users (i.e. people living with brain injury) and requires the collaborative efforts of researchers, clinicians, and implementation specialists (i.e. knowledge brokers /

implementation scientists) (Bauer et al., 2015). It was established in Study Three that clinical practice guidelines are often the first point of reference for clinicians seeking information about evidence-based interventions. Whilst improved intervention reporting in the guidelines and/or referring readers to detailed intervention protocols has been argued for, implementation is a process that involves much more than this. The important role of context, coupled with essential processes (such as a needs analysis), alongside the specific knowledge required to drive behaviour change at various levels makes the uptake of research in practice a complex task. It is therefore unrealistic to expect that guidelines alone can and should provide all the solutions. Guidelines have a very important role to play and could include implementation interventions for universal challenges faced by users (i.e. provide specific and targeted audit criteria). Despite this, there is currently no dialogue in stroke rehabilitation about who is best placed to advise on the uptake of research and adoption of recommendations in practice.

The importance and value of implementation has gained much attention in the past 20 years with growing interest in the field (Grol, Berwick, & Wensing, 2008). Funders are aware of the need to mobilise created knowledge into action (NHMRC, 2019; Government of Canada, 2019), scientific journals dedicated to the field have emerged (e.g. *Implementation Science* and *British Medical Journal Quality and Safety*) and healthcare organisations are focused on providing evidence-based care (Victorian State Government, 2018). Despite these advances, there has been little explicit discussion about whose role or responsibility it is to oversee and drive the uptake of research within the stroke/brain injury arena. In Australia, we are fortunate to have strong advocacy from the Stroke Foundation, however it is likely beyond their scope to comment on and improve organisational culture and health service provider context.

Grimshaw and colleagues (2012) suggested that the responsibility of implementation should largely rest with healthcare systems via the development of research knowledge infrastructures (Ellen, Lavis, Ouimet, Grimshaw, & Bedard, 2011), however it is currently assumed that all stakeholders (funding bodies, organisations, researchers, decision-makers, and clinicians) have a responsibility to implement evidence-based practice. In Study Two, clinical trialists reported that their responsibilities had been met when their research findings had been included in practice guidelines, a finding echoed in similar work (Lynch, Ramanathan, et al., 2018). In Study Three, clinicians reported that a lack of specificity in guidelines along with a healthcare system that does not monitor their performance restricts their ability to adopt research in practice. The audit and feedback study suggests that the successful outcome of behaviour change

becomes possible when implementation collaborative, and the responsibilities of each stakeholder (clinician, researcher, management) are clear. This study successfully saw researchers, clinicians and the organisation (management) collaboratively working together, each with a clear role and defined responsibilities. This is consistent with work of Mirzoev and colleagues (2012) who suggest that establishing clear roles, responsibilities and the commitment of stakeholders of various levels is important to the process initiating and maintaining sound partnerships in collaborative research. Taken together, findings from Study Four and Mirzoev (2012) support the recommendations of Gagnon (2011), confirming that collaborative relationships built on trust and frequent interactions between key stakeholders are crucial determinants of successful implementation.

An identified intervention to foster collaborative relationships with frequent interaction between key stakeholders is the use of a knowledge broker or facilitator (Dobbins, Robeson, et al., 2009; Kitson et al., 2008). As discussed in the literature review, knowledge brokers and facilitators are skilled in networking, collaboration, and appraising research evidence to support the uptake of research in practice (Bornbaum et al., 2015). In a new directive funded by the Victorian State Government, 10 Allied Health Research and Translation positions (akin to knowledge broker roles) were established and rolled out across the state in 2018, to create stronger links between hospitals and universities that were at the forefront of clinical research (Victorian State Government, 2018). Investment in these positions is a positive step forward, providing implementation specialists within contexts for change. These leaders may inspire an open dialogue about how all stakeholders can work together and define the responsibilities carried by each in the implementation process.

4. **Funding bodies and/or research institutions should incentivise and support clinical trialists to plan for impactful implementation interventions. Whilst publishing research findings is the most commonly reported implementation intervention by trialists, researchers should be more aware of the need to design for active implementation strategies in trial protocols (and supported to do so).**

Australian researchers, like most researchers around the world, are incentivised by their affiliated institution (often a university) to produce publications (Rawat & Meena, 2014). Although this metric is an expected performance indicator, and trialists reported

publication to be the most common implementation intervention (discussed in Study Two), publishing your research does not equate to intervention adoption (Beidas & Kendall, 2010; Fixsen et al., 2005). Australian funders should therefore consider initiatives such as mandating implementation to encourage trialists to incorporate implementation interventions into trial protocols. Such initiatives have successfully been achieved in other countries such as Canada. The Canadian Institute of Heath Research (CIHR) (their national health research funding agency) embedded financial implementation incentives into their funding schemes, in an effort to ensure health benefits returned to taxpayers for economic investment into health research (Government of Canada, 2019). The CIHR Act (Bill C-13) mandates that that the implementation of health knowledge permeates every aspect of its work (McLean et al., 2012; Parliament of Canada, 2000). This incentive presents active investment into implementation strategies with successful implementation outputs. In 2013, all CIHR-funded opportunities performed well against existing measures of success, and led to implementation resource outputs (including websites and decision aids), academic outputs (including journal articles and books) and capacity building (Government of Canada, 2013). Whilst the Australian NHMRC has dedicated implementation initiatives (i.e., dedicated grants for *knowledge translation* and annual symposiums), unlike the CIHR, funded phase III and IV trials are expected to collect have health economic data but are not required to have embedded implementation interventions (NHMRC, 2019). Tetroe and colleagues (2008) recommend funders provide clarity around what interventions (i.e. activities) are defined as implementation and what are not. That recommendation is further supported by Wilson and colleagues (2010) who recommend mandating theory-informed dissemination plans of funded trials. Gagnon (2011) highlights that although end-of-grant implementation interventions are appropriate for some trials, researchers should consider novel approaches to implementation commenced at earlier phases (such as collaborative partnership designs).

In a positive step, initiatives such as the WIDER reporting guidelines (for behaviour change interventions) (Albrecht et al., 2013), Trial Forge (Treweek et al., 2015) and online implementation toolkits for researchers (National Institute of Health) have been established to support trialists designing effective implementation. Results from the study of Australian clinical trialists (Study Two) show that more recent trials (designed within the past five years) were more likely to consider implementation in earlier phases (i.e. protocol development phase). Trialists of these studies were also more likely to engage with implementation scientists about designing for implementation and initiating novel

interventions such as partnering with peak body organisations (i.e. Stroke Foundation) and tertiary institutions (i.e. completing online learning modules) in their current or near-future trials.

5. **Behaviour monitoring systems should be built into health services so that clinicians are accountable for their practice and can access support when required.**

As discussed in Studies Three, Four, and Five, it is evident that very little (if any) behaviour regulation or monitoring of clinicians' practice occurs in Australian health service settings. In a quote from one clinician (taken from Study Three), *"no one is checking what I am doing";* a repeated finding across this program of research. It is imperative to understand that behaviour monitoring to facilitate implementation is not punitive, but rather underpinned by positive behavioural support (informed by behaviour change functions and theory) and designed to ensure support is given at an organisational level. In a Cochrane systematic review (Ivers et al., 2012) the effectiveness of audit and feedback was investigated. Given the variability in quality of the included studies, limited conclusions could be made, however authors postulated that audit and feedback was most likely to work as a behaviour change intervention if: feedback is provided more than once, delivered by a supervisor or colleague and includes clear targets (Ivers et al., 2012).

As explored in Study Four, audit and feedback was found to be an effective intervention for behaviour change. The success of this study is largely credited to (i) being theory informed (that is, the use of positive behavioural support in a Periodic Service Review framework) and (ii) set out with specific constraints (that is, the intended behaviour was made very clear). The benefit of employing behaviour monitoring systems was once again reinforced when audit and feedback was used in the facilitator-mediated implementation package group for the cluster study (Study Five). During post-intervention focus groups, participating clinicians reported valuing the opportunity to see (anonymously) how their daily practice compared to guideline recommendations. Clinicians found audit and feedback motivating and allowed them to identify areas for improvement, or aspects of the working environment that needed changing to support evidence-based practice. Findings from Study Four support the recommendations of Ivers (2012) and further identified important characteristics of the audit and feedback process for success. Audit and feedback studies that do not use theory to guide feedback, or don't set out clear process constrains are likely to vary in efficacy and disengage participants

(Sinuff, Muscedere, Rozmovits, Dale, & Scales, 2015). Sinuff and colleagues (2015) found that clinicians perceived the audit process to be insufficiently transparent and felt disconnected. Feedback was perceived as being untimely, incomplete, and not actionable. Furthermore the top-down approach left certain clinician cohorts feeling marginalised (Sinuff et al., 2015). Similar findings were found from a qualitative study of nurses' perceptions (Christina et al., 2016) in which increased receptiveness to audit and feedback was likely when feedback provided was helpful rather than critical and when work was acknowledged. In support of findings from Study Three, audit and feedback was taken more seriously when nurses were personally held accountable to a client's wellbeing (Christina et al., 2016).

Within Australian health care settings, in some states, it is usual practice for allied health clinicians to engage in fortnightly or monthly supervision with a senior colleague, and partake in annual performance reviews with a direct line manager (Victorian State Government, 2019). These two activities are designed to encourage self-reflection on practice (Victorian State Government, 2019), however clinical performance and skills are not usually measured objectively. Although less than perfect, these activities are the closest strategies in place akin to behaviour monitoring, however lack objectivity against evidence-based practice. Further problems of this approach include: the time gap between the behaviour and the reflection, the infrequency of supervision sessions, and, the reliance on the senior colleague to be evidence-based. Quality assurance roles and projects exist in many health services, with organisations focused on providing a safe and high-quality service. Despite quality improvement initiatives, current practices lack individual accountability; a necessary component of behaviour monitoring. Usually, aside from the Stroke Foundation's national audit against guideline recommendations, there is little local monitoring of the delivery of rehabilitation or other healthcare. One emerging strategy in Australian healthcare, particularly within the acute setting, is the use of clinical registries to monitor evidence-based clinical care (Aliprandi-Costa et al., 2013; Australian Stroke Clinical Registry, 2019). There is evidence to suggest that registries are effective at driving improvements in healthcare outcomes and adherence to guideline recommended care (Stey et al., 2015; Wilcox & McNeil, 2016). Active in 2009, the Australian Stroke Clinical Registry (AuSCR) was established to improve evidence-based care received by stroke survivors, and to monitor and evaluate stroke care experiences (Australian Stroke Clinical Registry, 2019). Voluntarily entered into by hospitals, the registry collects data on a range of acute care variables. The AuSCR also collects inpatient outcome data at 90 and 180 days post-admission to assess health indicators and level of disability. Outside of

Australia, registries such as “Get with the guidelines – Stroke” (American Heart Association, 2019) focus on capturing quality improvement data through iterative assessment of guideline-based care. In this way, clinical practices of participating services can be compared against guideline recommendations and areas for improvement can be identified.

Introducing personal accountability to target behaviour can lead to opportunities for reflection, skill-gap identification, as well as motivation and an incentive to perform against set standards (Michie, Atkins, et al., 2014). Embedding a monitoring system would provide oversight to management teams and organisations about the type and quality of care provided in rehabilitation (Aliprandi-Costa et al., 2013). Outlined in Michie and colleagues’ Behaviour Change Wheel (Michie, Atkins, et al., 2014), the concept of *behaviour change intervention* mapped to *behaviour change function* is thoroughly explored. Studies that have targeted personal accountability as a behaviour change intervention function within a regulatory process (i.e. audit and feedback) have found significant behaviour change with exemplars in emergency medicine (William et al., 2015) and cancer care (Aletti et al., 2009). Audit and feedback is an effective behaviour change intervention and has the strong potential to reduce implementation times of emerging evidence to practice. It does however need to be conducted constructively (not punitively), employ theory to positively support feedback and be conducted regularly (perhaps aided by a registry or electronic monitoring system).

6. **Implementation theory and frameworks should be used to underpin implementation interventions. Benefits include increased accuracy of identifying needs, ensures strategies are delivered in a systematic and effective way, and guides the process of implementation.**

Implementation planning is instrumental to successful implementation, and many theories, models and frameworks encourage extensive pre-implementation assessment (Damschroder et al., 2009; Grol et al., 2007; Meyers et al., 2012). Given the complex and dynamic environment that implementation usually occurs in, very rarely does one system work in isolation. Braithwaite and colleagues (2018) remind us that the healthcare system is ‘complex’ (as opposed to complicated) and implores us to consider the interconnections between stakeholders and health ecosystems when planning for implementation. Many stakeholders are required to dynamically interact for implementation efforts (such as

funders, decision-makers, advocacy groups, researchers and clinicians) and this chapter has already discussed the need to partner with these stakeholders for collective action.

As previously discussed, the roles and responsibilities of each stakeholder can be unclear and/or uncertain, further adding to the complexity. As discussed in the literature review, there are many frameworks and models to support the process of implementation. Despite this, less than 10% of guideline implementation strategies provided explicit theoretical rationale for their interventions (Grimshaw et al., 2004). Furthermore, Fernandez (2019) argue that despite the availability of determinant style models, limited guidance exists for applying these to design implementation interventions, recommending an implementation mapping protocol accompany frameworks. The strength of Studies Three, Four and Five are their strong application of implementation science frameworks and theoretically-informed underpinning. In the audit and feedback study, the Periodic Service Review approach was used (for the audit and feedback cycles) and positive behavioural support theory applied when giving feedback. The Theoretical Domains Framework was used to understand clinicians' perspectives about barriers and motivators (Study Three) and finally, in Study Five the Behaviour Change Wheel was used to map behaviour change functions to interventions. The success of these studies is credited in part to the appropriate practical application of implementation science models employed in each.

Whilst many frameworks exist in healthcare to guide implementation (Moullin et al., 2015), what remains unknown is the efficacy of applying such frameworks to implementation research. Although implementation scientists use a large number of criteria for the selection of theory in the design of their research, there is little consensus on the relative importance of the criteria (Birken et al., 2017). Furthermore, there are limited empirical studies (with head-to-head comparisons) to establish the efficacy of using theory or conceptual frameworks in implementation science. As raised by Wensing and Grol (2019), frameworks and models should be tested for efficacy in order to move the science forward, rather than investing efforts into the development of new theories that are rarely used (Strifler et al., 2018). Lynch and colleagues (Lynch, Mudge, et al., 2018) confirm a lack of empirical evidence about the advantages of using a theory for implementation, however suggest that goodness-of-fit between the study needs and aims and the theory is important to consider. Pragmatically, does the use of a specific theoretical model or framework matter? Or perhaps the use of any theory is sufficient. This appears to be an emerging area of interest for implementation in healthcare with Morrow and colleagues's (2019) protocol paper outlining their planned randomised

cluster controlled trial to test theory-informed targeted interventions against non-theory informed targeted interventions for the uptake of research in cancer care.

There is a strong need, albeit already known to implementation scientists, for implementation efforts to be conceptually informed by implementation theory and frameworks (Davidoff, Dixon-Woods, Leviton, & Michie, 2015; Eccles, Grimshaw, Walker, Johnston, & Pitts, 2005; Glanz & Bishop, 2010; Graham et al., 2006; Lynch, Mudge, et al., 2018). It is recommended that future clinical research which is targeting behaviour change integrate theory and frameworks appropriately for effective uptake of research into practice. This is a consistent finding from each of the studies of this thesis and one that is echoed in recommendations by other researchers (Eccles, Grimshaw, Walker, Johnston, et al., 2005; Fischer, Lange, Klose, Greiner, & Kraemer, 2016; French et al., 2012). Poor theoretical underpinning makes it difficult to understand and explain how and why implementation succeeds or fails (Nilsen, 2015). This perspective is shared by Eccles and colleagues (2005) who note that implementation research conducted in this way is described as "an expensive version of trial and error with no a priori reason to expect success" (p.108).

7. **Implementation interventions should be supported by employing a knowledge broker for greater uptake of evidence-based interventions. Having an expert intermediary providing practical support or modelling in the implementation context facilitates increased clinician skill development and confidence.**

Communication has been identified as a key contributor to implementation intervention success, however is often described as a transactional (rather than transformative) process in implementation literature (Manojlovich, Squires, Davies, & Graham, 2015). Jean-Louis and Lomas (2003) concur that communication and trust are essential ingredients for successful collaborative research, and suggest that trust is built through informal interaction. Designed as an intermediary between research producers and clinicians via interactive, in-person contact, the role of knowledge brokers has been described in the literature as linkage agents, knowledge managers and capacity builders (Bornbaum et al., 2015; Dobbins, DeCorby, & Twiddy, 2004). Key roles of knowledge brokers may include (but are not limited to): connecting stakeholders, facilitating collaboration, obtaining relevant information, facilitating development of analytical and interpretive skills, creating tailored knowledge products, co-ordinating projects,

supporting communication, developing networks, evaluating change, and supporting sustainability (Bornbaum et al., 2015). In a comprehensive systematic review on knowledge broker effectiveness, Bornbaum and colleagues (2015) identified 22 studies that used a knowledge broker. Unfortunately, given the methodological challenges implementation scientists face when assessing effectiveness of novel strategies, only two of the studies (Dobbins, Hanna, et al., 2009; Russell et al., 2010) were deemed methodologically rigorous (according to the Meta Quality Appraisal Tool (Rosella et al., 2016)) to be included in the review. While Russell and colleagues (2010) found knowledge brokering to be an effective strategy in their before-after study, the RCT by Dobbins and colleagues (2009) did not. Due to conflicting findings from these two included studies, inconclusive evidence for the effectiveness of knowledge brokers was concluded (Bornbaum et al., 2015).

It is interesting to note that knowledge brokers in the Dobbin's et al (2009) study were not situated within the public health department which was the intervention context (i.e. external to the context). The cluster study which employed a knowledge broker but described in Study Five as *facilitator-mediated*, shares consistent findings with that of Russell and colleagues (2010). Russell and colleagues' (2010) study used many knowledge brokers across participating sites. Study Five, although conducted on a much smaller scale, used just one knowledge broker. Despite this, similarities between these two studies include: (1) embedding the knowledge broker into the target context, (2) focusing on research uptake in practice (as opposed to evidence synthesis or teaching critical appraisal), and (3) enabling the broker to tailor and implement interventions led to successful behaviour change.

In stroke rehabilitation, a recent systematic review by Bird and colleagues (2019) found that the role of a facilitator was likely to be important within an implementation strategy for implementation success. Of the 16 RCTs included in the review, 10 used facilitators as part of their implementation strategy. Of these 10 trials (Jones, Tilling, Wilson-Barnett, Newham, & Wolfe, 2005; Lakshminarayan et al., 2010; Lynch et al., 2016; Middleton et al., 2011; Panella, Marchisio, Brambilla, Vanhaecht, & Di Stanislao, 2012; Power et al., 2014; Salbach et al., 2017; Strasser et al., 2008; Sulch, Perez, Melbourn, & Kalra, 2000; Williams et al., 2016), five showed moderate-level GRADE evidence indicating effectiveness in at least one primary outcome (Middleton et al., 2009; Munce, Graham, Salbach, Jaglal, Richards, & Eng, 2017; Power et al., 2014; Salbach et al., 2017; Strasser et al., 2008). Bird and colleagues (2019) attribute success of these trials to the presence of a facilitator, however facilitation was only one component of the

implementation strategy used. Considerable variety was found in *how* facilitators of included studies were used, and the review does not provide recommendations about type, dose or duties of the facilitator (Bird et al., 2019). Furthermore, no statistical analysis of overall effect was completed by the authors which therefore limits the strength of their findings. A Cochrane systematic review of implementation interventions in stroke rehabilitation is currently underway, and statistical analysis for overall effect is planned as described in the published protocol (Cahill, Carey, Lannin, Turville, & O'Connor, 2017). Further research employing rigorous methods into the effectiveness of knowledge brokers and facilitators is greatly needed and may be achieved through novel and adaptive trial designs (Bornbaum et al., 2015). Although knowledge brokering is a costly intervention, it may be a critical mechanism required to drive implementation efforts. Nevertheless, research in support of using knowledge brokers and facilitators in neurorehabilitation is growing.

8. Healthcare organisations and/or systems should embed process change for implementation sustainability.

Sustainability is often the last component of implementation frameworks, however it is the metric that many implementation researchers focus on to determine implementation success. Whether or not behaviour change (or program) is continued in the months and years after the implementation phase is a key outcome of interest. If a program is sustained, the implementation strategies are often credited for this success. Many implementation projects experience behaviour change or successful program implementation when the change driver is active and involved. Initiatives often fail to provide sustained effect in the longer term, once the change driver is removed (Lennox, Maher, & Reed, 2018). There is no standardised outcome measure or *gold standard* for evaluating long-term sustainability, and longitudinal studies exploring sustainability are rare (Chambers et al., 2013). Lennox and colleagues' (2018) systematic review identified 62 studies where a sustainability approach was outlined. Many of these studies identified a model or guiding framework, other suggested post-implementation strategies, and few had developed specific tools. Many of these frameworks suggest that changes occurring at various levels (e.g. at the inner and outer contexts) are more likely to be sustained in the longer term.

Audit of practice (with or without feedback) is a repeatedly discussed and currently used strategy for evaluating sustainability (Tricco et al., 2013). In the audit and feedback

study (Study Four), changes that clinicians made in process or at service levels were more likely to be sustained when the intervention ceased at the conclusion of the 15-month study duration. Similarly, in a 2013 publication, sustained behaviour continued two years post intervention due to reinforcement of the core activities (regular education, audit and feedback of compliance and reminder systems) (Allegranzi et al., 2013). It appears therefore that embedding behaviour monitoring may be important for long term sustainability. The way in which healthcare systems or organisations should set about achieving this remains largely unknown (and untested). Organisational priorities and management support appear key to behaviour change (as discussed in Study Three, Four and Five) which suggest that scaled-up behaviour monitoring initiatives should be built into existing infrastructure across an organisation. Such infrastructure may include electronic medical records, collected clinician statistics, or data linkage from clinical registries. Learnings from Study Four indicate that selecting a smaller number of audit indicators may allow behaviour monitoring to be more feasibly achieved and embedded (or automated). However it would be hypothesised that this alone would be unlikely to lead to change, and that more active implementation interventions need to be used in conjunction to support behaviour change. Management support would need to permeate all leadership levels so that clinicians received regular feedback (perhaps quarterly) about their performance in a supportive (and not punitive) manner.

Ultimately, further research is needed to understand the underlying mechanisms for sustained change. Until then, available research suggests that embedded process change will more likely lead to sustainability (Fleiszer, Semenic, Ritchie, Richer, & Denis, 2015; Gruen et al., 2008).

9. Collaborations between clinicians and decision-makers in an equal partnership should be encouraged to explore key issues, problem-solve, and facilitate change.

The role of implementation is a shared responsibility among many stakeholders, despite a lack of explicit discussion and delegation of implementation tasks. Implementation efforts work best when they employ partnerships between researchers and stakeholders (i.e. end users, management, policy makers), often using a co-creation approach from the onset (Goodyear-Smith, Jackson, & Greenhalgh, 2015; Nilsen et al., 2013). The audit and feedback study (Study Four) is a strong example of this. The research team's responsibilities were to complete audits, analyse data and provide

feedback to the clinical team. It was the responsibility of the clinical team to reflect on their practice, and develop changes to working practices, personal practice and/or process structures. The management and organisation's responsibilities included working closely with everyone involved (researchers and clinicians) to support the program (and subsequently) practice changes, to enable clinicians to perform at their best. After the initial period of settling into respective roles and the *no-blame* ethos was established, this equal partnership allowed for effective problem-solving and unity towards the shared goal (of increasing the use of evidence-based interventions).

Expanding on the above, and when thinking about system-level and agency-level levers (Raghavan et al., 2008), establishing cohesive relationships with advocacy groups, funders and policy makers are also essential to consider. As detailed in Study Two, clinical trialists reported that partnering with advocacy groups such as the Stroke Foundation, or engaging with consumers (perhaps through online platforms such as Facebook or Twitter) were initiatives considered important to: a) work more collaboratively, b) be more responsive to the needs of stakeholders, and c) decrease the time taken to disseminate research findings to users. Mandating implementation within funded research protocols (such as CHIR initiatives) provides incentive for researchers and agencies to establish relationships that perhaps would not have previously come about. Benefits of collaborative partnerships are further highlighted in Lavis et al's (2005) systematic review, in which collaborative interactions between researchers and healthcare policy-makers increased the prospects of research uptake by policy-makers. When influencers at various contextual levels work in solidarity, greater understanding and capacity is endorsed and uptake encouraged (Jagosh et al., 2012). A strong example of this is demonstrated by the implementation of a new service model for the treatment of leg ulcers in the community (Harrison et al., 2005). In this before-and-after study, researchers, organisations, and regional decision-makers successfully redesigned delivery of care to provide outpatients with guideline-based interventions. Furthermore, significant health outcomes and service cost-savings resulted from this initiative (Harrison et al., 2005). Given that Study Four was conducted over 15-months, there was appropriate opportunity to establish a productive and collaborative relationships between stakeholders. As described by Hewitt and colleagues (2007) and consistent with Study Four findings, necessary characteristics of active listening, agreed upon timelines, and mutual respect were found to be essential attributes for successful collaboration.

10. Regulatory agencies should strengthen regulation around continued professional development (CPD) within areas of practice.

Occupational therapists and physiotherapists are legally required to be registered with the Australian Health Practitioner Regulation Agency (AHPRA) to practice in Australia. A condition of annual registration is engagement in *continuing professional development* (CPD). This involves a minimum of 30 hours for occupational therapists, and 20 hours for physiotherapists of learning directed towards maintaining and improving practice competence (Occupational Therapy Board of Australia, 2017; Physiotherapy Board of Australia, 2018). As mentioned in section 8.4 (recommendation number five), the current (informal) system to monitor clinicians' performance is monthly 'supervision' meetings with a more senior colleague. During all focus groups conducted in the Study Three, at no point was continuing professional development or AHPRA's legally-binding regulations discussed. Whilst a lack of practice monitoring was discussed (from a local standpoint) it appears that legal regulatory approaches do not influence motivation for evidence-based practice. A large barrier that identified through this study, was a lack of clinician skill to conduct evidence-based interventions. This perhaps infers that the current clinical supervision structure in place within rehabilitation is not an adequate method for reflecting on personal practice, and that perhaps a more objective method should be added (as discussed in recommendation five). Despite clinicians being legally obligated to *maintain and improve practice competencies,* no specificity (i.e. topics within a practice area) is given (Occupational Therapy Board of Australia, 2017; Physiotherapy Board of Australia, 2018). Although it is unknown if strengthening regulation standards will make a difference to the provision of evidence-based care, and subsequently clinical outcomes, it may incentivise clinicians to engage in skill development relevant to key topics within practice areas and hold clinicians more accountable for their learning.

11. The reach (i.e. accessibility) of evidence-based professional development training and education to clinicians should be increased.

Clinicians' demonstrated awareness of practice guidelines, as well as knowledge about recommended interventions (outlined in Study Three). Further analyses revealed however, that clinicians were limited to implement certain interventions by lack of skills and decision-making capability. This therefore indicates that clinicians are more limited

by physical skills than knowledge for using complex guideline recommended interventions in practice. Aside from peer-learning from a *knowledgeable* colleague, clinicians felt that limited access, cost, and timeliness to education and training were some of the largest barriers to research uptake in practice.

Identifying effective interventions to educate and train clinicians has been a longstanding objective in health services. A systematic review published in 1995 of CPD activities concluded that formal activities such as conferences or workshops, without practice-reinforcing strategies had little impact (Davis et al., 1995). This review also found audit with feedback, and, educational materials less effective than the use of outreach visits, opinion leaders and implementation strategies (Davis et al., 1995). Over subsequent years, more research has strengthened the evidence in support of using audit and feedback for behaviour change (Hysong, 2009b; Ivers et al., 2012; Ivers et al., 2014). Evidence has also strengthened about interventions that have been shown to be not effective. Passive interventions such as the provision of education through written material have little to no effect on clinician behaviour change (Grol & Grimshaw, 2003). The provision of resources as well as tailored written material to the *self-directed* group of Study Five was no more effective than usual care for behaviour change. Didactic one-off training sessions or workshops are also ineffective for behaviour change (Bird et al., 2019; Forsetlund, Bjorndal, et al., 2009; Prior et al., 2008). Despite this, clinicians report a learning preference for interactive workshops or education sessions (Study Three and Study Five) a finding that has been supported by previous studies (Sargeant et al., 2004).

Collectively, it appears that implementation strategies with in-person support (through knowledge brokering or facilitation), tailoring to local context, and, behaviour monitoring are likely to lead to clinician behaviour change (Bird et al., 2019; Davis et al., 1995). Although likely effective, access to these implementation strategies, in which education and training is provided, is remains a pertinent issue for clinicians. Outside of organisational support for professional development, limited low-cost alternatives to text-based materials exist. Opportunities for observational learning or real-time explanation of clinical reasoning for complex evidence-based interventions are also restricted. Implementation scientists recommend clinical trialists engage in interactive, collaborative approaches with health services and stakeholders to facilitate the uptake of research findings in practice (Bauer et al., 2015; Graham & Tetroe, 2007a; Walter et al., 2003). In Study Two, clinicians reported that newer approaches for implementation were being created and tested, including interactive online modules. Although effectiveness research has not been conducted on such initiatives in neurorehabilitation, perhaps the use of *new*

media, which has the capacity to elevate some of the access and cost barriers associated with training, could be a worthwhile component of a broader implementation strategy.

If free interactive training was made accessible online, perhaps through a central hub or advocacy organisation, the reach of research findings to clinicians may be increased. Interactive webinars and online learning modules, with practice-reinforcing tasks, may be considered interventions that combine the positive aspects of online learning (accessibility and cost) with the positive aspects of in-person training (opportunity for interaction). The use of online media to promote research in practice is emerging with examples including free online introductory and demonstration videos (with clinical reasoning explained where appropriate) of therapy published on health network YouTube channels (South Western Sydney Local Health District, 2019) and through advocacy organisations (Stroke Foundation, 2019). Online training is also being used and tested in research trials (Chan, Mackintosh, & Dobbins, 2017; Sarkies et al., 2019). Despite the need for more effectiveness studies, centralised and interactive online approaches may be beneficial accompaniments to broader implementation strategies to meet the learning preferences and needs of clinicians.

Access, cost, and timeliness of clinician training raises broader issues around the responsibility of training provision. There is a level of responsibility incumbent on the clinician to invest in their own skill development; a tax-deductible cost that professionals across an array of industries face. Perhaps, however, there is a need for more support upstream. Many organisations are supportive of professional development for clinicians and assign a small budget to support study leave and conference attendance. Despite this, there often remains a cost shortfall. Much like previously discussed recommendations, this concept of *shared responsibility* is once again highlighted. Organisations need to support clinicians at the right time for newly developed knowledge and skills to be relevantly applied. Training for staff in key areas such as upper limb interventions in neurorehabilitation, should be universally offered rather than funding a representative clinician to attend. Perhaps as a collective, allied health professionals need to advocate for annual training-specific funding to be incorporated into the wage-award (using a similar model to medical colleagues). There is also a role for peak body organisations and advocacy groups to support clinician training; perhaps the recommended online resource hub for clinicians could be developed or funded by such groups.

12. Understanding the contextual issues (and motivators) and using a framework to guide implementation interventions are essential to ensure contextual needs are met.

As discussed in previous recommendations, the need for implementation to be guided by theory and frameworks is pertinent (Grol et al., 2007; Moullin et al., 2015). One of the first steps in most implementation frameworks is a needs analysis to gain a global understanding of contextual issues (Coles et al., 2017; Fischer et al., 2016). There is substantial literature on the aspects of context relevant to implementation research (Damschroder et al., 2009; Raghavan et al., 2008; Squires et al., 2015) which highlights determinants of specific implementation interventions. May and colleagues (2016) argue that these contextual *cofounders* (that may act as barriers or motivators) are in fact *normal* conditions of the healthcare system and are rarely taken into account as normal conditions. In a 2016 systematic review, Lau and colleagues (2016) concluded that clinicians and organisations need to remain aware of the organisational and system-level contextual factors (such as policy changes and culture) for their potential effect on the implementation process (Lau et al., 2016). In the study of clinician perspectives (Study Three), clinicians maintained that *the real world* was at odds with researched intervention contexts. Clinicians reported contextual factors of time, competing priorities, and limited resources to impede their ability to conduct an intervention with total fidelity (under experimental conditions). Braithwaite et al (2018) suggest that we need to contend with the world we actually inhabit and not the one we wish we did, and by doing so, we will be able to develop modifications effective for the local context. Deterministic frameworks such as the Theoretical Domains Framework or Behaviour Change Wheel, as well as process frameworks such as the Quality Implementation Framework and Knowledge-To-Action Framework are essential to conceptually guide an implementation process in a systematic way and allow for tailored implementation plans to be developed. Although these frameworks provide conceptual guidance, Fernandez and colleagues (2019) argue that an implementation-mapping protocol is required for intervention selection relevant to context determinants. Pfadenhauer and colleagues (2017) also argue that the effectiveness of complex interventions in practice are critically influenced by their implementation, yet current frameworks fail to address context and implementation in an integrated way. Whilst the need for empirical research on the effectiveness of frameworks and theories has been discussed in recommendation six in this section, context and its impact on

implementation efforts can be unpacked and addressed more readily if a framework or model can be applied (Pfadenhauer et al., 2017).

It has been suggested that an implementation method should be an iterative and responsive, ecologically-aware, and social science-informed approach rather than a standardised one, given the non-linear and unpredictable role that context plays (Braithwaite et al., 2018). This revelation is not a new one in implementation science, and the concept of 'adaptation' to context has been established in its response (Castro, Barrera, & Martinez, 2004; Hawe, Shiell, & Riley, 2004). This, however, poses new issues for implementation scientist when the focus shifts to fidelity and scale-up (Carroll et al., 2007; Ghate, 2016). Lanham and colleagues (2013) agree that the dynamic interplay context has on implementation, means that implementation interventions will scale-up more effectively if they are conceptualised as plans for action and tailored to contexts by local agents. By implementing in this way, a system (such as a healthcare system) has the capability to self-organise, learn from experience, and dynamically evolve (Braithwaite et al., 2018). Conceptualising such interventions for local tailoring relies heavily on: (1) sound theoretical underpinning, (2) frameworks to guide local action, (3) permission to conduct adaptation (without compromising fidelity), (4) collaborative partnerships between stakeholders, and (5) knowledge broker or intermediary with the knowledge of both implementation science and healthcare system. Currently, implementation research exploring sustainability and scale up is lacking and longitudinal studies are rare (May et al., 2016). Future work should investigate these essential concepts so mechanisms for adaptation and sustainability can be understood and developed.

8.5 CONCLUSIONS

This thesis has explored barriers and motivators to the uptake of guideline recommendations in neurorehabilitation, as well as implementation interventions effective for producing behaviour change. In doing so, it has highlighted potential barriers to the implementation of evidence into practice and identified approaches which may help to improve service delivery and healthcare outcomes. Fortunately, the field of implementation science is advancing and a shift from knowledge creation to implementation by healthcare organisations and funders can be seen. In Victoria, investment into initiatives such as the Allied Health Research and Translation roles by the State Government are a positive step forward in closing the research-practice gap and

showcasing the priority of implementation. Emerging initiatives such as TRIAL forge (Treweek et al., 2015), WIDER reporting guidelines (Albrecht et al., 2013), and international collaboratives such as the Global Implementation Society[1] (Global Implementation Society, 2019) aim to promote and unify implementation researchers and agendas. While these are important advances for the field, further improvements are still required. Troubling issues still exist, and include limited evidence for implementation interventions, limited monitoring of guideline recommended practice in rehabilitation, and, a need for novel implementation study designs. A concerted effort to address these via the recommendations provided within this thesis may aid in efforts to strengthen the delivery of quality neurorehabilitation for the benefit of those living with brain injury.

[1] The Global Implementation Society (Global Implementation Society, 2019) was developed to promote and establish collaborative, effective approaches to implementation science for the human services setting.

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Appendices

Appendix A: Copyright and permission

Appendix B: PROSPERO registration (Study One)

Appendix C: Ethics approvals and associated Participant Information Statements

Appendix D: Supplementary documents for Study One

Appendix E: Supplementary documents for Study Two

Appendix F: Supplementary documents for Study Three

Appendix G: Supplementary documents for Study Four

Appendix H: Supplementary documents for Study Five

Appendix I: Copies of published manuscripts

APPENDIX A: COPYRIGHT AND PERMISSIONS

Content subject to Copyright:

Content	Permission date	Licence number	Permission obtained from
Jolliffe, L., Hoffmann, T., & Lannin, N. A. (2019). Increasing the uptake of stroke upper limb guideline recommendations with occupational therapists and physiotherapists. A qualitative study using the Theoretical Domains Framework. *Australian Occupational Therapy Journal*. doi:10.1111/1440-1630.12599	18th November, 2019	4712241307287	John Wiley and Sons (Wiley Publishing)
Knowledge to Action Framework (Graham, 2006); Figure 2.1 of this thesis. Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W., & Robinson, N. (2006). Lost in knowledge translation: time for a map? *J Contin Educ Health Prof, 26*(1), 13-24. doi:10.1002/chp.47	November 25, 2019	4716070495200	Wolters Kluwer Health, Inc

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Content	Material obtained on (date)	Link to licence
Jolliffe, L., Lannin, N. A., Cadilhac, D. A., & Hoffmann, T. (2018). Systematic review of clinical practice guidelines to identify recommendations for rehabilitation after stroke and	September 17, 2019	https://creativecommons.org/licenses/by/4.0/

other acquired brain injuries. *British Medical Journal Open, 8*(2). doi:10.1136/bmjopen-2017-018791		
Jolliffe, L., Morarty, J., Hoffmann, T., Crotty, M., Hunter, P., Cameron, I. D., Li., X. Lannin, N. A. (2019). Using audit and feedback to increase clinician adherence to clinical practice guidelines in brain injury rehabilitation: A before and after study. *PLOS ONE*, 14(3), e0213525. doi:10.1371/journal.pone.0213525	September 17, 2019	https://creativecommons.org/licenses/by/4.0/
Behaviour Change Wheel, Figure 2.2 of this thesis.	September 17, 2019	https://creativecommons.org/licenses/by/4.0/
Michie, S., Van Stralen, M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science, 6*(1), 42. doi:10.1186/1748-5908-6-42		

APPENDIX B: PROSPERO REGISTRATION- STUDY ONE

UNIVERSITY of York
Centre for Reviews and Dissemination

NHS
National Institute for Health Research

PROSPERO International prospective register of systematic reviews

Review title and timescale

1 Review title
Give the working title of the review. This must be in English. Ideally it should state succinctly the interventions or exposures being reviewed and the associated health or social problem being addressed in the review.
Evidence-based rehabilitation interventions for adults with acquired brain injury: a systematic review of clinical practice guidelines to identify current best practice recommendations

2 Original language title
For reviews in languages other than English, this field should be used to enter the title in the language of the review. This will be displayed together with the English language title.

3 Anticipated or actual start date
Give the date when the systematic review commenced, or is expected to commence.
01/01/2016

4 Anticipated completion date
Give the date by which the review is expected to be completed.
30/11/2016

5 Stage of review at time of this submission
Indicate the stage of progress of the review by ticking the relevant boxes. Reviews that have progressed beyond the point of completing data extraction at the time of initial registration are not eligible for inclusion in PROSPERO. This field should be updated when any amendments are made to a published record.

The review has not yet started √

Review stage	Started	Completed
Preliminary searches	No	No
Piloting of the study selection process	No	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

Provide any other relevant information about the stage of the review here.

Review team details

6 Named contact
The named contact acts as the guarantor for the accuracy of the information presented in the register record.
Ms Jolliffe

7 Named contact email
Enter the electronic mail address of the named contact.
L.Jolliffe@latrobe.edu.au

8 Named contact address
Enter the full postal address for the named contact.
260 Kooyong Road, Caulfield, Victoria, 3163

9 Named contact phone number
Enter the telephone number for the named contact, including international dialing code.
0430282968

10 Organisational affiliation of the review
Full title of the organisational affiliations for this review, and website address if available. This field may be completed as 'None' if the review is not affiliated to any organisation.

LaTrobe University

Website address:
http://www.latrobe.edu.au/

11 Review team members and their organisational affiliations
Give the title, first name and last name of all members of the team working directly on the review. Give the organisational affiliations of each member of the review team.

Title	First name	Last name	Affiliation
Ms	Laura	Jolliffe	Latrobe University
Dr	Natasha	Lannin	Alfred Health and Latrobe University
Professor	Tammy	Hoffmann	Bond University

12 Funding sources/sponsors
Give details of the individuals, organizations, groups or other legal entities who take responsibility for initiating, managing, sponsoring and/or financing the review. Any unique identification numbers assigned to the review by the individuals or bodies listed should be included.
None

13 Conflicts of interest
List any conditions that could lead to actual or perceived undue influence on judgements concerning the main topic investigated in the review.
Are there any actual or potential conflicts of interest?
None known

14 Collaborators
Give the name, affiliation and role of any individuals or organisations who are working on the review but who are not listed as review team members.

Title	First name	Last name	Organisation details

Review methods

15 Review question(s)
State the question(s) to be addressed / review objectives. Please complete a separate box for each question.
To determine the quality of clinical practice guidelines for acquired brain injury rehabilitation.

To determine the scope of clinical practice guidelines for acquired brain injury rehabilitation.

To compare the consistency of guideline recommendations for acquired brain injury rehabilitation across guidelines.

To compile a list of main recommendations, according to their evidence-based grade.

16 Searches
Give details of the sources to be searched, and any restrictions (e.g. language or publication period). The full search strategy is not required, but may be supplied as a link or attachment.
Electronic databases of the medical literature, guideline organizations, and the websites of professional rehabilitation societies will be searched. Any published study that refers to a clinical practice guideline will be screened, and that guideline(s) included for review. A comprehensive list of all clinical practice guidelines found in this search will be developed. Search to include: electronic search of databases, including the National Guideline Clearinghouse and Guidelines International Network websites (http://www.guideline.gov), MEDLINE, EMBASE, CINAHL, PsycINFO and Cochrane Central Register of Controlled Trials (CENTRAL); review of reference lists from retrieved articles fulfilling eligibility criteria; and search of professional rehabilitation society websites internationally. The definition of ‘a clinical guideline’ used for the purpose of this systematic review is: “Clinical practice guidelines are statements that include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options” (Hoffmann et al., 2013). Multi-disciplinary clinical practice guidelines endorsed by a national governmental or provider organisation related to inpatient rehabilitation and community rehabilitation of patients with acquired brain injury or stroke diagnosis will be included. Clinical

practice guidelines that focus exclusively on a single component of rehabilitation (e.g. memory retraining) will be excluded. To ensure that the most up-to-date clinical practice guidelines are included, inclusion will be limited to January 2006 onwards. Only clinical practice guidelines written in English are included. Definition of rehabilitation used for the purpose of this systematic review: "Rehabilitation of people with disabilities is a process aimed at enabling them to reach and maintain their optimal physical, sensory, intellectual, psychological and social functional levels. Rehabilitation provides disabled people with the tools they need to attain independence and self-determination" (WHO, 2016). Definition of acquired brain injury for the purposes of this review: "Acquired brain injury (ABI) includes traumatic brain injuries (TBI's), strokes, brain illness, and any other kind of brain injury acquired after birth. However, ABI does not include what are classified as degenerative brain conditions such as Alzheimer's disease or Parkinson's disease" (Brain Injury Network, 2016).

17 URL to search strategy

If you have one, give the link to your search strategy here. Alternatively you can e-mail this to PROSPERO and we will store and link to it.

I give permission for this file to be made publicly available
No

18 Condition or domain being studied

Give a short description of the disease, condition or healthcare domain being studied. This could include health and wellbeing outcomes.
We will include clinical practice guidelines that comment on rehabilitation strategies / approaches for adults with a brain impairment acquired from traumatic (e.g. traumatic brain injury) or non-traumatic (e.g. hypoxia, stroke) causes.

19 Participants/population

Give summary criteria for the participants or populations being studied by the review. The preferred format includes details of both inclusion and exclusion criteria.
Guidelines will be eligible if they include studies of rehabilitation interventions for adults with a brain impairment acquired from traumatic (e.g. traumatic brain injury) or non-traumatic (e.g. hypoxia, stroke) causes. Guidelines for use with participants with degenerative neurological conditions will be excluded

20 Intervention(s), exposure(s)

Give full and clear descriptions of the nature of the interventions or the exposures to be reviewed
Guidelines will be eligible for inclusion if: 1) A systematic literature search and review of existing scientific evidence published in peer-reviewed journals was performed during the guideline development OR the guidelines were based on a systematic review published in the four years preceding publication of the guideline (PEDro, 2016). 2) The clinical practice guideline was produced under the support of a health professional association or society, public or private organisation, health care organisation or plan, or government agency (PEDro, 2016) 3) The clinical practice guideline contains systematically developed statements that include recommendations, strategies, or information to guide decisions about appropriate health care 4) Refer to inpatient rehabilitation and / or community rehabilitation of patients with acquired brain injury diagnosis. 5) Are published in English, from 1st January 2006 onwards. Guidelines will be excluded if: 1) Guidelines that are superseded by more current editions 2) A clinical practice guideline developed and issued by an individual or group of individuals not officially sponsored or supported by a health professional association or society, public or private organisation, health care organisation or plan, or government agency does not meet the inclusion criteria (PEDro, 2016) 3) Do not provide recommendations or statements pertaining to any of the aforementioned clinical questions. 4) Publish prior to 1st January 2006. 5) Rehabilitation is provided in the acute setting (i.e. early rehabilitation commenced in the acute setting). 6) That focus exclusively on a single component of rehabilitation (e.g. memory retraining).

21 Comparator(s)/control

Where relevant, give details of the alternatives against which the main subject/topic of the review will be compared (e.g. another intervention or a non-exposed control group).
Not applicable.

22 Types of study to be included initially

Give details of the study designs to be included in the review. If there are no restrictions on the types of study design eligible for inclusion, this should be stated.
In an effort to ensure that all relevant clinical practice guidelines are obtained, as part of the search strategy, any published article whereby an acquired brain injury clinical practice guideline is referred / referenced to will be screened by the author to extract the clinical practice guideline for potential inclusion in the review. Any published

clinical practice guideline for acquired brain injury (defined as above by Hoffmann et al., 2013) that meet the above mentioned inclusion criteria will be use in this review.

23 Context

Give summary details of the setting and other relevant characteristics which help define the inclusion or exclusion criteria.

Guidelines written for inpatient rehabilitation settings as well as community rehabilitation settings will be included for review.

24 Primary outcome(s)

Give the most important outcomes.

1) A comprehensive list of current ABI clinical practice guidelines that meet the above mentioned criteria and 2) AGREE - 2 rating for the quality of each.

Give information on timing and effect measures, as appropriate.

Two raters will independently rate each clinical practice guideline using the AGREE 2 tool

25 Secondary outcomes

List any additional outcomes that will be addressed. If there are no secondary outcomes enter None.

None

Give information on timing and effect measures, as appropriate.

26 Data extraction, (selection and coding)

Give the procedure for selecting studies for the review and extracting data, including the number of researchers involved and how discrepancies will be resolved. List the data to be extracted.

Once all database searches are complete, one author will screen eligibility based on title and abstract using pre-determined criteria. Full text of all relevant studies will be retrieved. The same author will then review all full texts to extract all clinical practice guidelines referred to that meet the review criteria. A comprehensive list of all acquired brain injury rehabilitation clinical practice guidelines will be generated as the primary data to be extracted.

27

APPENDIX C: ETHICS APPROVAL AND ASSOCIATED PARTICIPANT INFORMATION STATEMENTS

SHE COLLEGE HUMAN ETHICS SUBCOMMITTEE (SHE CHESC) MEMORANDUM

To: **Natasha Lannin**
Student: **Laura Jolliffe**
From: **Secretariat, SHE College Human Ethics Sub-Committee (SHE CHESC) Reference:** **S16-138 - Ethics application for negligible risk project - accepted Title:** **Research translation in stroke in Australia; a survey of researchers. Date:** **13 September 2016**

The SHE CHESC Chair has evaluated your application as being of negligible risk and has accepted the project without review.

As a negligible-risk project (see Negligible risk guidelines), you are not required to submit annual and final reports, but you are required to maintain auditable records of the project.

Negligible risk studies cannot be modified using the Modification form, minor changes to a project do not require review. Researchers are responsible for informing the CHESC of any major modifications that may mean the research no longer fits the requirements of a negligible risk project. The Chief Investigator should send an email to the relevant CHESC entitled "modification for negligible risk project" with the project reference number (e.g. S16-500). Researchers will be informed via email if they are required to submit an application for human ethics review and approval to the CHESC or UHEC or if the modification is acceptable.

Please note that any data and consent forms need to be retained for a minimum of 5 years and that the consent forms must be stored separately from the data. Please also ensure that each participant retains a copy of the Participant Information Statement.

Kind regards,

Ms Kate Ferris
Human Ethics Officer
Secretariat – SHE College Human Ethics Sub-Committee Ethics and Integrity / Research Office
La Trobe University Bundoora, Victoria
3086 M-F 9am – 5pm
T: 03 9479 3370 | E: chesc.she@latrobe.edu.au
http://www.latrobe.edu.au/researchers/research-office/ethics/human-ethics Research Office Reception +61 3 9479 1144
CRICOS Provider 00115M

LA TROBE UNIVERSITY

COLLEGE OF SCIENCE, HEALTH AND ENGINEERING

SCHOOL OF ALLIED HEALTH

Mailing address
La Trobe University
Victoria 3086 Australia

T **+ 61 3 9479-2693**
alliedhos@latrobe.edu.au
www.latrobe.edu.au/school-allied-health

MELBOURNE CAMPUSES
Bundoora
Collins Street CBD
Franklin Street CBD

REGIONAL CAMPUSES
Bendigo
Albury-Wodonga
Mildura
Shepparton

Title	**Research translation in stroke in Australia; a survey of researchers.**
Principal Investigator of the Evaluation Team	Associate Professor Natasha Lannin
Evaluation Team	Ms. Laura Jolliffe, Prof Tammy Hoffmann, Dr. Kate Laver, Dr Annie McCluskey

Why is the research being conducted?

This study is part of the project entitled 'Research translation in stroke in Australia; a survey of researchers'. This project seeks to understand the extent of research translation and barriers to research translation in stroke from clinical trials conducted in Australia. This project is unfunded, and is supported by La Trobe University, Department of Occupational Therapy.

Purpose of the study:

This project aims to understand how often findings from clinical trials conducted in Australia implemented (i.e. translated) in clinical practice- firstly at sites where there clinical trial took place, and secondly more broadly- both here in Australia and further abroad. We also wish to understand any and all barriers and enablers to research translation at the site of the research study that you are able to identify.

What you will be asked to do

You are invited to complete a survey regarding the intervention tested in your study, whether or not the intervention was adopted into clinical practice at the study site (and if so, to what extent) and the barriers that you felt impacted on research translation. We will then ask you about translation of the findings into clinical practice more broadly. Completion of the survey will take 5-10 minutes. Once you submit your responses, the data will be sent to the researcher. The data will be synthesised with data from other participants and stored as a computer file. Participation in the study is voluntary. All data is anonymous and will be reported in a way so that it is not possible to identify individual researchers or studies.

The expected benefits of the research

Results will be published and presented at national conferences for stroke and brain injury. The results will provide information regarding the extent of research translation and capture important knowledge regarding barriers and enablers from the perspective of the trialist.

Risks to you

We do not perceive that there will be any risks to you from participating in this survey. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

Your confidentiality

We do not need your name or any identifiable information and you will be anonymous. All survey responses are anonymous. Any identifying information will be removed and the file stored on a password protected computer file that only the research team will have access to. Your comments will not be linked directly to you.

Your participation is voluntary

Your participation is voluntary and your participation in the study will not affect your relationship with La Trobe University.

How do I agree to participate?

Participation is voluntary. Participation is assumed if you complete the survey. A follow up reminder request to complete the survey will be sent to all potential participants 2 weeks after the initial point of contact.

Can I withdraw from the study?

Participation in the survey is voluntary and anonymous. Once you have submitted your survey, there will be no way of identifying it to withdraw your data.

How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them. Please email Laura Jolliffe (Research Assistant) on L.Jolliffe@latrobe.edu.au if you would like to receive a copy of this summary

Questions / further information

You may contact a member of the research team for additional information about the project:
Name: Laura Jolliffe
Position: Research Assistant and PhD Scholar
Telephone: (03) 90767406
Email: l.jolliffe@latrobe.edu.au

Complaints

If you have any complaints or concerns about your participation in the study that the researcher has not been able to answer to your satisfaction, you may contact the Senior Human Ethics Officer, Ethics and Integrity, Research Office, La Trobe University, Victoria, 3086 (P: 03 9479 1443, E: humanethics@latrobe.edu.au) . Please quote the application reference number S16-138.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the La Trobe University SHE College Human Research Ethics Sub-Committee (SHE-CHESC) project number S16-138.

Please retain these pages for your later reference.

ETHICS COMMITTEE CERTIFICATE OF APPROVAL

This is to certify that

Project Number: HREC/16/Alfred/169 (Local Reference: Project 522/16)

Project Title: Implementation of upper limb guidelines after stroke – a qualitative exploration

Coordinating Principal Investigator: A/Professor Natasha Lannin

*was considered under the Victorian Streamlined Ethical Review Process (SERP) by the Ethics Committee on **24-Nov-2016**, meets the requirements of the National Statement on Ethical Conduct in Human Research (2007) and was **APPROVED** on **30-Nov-2016**.*

It is the Coordinating Principal Investigator's responsibility to ensure that all researchers associated with this project are aware of the conditions of approval and which documents have been approved.

The Coordinating Principal Investigator is required to notify the Secretary of the Ethics Committee, via amendment or progress report, of

- Any significant change to the project and the reason for that change, including an indication of ethical implications
  (if any);
- Serious adverse effects on participants and the action taken to address those effects;
- Any other unforeseen events or unexpected developments that merit notification;
- The inability of the Coordinating Principal Investigator to continue in that role, or any other change in research personnel involved in the project;
- Any expiry of the insurance coverage provided with respect to sponsored clinical trials and proof of re-insurance;
- A delay of more than 12 months in the commencement of the project; and,
- Termination or closure of the project.

Additionally, the Coordinating Principal Investigator is required to submit

- A Progress Report on the anniversary of approval and on completion of the project.

The Ethics Committee may conduct an audit at any time.

All research subject to the Alfred Hospital Ethics Committee review must be conducted in accordance with the National Statement on Ethical Conduct in Human Research (2007).

The Alfred Hospital Ethics Committee is a properly constituted Human Research Ethics Committee in accordance with the National Statement on Ethical Conduct in Human Research (2007).

SPECIAL CONDITIONS

None

APPROVED DOCUMENTS

Documents reviewed and approved at the meeting were:

Document	*Version*	*Date*
Project Proposal	2.0	13-Nov-2016
MASTER Participant Information Sheet (Survey)	2.0	29-Nov-2016
MASTER Participant Information Sheet & Consent Form (Focus Group)	2.0	29-Nov-2016
Recruitment Email (Survey)	2.0	13-Nov-2016
Recruitment Email (Focus Group)	-	-
Clinician Survey	-	-
Focus Group Discussion Guide	-	-

APPROVED SITES

Approval is given for this research project to be conducted at the following sites and campuses:

- Caulfield Hospital (Alfred Health)
- Independent Rehabilitation Services
- Peninsula Health

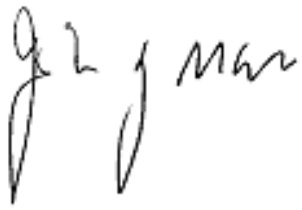
The Alfred Hospital Ethics Committee has approved the study but does not take responsibility for research governance processes at the participating sites. It is the responsibility of each participating site to create and implement research governance practices to adequately authorise, monitor and oversee the conduct of the study at their site.

Site-Specific Assessment (SSA)
SSA authorisation is required at all sites participating in the study. SSA must be authorised at a site before the research project can commence.

The completed Site-Specific Assessment Form and a copy of this ethics approval letter must be submitted to the Research Governance Officer for authorisation by the Chief Executive or delegate. This applies to each site participating in the research.

The HREC wishes you and your colleagues every success in your research.

SIGNED:



Chair, Ethics Committee (or delegate)

Please quote project number and title in all correspondence

Peninsula Health

Office for Research

Frankston Hospital
2 Hastings Road
PO Box 52
Frankston Vic 3199
Telephone (03) 9784 2680

STREAMILINED ETHICAL REVIEWN

RESEARCH GOVERNANCE | Site Specific Approval

31 January 2017

Ms Catherine Devanny
Senior Clinician Occupational Therapist
Community Rehabilitation Program
Peninsula Health
PO Box 52
FRANKSTON VIC 3199

Dear Ms Devanny

Implementation of upper limb guidelines after stroke – a qualitative exploration

HREC Reference Number: HREC/16/Alfred/169
SSA Reference Number: SSA/17/PH/6
Protocol: Version 2.0: 13 November 2016

Thank you for submitting a Site Specific Assessment Form for authorisation of the above project at Peninsula Health; I can confirm that the valid submission was received on 24 January 2017. Ethical approval was granted on 30 November 2016 by Alfred Health Ethics Committee under the Consultative Council for Clinical Trial Research single ethical review system for this project. A list of all approved documents is contained in the Certificate of Approval dated 30 November 2016.

I am pleased to inform you that authorisation has been granted for this project to be conducted at Peninsula Health.

The documents reviewed and approved at Peninsula Health include:

Document	*Version*	*Date*
SSA Application:		16 January 2017
Participant Information and Consent Form (PH):		
Survey: (based on Master Version 2.0: 19 November 2016)	Version 1	18 January 2017
Focus Group: (based on Master Version 2.0: 19 November 2016)	Version 1	18 January 2017
Recruitment e-mail (PH):		
Survey: (based on Master Version 2.0: 13 November 2016)	Version 2.0	24 January 2017
Focus Group: (based on Master Version: undated)	Version 1.0	24 January 2017

The following conditions apply to this research project at this site. These conditions are additional to those imposed by the Human Research Ethics Committee that granted ethical approval:

1. The principal investigator will immediately report anything to the Manager, Office for Research which might warrant review of approval of the project in the specified format, including:
   a. Any serious or unexpected adverse events at this site
   b. Unforeseen events that might affect continued ethical/governance acceptability of the project.

2. The Manager Office for Research will be notified, giving reasons, if the project is discontinued at this site before the expected date of completion.

3. The principal investigator will provide an annual report for this site to the Manager Office for Research and at completion of the study a final report, in the specified format.

If you have any matters that arise regarding conduct of the research at this site, please ensure you contact the Office for Research:

Ms Lee-Anne Clavarino, Manager
Telephone: 9784 2679

For further information regarding the responsibilities of principal investigators please refer to: Standard Operating Procedures for Streamlining Ethical Review of Research Projects.

Yours sincerely

3.2.17.

Dr Timothy Williams
Executive Director Medical Services
Executive Sponsor Research

LA TROBE UNIVERSITY

University Human Ethics Committee

RESEARCH OFFICE

MEMORANDUM

To: **Associate Professor Natasha Lannin, School of Allied Health, College of ASSC**

From: **Senior Human Ethics Officer, Ethics and Integrity, Research Office**

Subject: **UHEC acceptance of The Alfred HREC approved project – HREC/16/Alfred/169 (Local Reference: Project 522/16)**

Title: **Implementation of upper limb guidelines after stroke – a qualitative exploration**

Date: **10 May, 2017**

Thank you for submitting the above protocol to the University Human Ethics Committee (UHEC). Your material was forwarded to the UHEC Chair for consideration. Following evidence of a full review and subsequent final approval by **The Alfred HREC**, the UHEC Chair agrees that the protocol complies with the National Health and Medical Research Council's *National Statement on Ethical Conduct in Human Research* and is in accordance with La Trobe University's *Human Research Ethics Guidelines*.

Endorsement is given for you to take part in this study in line with the conditions of final approval outlined by **The Alfred HREC.**

Limit of Approval. La Trobe UHEC endorsement is limited strictly to the research protocol as approved by **The Alfred HREC**.

Variation to Project. As a consequence of the previous condition, any subsequent modifications approved by **The Alfred HREC** for the project should be notified formally to the UHEC.

Annual Progress Reports. Copies of all progress reports submitted to **The Alfred HREC** must be forwarded to the UHEC. Failure to submit a progress report will mean that endorsement for your involvement this project will be rescinded. An audit related to your involvement in the study may be conducted by the UHEC at any time.

Final Report. A copy of the final report is to be forwarded to the UHEC within one month of it being submitted to **The Alfred HREC.**

If you have any queries on the information above please e-mail: **humanethics@latrobe.edu.au** or contact me by phone.

On behalf of the La Trobe University Human Ethics Committee, best wishes with your research!

Kind regards,

Sara Paradowski
Senior Human Ethics Officer
Executive Officer – University Human Ethics Committee
Ethics and Integrity / Research Office
La Trobe University Bundoora, Victoria 3086
P: (03) 9479 – 1443 / F: (03) 9479 - 1464
http://www.latrobe.edu.au/researchers/ethics/human-ethics

Title	**Implementation of upper limb guidelines after stroke; a qualitative exploration (survey)**
Principal Investigator	Associate Professor Natasha Lannin
Research Team	Ms. Laura Jolliffe, Prof Tammy Hoffmann

Why is the research being conducted?

This study is part of the project entitled 'Implementation of upper limb guidelines after stroke; a qualitative exploration'. This survey seeks to understand which intervention components could overcome the modifiable barriers and enhance the enablers to increase the use of the upper limb clinical practice guidelines in stroke rehabilitation. Only clinicians and no patients will be recruited for this study. This project has support funding from La Trobe University.

Purpose of the study:

This project aims to understand any and all barriers and enablers to implementing upper limb clinical practice guidelines for treating stroke patients during rehabilitation from an occupational therapist or physiotherapist's point of view.

What you will be asked to do

You are invited to complete a survey about using the upper limb clinical practice guidelines in the stroke rehabilitation guidelines, importantly we would like to understand your views on what stops you using the guidelines (the barriers) and what helps you use the guidelines (the enablers). Completing the survey will take 10-15 minutes. Once you submit your responses, the data will be sent to the researchers anonymously. The data will then be synthesised with data from other participants and stored as a computer file. Participation in the study is voluntary. All data is anonymous and will be reported in a way so that it is not possible to identify individual researchers or studies.

The expected benefits of the research

Results will be published and presented at national conferences for stroke and brain injury. The results of this survey and focus groups which will also be completed, will provide important information about the barriers and enablers for using the guidelines from the perspective of clinicians (occupational therapists and physiotherapists). These findings may be used to plan how rehabilitation services in Victoria could help clinicians to use the clinical practice guidelines.

Risks to you

We do not perceive that there will be any risks to you from participating in this anonymous survey. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

Your confidentiality

We do not need your name or any identifiable information and you will be anonymous. All survey responses are anonymous. To ensure that you will not be able to be identified from your responses, we have made sure to recruit a number of organisations that are of similar services and sizes- this will further protect you and your organization from identification. Any identifying information recorded in the free-text areas of the survey will be removed prior to data entry, and the file stored on a password protected computer file that only the research team will have access to. Your comments will not be linked directly to you.

Your participation is voluntary

Your participation is voluntary and your participation in the study will not effect your relationship with Alfred Health, Independent Rehabilitation Services, Peninsula Health nor LaTrobe University.

How do I agree to participate?

Participation is assumed if you complete the survey. A follow up reminder request to complete the survey will be sent to all potential participants 2 weeks after the initial point of contact; if you have already completed the survey, please ignore this email.

Can I withdraw from the study?

Participation in the survey is anonymous; once you have submitted your survey, there will be no way of identifying your survey in order to withdraw your data. Therefore, once submitted, it is not possible to withdraw from the study.

How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them. Please email Laura Jolliffe (Research Assistant) on L.Jolliffe@latrobe.edu.au if you would like to receive a copy of this summary. We anticipate that this summary will be available around late 2017.

Questions / further information

If you have any questions you may contact a member of the research team for additional information about the project:

LAURA JOLLIFFE	**NATASHA LANNIN**
Research Assistant and PhD Scholar	Occupational Therapist and PhD Supervisor
Telephone: (03) 90767406	Telephone: 0417 135153
l.jolliffe@latrobe.edu.au	n.lannin@alfred.org.au

Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact: Complaints Officer, Office of Ethics & Research Governance, Alfred Health, Ph: 9076 3619, E: research@alfred.org.au. Please quote the application reference number HREC/16/ALFRED/169

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Alfred Hospital Ethics Committee

Please retain these pages for your later reference.

Title	**Implementation of upper limb guidelines after stroke; a qualitative exploration (focus group)**
Principal Investigator	Associate Professor Natasha Lannin
Research Team	Ms. Laura Jolliffe, Prof Tammy Hoffmann

Why is the research being conducted?

This study is part of the project entitled 'Implementation of upper limb guidelines after stroke; a qualitative exploration'. This project seeks to understand which intervention components could overcome the modifiable barriers and enhance the enablers to increase the use of the upper limb clinical practice guidelines in stroke rehabilitation. Only clinicians and no patients will be recruited for this study. This project has support funding from La Trobe University.

Purpose of the study:

This project aims to understand any and all barriers and enablers to implementing upper limb clinical practice guidelines in depth and in your own words.

What you will be asked to do

You are invited to participate in a single 1-hour focus group, to be held at your usual workplace site, with approximately 5 other occupational therapists and/or physiotherapists. These therapists may or may not be people you work with (you may choose to attend whichever focus group you wish). The focus group will be audio recorded and then transcribed word-for-word.

Clinicians are free to participate as much or as little as desired in the focus group discussion and can leave at any time. The focus group is seen as an avenue for researchers to understand and gather detailed qualitative data about clinician's perspectives on the barriers and enablers of applying upper limb clinical practice guidelines. Focus groups will be offered at a variety of times including lunch time, after hours and during the work day. The audio files will be transcribed verbatim and all names and identifiable information will be removed.

If you agree to take part in the focus group, you agree to uphold the Chatham House Rule whereby discussions within the group are to remain confidential and must not be attributed to any individual participating in the discussion.

The expected benefits of the research

This study is funded by a research grant from La Trobe University. This research will provide a basis for future decisions on the development of implementation strategies for rehabilitation therapists and the support required for their use. Findings from the study will be presented at rehabilitation conferences and published in medical journals, and will be used in a PhD thesis for Laura Jolliffe. Confidentiality is assured; you and your employing organisation will not be identified in any part of the research or subsequent publications.

Risks to you

Participation in this study should involve no physical or mental discomfort, and no risks beyond those of everyday living. If, however, you should find any question to be invasive or offensive, you are free to omit answering or participating in that aspect of the study. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

Your confidentiality

All data collected in this study will be stored confidentially. Only members of the research team will have access to identified data. All data will be coded in a de-identified manner and subsequently analysed and reported in such a way that responses will not be able to be linked to any individual. The data you provide will only be used for the specific research purposes of this study.

Your participation is voluntary
Your participation is voluntary and your participation in the study will not effect your relationship with Alfred Health, Independent Rehabilitation Service, Peninsula Health or La Trobe University.

How do I agree to participate?
You will have received an email inviting you to participate in the focus group. You may email one of the researchers (listed in the email or on this form) and then one of the researchers will then send you a consent form which you will need to sign and return either via email or post prior to the Focus Group.

Can I withdraw from the study?
Participation in this study is completely voluntary and you are free to withdraw from this study at any time without prejudice or penalty. If you wish to withdraw, leave the focus group. If you withdraw from the study, the materials that you have completed to that point will be deleted (after the audio file has been transcribed) and will not be included in the analysis.

Should you withdraw, you will need to complete a withdrawal form so that the research team can be sure to remove all your data. Once data has been analysed, however, it will no longer possible to withdraw from the study because when we transcribe the audio tapes we de-identify them and so we will no longer know who said what in each interview transcript. This is deliberate to protect the anonymity of participants.

How will I receive feedback?
Outcomes from the project will be summarised and given to you by the investigator if you would like to see them. Please email Laura Jolliffe (Research Assistant) on L.Jolliffe@latrobe.edu.au if you would like to receive a copy of this summary. We anticipate that this summary will be available around late 2017.

Questions / further information
If you have any questions you may contact a member of the research team for additional information about the project:

LAURA JOLLIFFE	**NATASHA LANNIN**
Research Assistant and PhD Scholar	Occupational Therapist and PhD Supervisor
Telephone: (03) 90767406	Telephone: 0417 135153
l.jolliffe@latrobe.edu.au	n.lannin@alfred.org.au

Complaints
If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact: Complaints Officer, Office of Ethics & Research Governance, Alfred Health, Ph: 9076 3619, E: research@alfred.org.au. Please quote the application reference number HREC/16/ALFRED/169

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Alfred Hospital Ethics Committee.

Please retain these pages for your later reference.

Consent Form

Title	**Implementation of upper limb guidelines after stroke; a qualitative exploration.**
Principal Investigator	Associate Professor Natasha Lannin
Associate Investigator(s)	Laura Jolliffe, Prof Tammy Hoffmann
Location	Caulfield Hospital, Independent Rehabilitation Services, Peninsula Health

Declaration by Participant

I have read the Participant Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research described in the project.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the project without affecting my future care.

I understand that I will be given a signed copy of this document to keep.

Name of Participant (please print) _____

Signature _____ Date _____

Declaration by Researcher†

I have given a verbal explanation of the research project, its procedures and risks and I believe that the participant has understood that explanation.

Name of Researcher† (please print) _____

Signature _____ Date _____

† An appropriately qualified member of the research team must provide the explanation of, and information concerning, the research project.

Note: All parties signing the consent section must date their own signature.

Form for Withdrawal of Participation

Title	**Implementation of upper limb guidelines after stroke; a qualitative exploration.**
Principal Investigator	Associate Professor Natasha Lannin
Associate Investigator(s)	Laura Jolliffe, Prof Tammy Hoffmann
Location	Caulfield Hospital, Independent Rehabilitation Services, Peninsula Health

Declaration by Participant

I, (the participant), wish to WITHDRAW my consent to the use of data arising from my participation. Data arising from my participation must NOT be used in this research project as described in the Information and Consent Form. I understand that data arising from my participation will be destroyed provided this request is received within four weeks of the completion of my participation in this project. I understand that this notification will be retained together with my consent form as evidence of the withdrawal of my consent to use the data I have provided specifically for this research project.

Participant's name (printed):……

Signature: ……

Date: ……

TheAlfred

Ethics Committee

Certificate of Approval of Amendments

This is to certify that amendments to

Project: **355/14 PROCESS-ABI: An evaluation of the process of developing a state-wide specialist severe ABI rehabilitation service.**

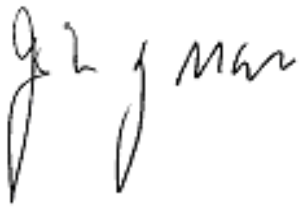
Principal Researcher: **A/Prof Natasha Lannin**

Amendment:

Inclusion of focus groups to gather feedback on audit criteria used in periodic service audit tool
Protocol Version **1.4** dated: **17-Oct-2014**
Email wording Version **2.0** dated: **17-Oct-2014**
Patient Audit Focus Group Guide Version **1.0** dated: **17-Oct-2014**

have been approved in accordance with your amendment application dated **17-Oct-2014** on the understanding that you observe the National Statement on Ethical Conduct in Human Research.

It is now your responsibility to ensure that all people associated with this particular research project are made aware of what has actually been approved and any caveats specified in correspondence with the Ethics Committee. Any further change to the application which is likely to have a significant impact on the ethical considerations of this project will require approval from the Ethics Committee.



Professor John J. McNeil
Chair, Ethics Committee

Date: **5-Nov-2014**

All research subject to Alfred Hospital Ethics Committee review must be conducted in accordance with the National Statement on Ethical Conduct in Human Research (2007).

The Alfred Ethics Committee is a properly constituted Human Research Ethics Committee operating in accordance with the National Statement on Ethical Conduct in Human Research (2007).

LA TROBE UNIVERSITY

University Human Ethics Committee

RESEARCH SERVICES

MEMORANDUM

To: **A/Prof Natasha Lannin, Occupational Therapy, FHS**

From: **Executive Officer, La Trobe University Human Ethics Committee**

Subject: **UHEC acceptance of The Alfred HREC approved project – 355/14**

Title: **PROCESS-ABI: An evaluation of the process of developing a state-wide specialist severe ABI rehabilitation service.**

Date: **16 October 2014**

Thank you for submitting the above protocol to the University Human Ethics Committee (UHEC). Your material was forwarded to the UHEC Chair for consideration. Following evidence of a full review and subsequent final approval by the **The Alfred HREC**, the UHEC Chair agrees that the protocol complies with the National Health and Medical Research Council's *National Statement on Ethical Conduct in Human Research* and is in accordance with La Trobe University's *Human Research Ethics Guidelines*.

Endorsement is given for you to take part in this study in line with the conditions of final approval outlined by **The Alfred HREC.**

Limit of Approval. La Trobe UHEC endorsement is limited strictly to the research protocol as approved by **The Alfred HREC**.

Variation to Project. As a consequence of the previous condition, any subsequent modifications approved by **The Alfred HREC** for the project should be notified formally to the UHEC.

Annual Progress Reports. Copies of all progress reports submitted to **The Alfred HREC** must be forwarded to the UHEC. Failure to submit a progress report will mean that endorsement for your involvement this project will be rescinded. An audit related to your involvement in the study may be conducted by the UHEC at any time.

Final Report. A copy of the final report is to be forwarded to the UHEC within one month of it being submitted to **The Alfred HREC.**

If you have any queries on the information above please e-mail: **humanethics@latrobe.edu.au** or

contact me by phone.

On behalf of the La Trobe University Human Ethics Committee, best wishes with your research!

Kind regards,

Sara Paradowski
Executive Officer – Human Ethics / University Human Ethics Committee
Research Integrity Unit / Research Services
La Trobe University Bundoora, Victoria 3086
P: (03) 9479 – 1443 / F: (03) 9479 - 1464
http://www.latrobe.edu.au/researchers/starting-your-research/human-ethics

ETHICS COMMITTEE CERTIFICATE OF APPROVAL

This is to certify that

Project Number: HREC/16/Alfred/174 (Local Reference: Project 565/16)

Project Title: Knowledge Translation Interventions; which are most effective in upper limb rehabilitation?

Coordinating Principal Investigator: A/Professor Natasha Lannin

*was considered under the Victorian Streamlined Ethical Review Process (SERP) by the Ethics Committee on **15-Dec-2016**, meets the requirements of the National Statement on Ethical Conduct in Human Research (2007) and was **APPROVED** on **30-Jan-2017**.*

It is the Coordinating Principal Investigator's responsibility to ensure that all researchers associated with this project are aware of the conditions of approval and which documents have been approved.

The Coordinating Principal Investigator is required to notify the Secretary of the Ethics Committee, via amendment or progress report, of

- Any significant change to the project and the reason for that change, including an indication of ethical implications
  (if any);
- Serious adverse effects on participants and the action taken to address those effects;
- Any other unforeseen events or unexpected developments that merit notification;
- The inability of the Coordinating Principal Investigator to continue in that role, or any other change in research personnel involved in the project;
- Any expiry of the insurance coverage provided with respect to sponsored clinical trials and proof of re-insurance;
- A delay of more than 12 months in the commencement of the project; and,
- Termination or closure of the project.

Additionally, the Coordinating Principal Investigator is required to submit

- A Progress Report on the anniversary of approval and on completion of the project.

The Ethics Committee may conduct an audit at any time.

All research subject to the Alfred Hospital Ethics Committee review must be conducted in accordance with the National Statement on Ethical Conduct in Human Research (2007).

The Alfred Hospital Ethics Committee is a properly constituted Human Research Ethics Committee in accordance with the National Statement on Ethical Conduct in Human Research (2007).

SPECIAL CONDITIONS

None

CONSENT WAIVER (if applicable)

In accordance with the Office of the Health Services Commissioner's Statutory Guidelines on Research issued for the purposes of Health Privacy Principles 1.1(e)(iii) & 2.2(g)(iii), the Alfred Hospital Ethics Committee granted a consent waiver for the collection, use and disclosure of participants' health and personal information (as detailed in the Victorian Specific Module dated 21-Nov-2016).

APPROVED DOCUMENTS

Documents reviewed and approved at the meeting were:

Document	*Version*	*Date*
Protocol	3.0	24-Jan-2017
Participant Information Sheet & Consent Form (Clinician)	3.0	5-Dec-2016
Participant Information Sheet & Consent Form (Patient)	3.0	5-Dec-2016
Feasibility questionnaire	1.0	22-Nov-2016
Phone script (consent)	2.0	22-Nov-2016
Phone script (return log sheet)	1.0	13-Nov-2016
Log sheet	1.0	13-Nov-2016
Patient assessments	1.0	13-Nov-2016
Audit data collection sheet	1.0	20-Nov-2016

APPROVED SITES

Approval is given for this research project to be conducted at the following sites and campuses:

- Caulfield Hospital (Alfred Health)
- Independent Rehabilitation Service
- Peninsula Health

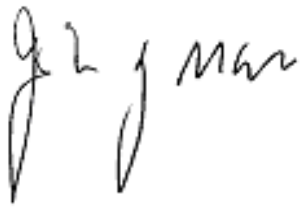
The Alfred Hospital Ethics Committee has approved the study but does not take responsibility for research governance processes at the participating sites. It is the responsibility of each participating site to create and implement research governance practices to adequately authorise, monitor and oversee the conduct of the study at their site.

Site-Specific Assessment (SSA)
SSA authorisation is required at all sites participating in the study. SSA must be authorised at a site before the research project can commence.

The completed Site-Specific Assessment Form and a copy of this ethics approval letter must be submitted to the Research Governance Officer for authorisation by the Chief Executive or delegate. This applies to each site participating in the research.

The HREC wishes you and your colleagues every success in your research.

SIGNED:



Chair, Ethics Committee (or delegate)

Please quote project number and title in all correspondence

Peninsula Health

Office for Research

Frankston Hospital
2 Hastings Road
PO Box 52
Frankston Vic 3199
Telephone (03) 9784 2680

STREAMILINED ETHICAL REVIEWN

RESEARCH GOVERNANCE | Site Specific Approval

26 June 2017

Ms Catherine Devanny
Senior Clinician Occupational Therapist
Peninsula Health
PO Box 52
FRANKSTON VIC 3199

Dear Ms Devanny

Knowledge translation interventions; which is most effective in upper limb rehabilitation?

HREC Reference Number: HREC/16/Alfred/174
SSA Reference Number: SSA/17/PH/7
Protocol: Version 3.0: 24 January 2017

Thank you for submitting a Site Specific Assessment Form for authorisation of the above project at Peninsula Health; I can confirm that the valid submission was received on 20 June 2017. Ethical approval was granted on 30 January 2017 by The Alfred Hospital Ethics Committee under the Consultative Council for Clinical Trial Research single ethical review system for this project. A list of all approved documents is contained in the Certificate of Approval of this date.

I am pleased to inform you that authorisation has been granted for this project to be conducted at Peninsula Health.

The documents reviewed and approved at Peninsula Health include:

Document	*Version*	*Date*
SSA Application:		10 May 2017
Participant Information and Consent Form: **Patient:** (based on Master Version 3.0: 5 December 2016)	Version 1	1 March 2017

The following conditions apply to this research project at this site. These conditions are additional to those imposed by the Human Research Ethics Committee that granted ethical approval:

1. The principal investigator will immediately report anything to the Manager, Office for Research which might warrant review of approval of the project in the specified format, including:
   a. Any serious or unexpected adverse events at this site
   b. Unforeseen events that might affect continued ethical/governance acceptability of the project.

2. The Manager Office for Research will be notified, giving reasons, if the project is discontinued at this site before the expected date of completion.

3. The principal investigator will provide an annual report for this site to the Manager Office for Research and at completion of the study a final report, in the specified format.

If you have any matters that arise regarding conduct of the research at this site, please ensure you contact the Office for Research:

Ms Lee-Anne Clavarino, Manager
Telephone: 9784 2679

For further information regarding the responsibilities of principal investigators please refer to: Standard Operating Procedures for Streamlining Ethical Review of Research Projects.

Yours sincerely

Dr Timothy Williams
Executive Director Medical Services
Executive Sponsor Research

LA TROBE UNIVERSITY

COLLEGE OF SCIENCE, HEALTH & ENGINEERING

MEMORANDUM

To:	**Natasha Lannin**
Student:	**Laura Jolliffe**
From:	**Secretariat, SHE College Human Ethics Sub-Committee (SHE CHESC)**
Reference:	**SHE CHESC acceptance of Alfred HREC approved project – HREC/16/Alfred/174**
Title:	**Knowledge Translation Interventions; which are most effective in upper limb rehabilitation?**
Date:	**11/10/2017**

Thank you for submitting the above protocol to the SHE College Human Ethics Sub-Committee (SHE CHESC). Your material was forwarded to the SHE CHESC Chair for consideration. Following evidence of a full review and subsequent final approval by the **The Alfred HREC**, the SHE CHESC Chair agrees that the protocol complies with the National Health and Medical Research Council's *National Statement on Ethical Conduct in Human Research* and is in accordance with La Trobe University's *Human Research Ethics Guidelines*.

Endorsement is given for you to take part in this study in line with the conditions of final approval outlined by The Alfred HREC.

Limit of Approval. La Trobe SHE CHESC endorsement is limited strictly to the research protocol as approved by The Alfred HREC.

Variation to Project. As a consequence of the previous condition, any subsequent modifications approved by The Alfred HREC for the project should be notified formally to the SHE CHESC

Annual Progress Reports. Copies of all progress reports submitted to The Alfred HREC are to be forwarded to the SHE CHESC. Failure to submit a progress report will mean that endorsement for your involvement in this project will be rescinded. An audit related of your involvement in the study may be conducted by the SHE CHESC at any time.

Final Report. A copy of the final report is to be forwarded to the CHESC within one month of it being submitted by The Alfred HREC.

If you have any queries related to the information above or require further clarifications, please contact chesc.she@latrobe.edu.au. Please quote reference number **HREC/16/Alfred/174**.

On behalf of the SHE College Human Ethics Sub-Committee, best wishes with your research!

Ms Kate Ferris
Human Ethics Officer
Secretariat – SHE College Human Ethics Sub-Committee
Ethics and Integrity / Research Office
La Trobe University Bundoora, Victoria 3086
E: chesc.she@latrobe.edu.au
P: (03) 9479 – 3370
http://www.latrobe.edu.au/researchers/ethics/human-ethics

Title	**Knowledge translation interventions; which is most effective in upper limb rehabilitation?**
Principal Investigator	Associate Professor Natasha Lannin
Research Team	Ms. Laura Jolliffe, Prof Tammy Hoffmann

Why is the research being conducted?

This study is titled 'Knowledge translation interventions; which is most effective in upper limb rehabilitation? The main purpose of this study is to try new education strategies (knowledge translation interventions) to assist therapists increase the amount of upper limb rehabilitation received by acquired brain injury (ABI) survivors with hemiplegia. We have developed two packages of knowledge translation strategies, which we will test with two groups (plus a control group). Each group will receive a different package of educational (knowledge translation) strategies. This study will be completed with occupational therapists and physiotherapists.

Purpose of the study:

This study aims to understand which of the two packages of education strategies are more effective at increasing the amount of upper limb rehabilitation provided and secondly, if better patient outcomes (in upper limb rehabilitation) result from the education packages provided to therapists.

What you will be asked to do

1. By agreeing to take part in this study, you are consenting to a research team member accessing the medical notes you have written for the patients you currently have on your clinical caseload. Your medical entries will be retrospectively audited against set criteria at two time points (prior to the intervention phase and after the intervention phase). This will require no time or additional tasks to you. The researcher involved in reading your notes will be a staff member or honorary staff member at your organisation, and a waiver of patient consent has been approved by the HREC for this audit to occur.
2. By agreeing to take part in this study, you and a research team member will screen your current patient caseload. Patients who have a diagnosis of stroke or acquired brain injury **and** have upper limb rehabilitation goals will be eligible to participate in this study. For those patients who meet the inclusion criteria, you agree to informing these patients about the study (verbally). You will then ask them for their verbal consent to pass on their name and contact details to the research team if they would like to hear more about the study from a research team member. This will require approximately 5-10 minutes of your time for each patient that meets the inclusion criteria. If none of your patients meet the inclusion criteria, you will not need to do anything further.
3. For each patient that consents to participating in the study, you agree to completing a 7-day log book at week 1 and again at week 15. You will be asked to write down the duration of each upper limb session you have with that patient in the 7-day period. It is anticipated that this will require a total of 10 minutes of your time at each time point (week 1 and week 15).
4. If a patient that has consented the study is to be discharged before the end of the study period (4 months in total), you agree to informing a research team member (via email, phone or in person) as soon as you are made aware. It is anticipated that this will take approximately 5-10 minutes of your time.
5. This study involved three different groups. Each group (or site cluster) will be provided with a package of knowledge translation strategies. If you agree to take part in this study, your work site (as a cluster) will be assigned to one of the three groups.
    a. Group One: If you are assigned to this group, you will be invited to participate in fortnightly feedback meetings (10 minutes in total) for the duration of the intervention period (3 months). You will also be invited to participate in in-services, coaching and mentoring sessions, consumer seminars, online education, access to pre-planned treatment plans, face to face journal club, and point of care videos to support your practice.
    b. Group Two: If you are assigned to this group, you will have support material made available to you, this may include: education handouts for patients, evidence summary material, online

educational modules, posters for clinic rooms, access to twitter journal club, and point of care videos to support your clinical practice.

c. Group Three: If you are assigned to this group, you will not receive additional support or material; you will continue to receive your usual organisation delivered professional development. At the end of week 16 (intervention phase of the study), you will receive the active interventions that were provided to the other groups in this study.

6. At the end of the study, we will ask you to complete a short 10-minute survey (online) about your perceptions of the study. Given this is a feasibility study, we are interested to know your thoughts on the knowledge translation package of interventions that you were provided with.

The expected benefits of the research

This research will provide a basis for future decisions on the development of implementation strategies for rehabilitation therapists and the support required for their use. Findings from the study will be presented at rehabilitation conferences and published in medical journals, and will be used in a PhD thesis for Laura Jolliffe. Confidentiality is assured; you and your employing organisation will not be identified in any part of the research or subsequent publications.

Risks to you

Participation in this study should involve no physical or mental discomfort, and no risks beyond those of everyday living. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

Your confidentiality

All data will be stored in re-identifiable form (coded) and subsequently analysed and reported in such a way that responses will not be able to be linked to any individual. Only members of the research team will have access to identified data. All data collected in this study will be stored confidentially. The data you provide will only be used for the specific research purposes of this study.

Your participation is voluntary

Your participation is voluntary and your participation in the study will not affect your relationship with Alfred Health, Independent Rehabilitation Service, Peninsula Health or La Trobe University.

How do I agree to participate?

You will have received an email inviting you to participate in the study. You may email one of the researchers (listed in the email or on this form) and then one of the researchers will then send you a consent form which you will need to sign and return either via email or in person. Alternatively, you are very welcome to phone L.Jolliffe (contact details below) or speak to any of the research team members in person.

Can I withdraw from the study?

Participation in this study is completely voluntary and you are free to withdraw from this study at any time without prejudice or penalty. If you wish to withdraw, please contact one of the researchers listed on this form. If you withdraw from the study, the data collected from you will not be used in the analysis of the study.

How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them. Please email Laura Jolliffe (Research Assistant) on L.Jolliffe@latrobe.edu.au if you would like to receive a copy of this summary. We anticipate that this summary will be available around late 2017.

Questions / further information

If you have any questions you may contact a member of the research team for additional information about the project:

LAURA JOLLIFFE	NATASHA LANNIN
Research Assistant and PhD Scholar	Occupational Therapist and PhD Supervisor
Telephone: (03) 90767406	Telephone: 0417 135153
l.jolliffe@latrobe.edu.au	n.lannin@alfred.org.au

Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact: Complaints Officer, Office of Ethics & Research Governance, Alfred Health, Ph: 9076 3619, E: research@alfred.org.au. Please quote the application reference number HREC/16/Alfred/174

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Alfred Hospital Ethics Committee.

Please retain these pages for your later reference.

Consent Form

Title	**Knowledge translation interventions; which is most effective in upper limb rehabilitation?**
Principal Investigator	Associate Professor Natasha Lannin
Associate Investigator(s)	Laura Jolliffe, Prof Tammy Hoffmann
Location	Caulfield Hospital, Independent Rehabilitation Services, Peninsula Health

Declaration by Participant

I have read the Participant Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research described in the project.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the project without affecting my future care.

I understand that I will be given a signed copy of this document to keep.

Name of Participant (please print) _____

Signature _____ Date _____

Declaration by Researcher†

I have given a verbal explanation of the research project, its procedures and risks and I believe that the participant has understood that explanation.

Name of Researcher† (please print) _____

Signature _____ Date _____

† An appropriately qualified member of the research team must provide the explanation of, and information concerning, the research project.

Note: All parties signing the consent section must date their own signature.

Form for Withdrawal of Participation

Title	**Knowledge translation interventions; which is most effective in upper limb rehabilitation?**
Principal Investigator	Associate Professor Natasha Lannin
Associate Investigator(s)	Laura Jolliffe, Prof Tammy Hoffmann
Location	Caulfield Hospital, Independent Rehabilitation Services, Peninsula Health

Declaration by Participant

I, (the participant), wish to WITHDRAW my consent to the use of data arising from my participation. Data arising from my participation must NOT be used in this research project as described in the Information and Consent Form. I understand that data arising from my participation will be destroyed provided this request is received within four weeks of the completion of my participation in this project. I understand that this notification will be retained together with my consent form as evidence of the withdrawal of my consent to use the data I have provided specifically for this research project.

Participant's name (printed):……

Signature: ……

Date: ……

Title	**Knowledge translation interventions; which is most effective in upper limb rehabilitation?**
Principal Investigator	Associate Professor Natasha Lannin
Research Team	Ms. Laura Jolliffe, Prof Tammy Hoffmann

Why is the research being conducted?

This study is titled 'Knowledge translation interventions; which is most effective in upper limb rehabilitation?' Occupational therapists and physiotherapists are continuously learning about which rehabilitation interventions to give to patients. To help understand *how* to provide as much rehabilitation as possible, our study has designed two packages of education strategies (called knowledge translation strategies). There is also a group who will receive no extra support or education than is normally provided by their hospital. We plan to provide your therapists with one of these packages to your therapists. This study will be completed with occupational therapists and physiotherapists, but we are also interested in whether there is an impact on the upper limb outcomes attained by patients who are treated by these therapists.

Purpose of the study:

This study aims to understand which of the two educational packages (knowledge translation packages) is more effective at increasing the amount of upper limb rehabilitation provided and secondly, if better patient outcomes (in upper limb rehabilitation) result from the knowledge translation program provided to therapists.

What you will be asked to do

As we want to know which education packages are most effective for increased patient outcomes in upper limb rehabilitation, we would like to measure your rehabilitation progress (of your affected arm).

If you agree to take part in this study, a research team member will complete two assessments with you on your affected arm. Both assessments will take about 20 minutes to complete. These assessments will be completed when you first agree to take part in the study and again at the end of the study (after 3 months) OR before you go home from hospital/ are discharged from the service.

If you agree to participate in this study, we also ask you to complete a 7-day log book of how much therapy you do both with your therapist, on your own and/or with your family. We will ask you to fill out this book when you agree to be a part of the study and again at the end of the study (after 3 months) OR before you go home from hospital/ are discharged from the service. It is expected that it will require 10 minutes of your time to complete the log book at both time points (at the start, and again at the end).

The expected benefits of the research

This research will provide a basis for future decisions on the development of implementation strategies for rehabilitation therapists and the support required for their use. Findings from the study will be presented at rehabilitation conferences and published in medical journals, and will be used in a PhD thesis for Laura Jolliffe. Confidentiality is assured; you will not be identified in any part of the research or subsequent publications.

Risks to you

Participation in this study should involve no physical or mental discomfort, and no risks beyond those of everyday living. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

Your confidentiality

All data will be stored in re-identifiable form (coded) and subsequently analysed and reported in such a way that responses will not be able to be linked to any individual. Only members of the research team will have access to identified data. All data collected in this study will be stored confidentially on password protected databases and computers. All paper based assessment and signed consent forms will be stored in locked filing cabinets within the locked research office of N.Lannin. Only the research team will have access to the data and it will only be used for the specific research purposes of this study.

Your participation is voluntary

Your participation is voluntary and your participation in the study will not affect your relationship with Alfred Health, Independent Rehabilitation Service, Peninsula Health or La Trobe University.

How do I agree to participate?

If you agree to participate, you will need to sign a consent form which will be collected from you either via return post or in person by a research team member.

Can I withdraw from the study?

Participation in this study is completely voluntary and you are free to withdraw from this study at any time without prejudice or penalty. If you wish to withdraw, please contact one of the researchers listed on this form. If you withdraw from the study, the data collected from you until that point will be removed.

Should you withdraw, you will need to complete a withdrawal form so that the research team can be sure to remove all your data. Once data has been incorporated without identity to a central database, it will no longer be possible for you to withdraw from the study as there will be no way to identify data specific to you.

How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them. Please email Laura Jolliffe (Research Assistant) on L.Jolliffe@latrobe.edu.au if you would like to receive a copy of this summary. We anticipate that this summary will be available around late 2017.

Questions / further information

If you have any questions you may contact a member of the research team for additional information about the project:

LAURA JOLLIFFE	**NATASHA LANNIN**
Research Assistant and PhD Scholar	Occupational Therapist and PhD Supervisor
Telephone: (03) 90767406	Telephone: 0417 135153
l.jolliffe@latrobe.edu.au	n.lannin@alfred.org.au

Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact: Complaints Officer, Office of Ethics & Research Governance, Alfred Health, Ph: 9076 3619, E: research@alfred.org.au. Please quote the application reference number HREC/16/Alfred/174

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Alfred Hospital Ethics Committee.

Please retain these pages for your later reference.

Consent Form

Title	**Knowledge translation interventions; which is most effective in upper limb rehabilitation?**
Principal Investigator	Associate Professor Natasha Lannin
Associate Investigator(s)	Laura Jolliffe, Prof Tammy Hoffmann
Location	Caulfield Hospital, Independent Rehabilitation Services, Peninsula Health

Declaration by Participant

I have read the Participant Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research described in the project.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the project without affecting my future care.

I understand that I will be given a signed copy of this document to keep.

Name of Participant (please print) _____

Signature _____ Date _____

Declaration by Researcher†

I have given a verbal explanation of the research project, its procedures and risks and I believe that the participant has understood that explanation.

Name of Researcher† (please print) _____

Signature _____ Date _____

† An appropriately qualified member of the research team must provide the explanation of, and information concerning, the research project.

Note: All parties signing the consent section must date their own signature.

Form for Withdrawal of Participation

Title	**Knowledge translation interventions; which is most effective in upper limb rehabilitation?**
Principal Investigator	Associate Professor Natasha Lannin
Associate Investigator(s)	Laura Jolliffe, Prof Tammy Hoffmann
Location	Caulfield Hospital, Independent Rehabilitation Services, Peninsula Health

Declaration by Participant

I, (the participant), wish to WITHDRAW my consent to the use of data arising from my participation. Data arising from my participation must NOT be used in this research project as described in the Information and Consent Form. I understand that data arising from my participation will be destroyed provided this request is received within four weeks of the completion of my participation in this project. I understand that this notification will be retained together with my consent form as evidence of the withdrawal of my consent to use the data I have provided specifically for this research project.

Participant's name (printed):……

Signature: ……

Date: ……

APPENDIX D: SUPPLEMENTARY DOCUMENTS FOR STUDY ONE

Supplementary document one: Search terms

Searches were conducted on each database on 25th May 2016

MEDLINE search terms

1. exp Craniocerebral Trauma/
2. exp Stroke/
3. exp Anoxia/
4. exp Hypoxia, Brain/
5. ((brain or head or intracran* or cerebr* or cerebellar or brainstem or vertebrobasilar) adj3 (injur* or infarc* or isch?em* or thrombo* or apoplexy or emboli* or h?emorrhag* or h?ematoma* or aneurysm* or anoxi* or hypoxi*)).ab,ti.
6. (encephaliti* or mening*).ab,ti.
7. 1 or 2 or 3 or 4 or 5 or 6
8. rehabilitation.fs.
9. exp Rehabilitation/
10. exp Rehabilitation Centers/
11. "rehabilitat*".ab,ti.
12. 8 or 9 or 10 or 11
13. 7 and 12
14. exp guideline/
15. Guideline$.ti
16. (guideline or practice guideline).pt
17. Or/14-16
18. 13 and 17

EMBASE search terms

1. exp Head Injury/
2. exp CEREBROVASCULAR ACCIDENT/
3. exp ANOXIA/
4. exp STROKE/
5. ((brain or head or intracran* or cerebr* or cerebellar or brainstem or vertebrobasilar) adj3 (injur* or infarc* or isch?em* or thrombo* or apoplexy or

emboli* or h?emorrhag* or h?ematoma* or aneurysm* or anoxi* or hypoxi*)).ab,ti.

6. (encephaliti* or mening*).ab,ti.
7. or/1-6
8. exp Rehabilitation/
9. "Rehabilitation and Physical Medicine".ec.
10. exp Rehabilitation Care/
11. exp REHABILITATION CENTER/
12. rehabilitat*.ab,ti.
13. rh.fs.
14. or/8-13
15. 7 and 14
16. practice guideline.ti
17. Guideline$.ti
18. 16 or 17
19. 15 and 18

Guideline organizations:

1. Guidelines International Network
2. National Guideline Clearinghouse
3. Intercollegiate Guidelines Network
4. National Collaborating Centre for Chronic Conditions

Professional rehabilitation society websites:

1. Australian Faculty of Rehabilitation Medicine
2. International society of Physical and Rehabilitation Medicine
3. British society of Rehabilitation medicine
4. Asia-Oceanian Society of Physical and Rehabilitation
5. American Congress of Rehabilitation Medicine
6. American Academy of Physical Medicine and Rehabilitation
7. American Society for Neurorehabilitation
8. Canadian Association of Physical Medicine and Rehabilitation
9. Quebec Physiatrist Association
10. European Society of Physical and Rehabilitation Medicine
11. Royal Association for Disability and Rehabilitation

12. Scottish Society of Physical and Rehabilitation Medicine
13. Society for Research in Rehabilitation
14. Hong Kong Association of Rehabilitation Medicine
15. Hong Kong Society for Rehabilitation
16. The New Zealand Rehabilitation Association (NZRA)

Grey Literature: Reference Lists

The reference list of all included full text papers were screened for relevant guidelines that met the inclusion criteria.

Supplementary document two: Excluded papers

Appendix Table 1. Excluded papers

Publications	Reasons for exclusion						
	1	**2**	**3**	**4**	**5**	**6**	**7**
AANN (2008b)	✓						
AANN (2009)	✓						
AANN (2008a)	✓						
Timmermans et al. (2009)		✓	✓				
Carney et al. (2016)	✓						
Ehlhardt et al. (2008)				✓			
NICE (2009)					✓		
Seel et al. (2010)				✓		✓	
Sohlberg et al. (2007)				✓			
Stergiou-Kita, Dawson, & Rappolt (2012)		✓		✓			
Taricco et al. (2006)						✓	
Work Loss Data Institute (2013)	✓				✓		
Colorado Division of Workers' Compensation (2012)							✓
Irish Heart Foundation (2010)							✓

1 = Does not refer to an inpatient rehabilitation and / or community rehabilitation setting
2 = Guideline is not officially sponsored or supported by a health professional association or society, public or private organization, health care organization or plan, or government agency.

3 = No recommendation statements provided

4 = Guideline focuses exclusively on a single component of rehabilitation

5 = Incorrect patient population

6 = Does not meet definition of a clinical practice guideline

7 =Guideline is not based on a systematic literature search

AANN = American Association of Neuroscience Nurses, NICE = National Institute for Health and Clinical Excellence, WLDI = Work Loss Data Institute, CDWC= Colorado Division of Workers' Compensation, IHF= Irish Heart Foundation

Supplementary document three: Synthesised guideline recommendations.

Appendix Table 2. Synthesised guideline recommendations from those with the highest quality and broadest scope and comparison between stroke guideline recommendations with top rated traumatic brain injury guideline

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.0	MEDICATION MANAGEMENT THEME						
1.1	General guidance						
1.1.1	The following drugs should not be given with the goal of enhancing recovery outside the context of clinical trials: amphetamines, bromocriptine and other dopamine agonists, piracetam, meprobamate, benzodiazepines and chlormethiazole.					X	
1.2	Depression / mood management						

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.2.1	Patients diagnosed with a depressive disorder should be given a trial of antidepressant medication, if no contraindication exists. No recommendation is made for the use of one class of antidepressants over another; however, side effect profiles suggest that selective serotonin reuptake inhibitors may be favoured in this patient population	X			X		●
1.2.2	In adult patients with severe, persistent or troublesome tearfulness, selective serotonin reuptake inhibitors) or tricyclic antidepressants are recommended. Treatment should be monitored and should continue for a minimum of six months if a good response is achieved	X			X		
1.2.3	For stroke survivors, routine use of antidepressants to prevent post-stroke depression is not recommended.	X	X	X	X	X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.2.4	Patients prescribed antidepressant drug treatment for depression or anxiety should be monitored for known adverse effects, and treatment continued for at least 4 months beyond initial recovery. If the patient's mood has not improved 2–4 weeks after initiating treatment, check that the patient is taking the medicine as prescribed. If they are, then consider increasing the dose or changing to another antidepressant.					X	
1.3	Aggression management						
1.3.1	Minimize use of Benzodiazepines and Neuroleptic antipsychotic medications as animal studies suggest these medications may slow recovery after brain injury.					X	●
1.4	Antiplatelet therapy						

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.4.1	Antiplatelet therapy should be used for people with ischaemic stroke to help prevent deep vein thrombosis/ pulmonary embolism (DVT/PE)	X		X			
1.4.2	Antithrombotic therapy is NOT recommended for the prevention of DVT/PE in haemorrhagic stroke patients.	X		X			
1.5	Anti-coagulation therapy						
1.5.1	For acute ischaemic stroke patients who are immobile, low molecular weight heparin in prophylactic doses may be used in the absence of contraindications.	X	X	X			
1.6	Pain						
1.6.1	Patients with persistent Central Post Stroke Pain (CPSP) should receive a trial of low-dose, centrally acting analgesics				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.6.2	Patients should receive an anticonvulsant (such as gabapentin or pregabalin) as a first-line treatment				X		
1.6.3	Patients should receive a tricyclic antidepressant (e.g., amitriptyline) or an Serotonin and Norepinephrine Reuptake Inhibitors (SNRI) (particularly duloxetine) as second-line treatment				X		
1.6.4	Treatment for patients resistant to first and second line treatment can include opioids or tramadol. Caution is advised for the use of Opioids as there is a significant risk of physical dependency.				X		
1.6.5	People with stroke found to have unresolved central post-stroke pain should receive a trial of: a) tricyclic antidepressants e.g. amitriptyline first, followed by other		X	X		X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	tricyclic agents or venlafaxine b) anticonvulsants e.g. carbamazepine. If there is satisfactory improvement, continue the treatment; consider gradually reducing the dose over time if improvement is sustained						
1.6.6	Based on both the early and subsequent regular clinical reviews if amitriptyline as first-line treatment results in satisfactory pain reduction but the person cannot tolerate the adverse effects, consider oral imipramine or nortriptyline as an alternative					X	
1.7	Shoulder pain						
1.7.1	If there are no contraindications, analgesics (such as acetaminophen or ibuprofen) can be used for pain relief				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.7.2	Injections of botulinum toxin into the subscapularis and pectoralis muscles could be used to treat hemiplegic shoulder pain thought to be related to spasticity.	X			X		
1.7.3	Subacromial corticosteroid injections can be used in patients when pain is thought to be related to injury or inflammation of the subacromial region (rotator cuff or bursa) in the hemiplegic shoulder		X		X		
1.7.4	For stroke survivors with shoulder pain, shoulder injections (either sub acromial steroid injections for patients with rotator cuff syndrome, or methylprednisolone and bupivacaine for suprascapular nerve block) may be used to reduce pain.	X					

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.7.5	For patients post stroke with complex regional pain syndrome, oral corticosteroids in tapering doses may be used to reduce swelling and pain in the shoulder-hand.				X		
1.8	Incontinence						
1.8.1	For people with urge incontinence anticholinergic drugs can be trialled	X					●
1.9	Spasticity						
1.9.1	Chemodenervation using botulinum toxin can be used to increase range of motion and decrease pain for patients with focal and/or symptomatically distressing spasticity (in conjunction with rehabilitation therapy which includes setting clear goals)	X	X	X	X	X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.9.2	Oral medications can be prescribed for the treatment of disabling spasticity: a. Tizanidine can be used to treat more generalized, disabling spasticity. b. Baclofen can be used as a lower cost alternative but has not been studied in this population (note: Baclofen initial doseing should be low and titrated upwards slowly as tolerated by patient)				X	X	●
1.9.3	Intrathecal baclofen, intra-neural phenol and other rare procedures should only be used in the context of a specialist multidisciplinary spasticity service or a clinical trial				X	X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.9.4	Recommend against prescription of benzodiazepines during stroke recovery period due to sedating side effects and impact on recovery.				X		
1.10	Complex Regional Pain Syndrome (CRPS) or Shoulder-Hand Syndrome						
1.10.1	Management of CRPS: An early course of oral corticosteroids, starting at 30–50mg daily for 3–5 days, and then tapering doses over 1–2 weeks can be used to reduce swelling and pain				X		
1.11	Activities of daily living (ADL)						
1.11.1	Administration of amphetamines to improve ADL is not recommended.	X		X			

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
1.11.2	For stroke survivors, selective serotonin reuptake inhibitors may be used to improve performance of ADL.	X					
2.0	ORGANIZATION OF SERVICES THEME						
2.1	Initial Stroke Rehabilitation Assessment						
2.1.1	An interprofessional team that is resourced to provide prescribed levels of rehabilitation therapy.				X		●
2.1.2	A clear process referral of patients to rehabilitation professionals and programs after acute admission.				X		
2.1.3	Mechanisms to periodically re-evaluate those patients with severe stroke who are admitted to nursing homes, continuing care, or other settings to ensure that they have access to				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	rehabilitation as appropriate, if the patient progresses sufficiently and has goals amenable to rehabilitation.						
2.1.4	Proportion of stroke patients with a rehabilitation assessment within 48 hours of hospital admission for acute stroke by at least one stroke rehabilitation specialist as appropriate to patient needs (core).				X		
2.1.5	Median time from hospital admission for stroke to initial rehabilitation assessment for each of the rehabilitation disciplines (Target is within 48 hours of hospital admission).				X		
2.1.6	Home-based rehabilitation may be considered as a preferred model for delivering rehabilitation in the community. Where home rehabilitation is unavailable, stroke patients requiring rehabilitation should receive centrebased care	X					

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
2.2	Inpatient rehabilitation						
2.2.1	An adequate number of geographically defined stroke rehabilitation units with a critical mass of trained staff with expertise in stroke rehabilitation; interprofessional team care during the rehabilitation period following stroke.				X		
2.2.2	To ensure all stroke patients receive early, active rehabilitation by a dedicated stroke team, health systems should have comprehensive services which include and link the fundamentals of acute and rehabilitation care.		X	X			
2.2.3	Timely access to specialized, interprofessional stroke rehabilitation services, regardless of geographic location of the patients' home community and the patient's financial means.				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
2.2.4	A critical mass of trained healthcare providers functioning as a coordinated interprofessional team during the rehabilitation period following stroke.				X		●
2.2.5	If a stroke rehabilitation unit is not available then those with stroke who require ongoing inpatient rehabilitation should be transferred to a mixed rehabilitation unit with access specialist clinicians are available by consultation.		X	X	X		
2.2.6	Patients treated on general rehabilitation units should receive the same levels of care and interventions as patients treated on stroke rehabilitation units				X		
2.2.7	The staff should have specialist expertise in stroke and rehabilitation		X		X	X	●

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
2.2.8	The interprofessional rehabilitation team follows evidence-based best practices as defined by current consensus-based clinical practice guidelines				X		
2.2.9	Resources to enable patient access to appropriate type and intensity of rehabilitation professionals throughout their stay (including weekends when required).				X		
2.2.10	The unit should have agreed management protocols for common problems and complications, based on available evidence and communicated to all staff				X	X	●
2.2.11	The inter-professional rehabilitation team should consist of appropriate staffing: physician, nurse, physical therapist, occupational therapist, speech-language pathologist,		X		X	X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	psychologist, recreational therapist, patient, and family and/or carers						
2.2.12	System and process changes to allow therapists to ensure effective therapist to patient rations in rehabilitation settings, with the goal of therapists spending approximately 80% of their time providing direct care to patients.				X		
2.2.13	Patients should be transferred to a stroke specialist rehabilitation unit if inpatient rehabilitation is required. If a stroke rehab unit is not available, patients who required ongoing inpatient rehabilitation should be transferred to a conventional rehabilitation unit where staff have stroke-specific expertise.		X	X	X	X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
2.2.14	Younger adults who have had a stroke should be managed within specialist medical and rehabilitation services that: recognise and manage the particular physical, psychological and social needs of younger patients with stroke (eg vocational rehabilitation, childcare activities) and are provided in an environment suited to their specific social needs.					X	
2.2.15	The inter-professional rehabilitation team should assess patients within 24 to 48 hours of admission and develop a comprehensive individualized rehabilitation plan which reflects the severity of the stroke and the needs and goals of the patient, the best available research evidence, and clinical judgement.				X		
2.2.16	Members of the core team should identify problems and ensure that the appropriate allied healthcare professionals		X				

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	contribute to the treatment and rehabilitation of their patients as appropriate						
2.2.17	At all times the views of the patient on the involvement of their carers should be sought, to establish if possible the extent to which the patient wants family members and others involved. Patients and carers should have an early active involvement in the rehabilitation process. Carers should be invited to attend therapy sessions at an early stage. Care should follow a client centered approach responding to the needs and choices of persons with moderate to severe Acquired Brain Injury (ABI) as they evolve over time		X			X	●
2.3	Telehealth						

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
2.3.1	Telestroke services should be part of an integrated stroke services delivery plan that addresses hyperacute stroke care, acute stroke care, stroke prevention, rehabilitation, home-based, and ambulatory care to support optimal patient recovery and family support regardless of geographic location			X	X		
2.3.2	Telehealth enabling technologies, including real-time two-way video-conferencing with or without medical peripheral devices and potentially asynchronous (store-forward) tools, such as an e-referral system for non-urgent consultations and remote patient monitoring devices, can be used to enable consultations and/or service delivery regarding:				X		

Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
a. Optimal in-hospital stroke care (virtual stroke unit) including medical decision making and rehabilitation treatment						
b. Stroke rehabilitation services (Telestroke-rehabilitation), where all rehabilitation disciplines should consider the use of telemedicine technology for patient assessment and clinical therapies (e.g., exercise monitoring and intensity adjustments, speech therapies for aphasia)						
c. Secondary prevention consultation and follow-up services (virtual neurovascular clinic or stroke prevention clinic) in communities where these services do not exist						
d. Home-based patient monitoring through web-based applications may be considered as an alternative to face-to-						

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	face clinic visits in instances where frequent patient monitoring is necessary, such as for out-patient rehabilitation services e. Patients with reduced mobility in long-term care facilities, or those living at a prohibitive distance from the clinic/hospital.						
2.3.3	Clearly defined criteria and protocols or algorithms should be available for referring sites to determine when and how to access these rehabilitation, prevention, and ambulatory services for stroke patients				X		
2.3.4	The consulting healthcare provider may provide documentation to the referring site to be included in the patient medical record, regarding patient progress, treatment				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	plans, plans for ongoing follow-up, and discharge recommendations (in accordance with clinical care processes, organizational requirements, jurisdictional legislation, and regulatory bodies)						
2.3.5	The need for all users of a Telestroke system to be aware of their roles and responsibilities, and be familiar with operating the technology, including regular updates to maintain competence.				X	X	
2.3.6	These networks should be used to help establish appropriate stroke services along with protocols governing rapid assessment, telestroke services and rapid transfers. Telestroke can be used to improve assessment and management of			X			

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	rehabilitation where there is limited access to on-site stroke rehabilitation expertise.						
2.3.7	The quality of decisions made through telemedicine should be regularly audited					X	
2.3.8	It is recommended that Telestroke care providers attain and maintain the necessary competencies required in telemedicine in order to provide safe, competent care and to create a satisfactory telehealth encounter for both the patient and the healthcare provider				X		
2.3.9	Training should include physicians, nurses, therapists, and any support staff (such as members of technology department), who may be involved in any Telestroke consultation or therapy appointment				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
2.3.10	Ongoing Telestroke training and education with a regular update cycle is useful to ensure competency of providers. Refer to Telestroke Resource Toolkit Technical section (online supplementary material) for additional information and resources for staff training				X		
2.3.11	Consulting physicians and other healthcare professionals involved in Telestroke consults should have expertise and experience in managing stroke patients				X		
2.3.12	Continuing education in online and face-to-face formats is useful to ensure remote-based practitioners have access to ongoing education				X		
2.4	Discharge planning						

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
2.4.1	An inpatient stroke care coordinator / discharge planner should be used to coordinate services and assist in discharge planning	X		X			●
2.4.2	A locally developed protocol may assist in implementation of a safe discharge process	X		X			
2.4.3	Establishment of protocols and partnerships between inpatient rehabilitation and community care providers to ensure safe and efficient transitions between hospital and community. Particular considerations should be made for patients residing in more rural or remote locations.				X		
2.4.4	All patients who are not receiving palliative care should be assessed by the specialist rehabilitation team prior to			X	X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	discharge from hospital regarding their suitability for ongoing rehabilitation						
2.4.5	Discharge planning should commence as soon as possible after the stroke patient has been admitted to hospital.	X					
2.4.6	Comprehensive discharge care plans that address the specific needs of the stroke survivor should be developed in conjunction with the stroke survivor and carer prior to discharge.	X					
2.4.7	All stroke survivors and their families/carers should be offered information tailored to meet their individual needs using relevant language and communication formats. A) Information should be provided at different stages in the recovery process. B) An approach of active engagement with	X					

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	stroke survivors and their families/carers should be used allowing for the provision of material, opportunities for follow-up, clarification, and reinforcement.						
2.4.8	Stroke survivors and their families/carers should be educated in the *Face-Arms-Speech-Time* (FAST) stroke recognition message to maximise early presentation to hospital in case of recurrent stroke. The need for education, information and behaviour change to address long-term secondary stroke prevention should be emphasised.	X					
2.4.9	Prior to hospital discharge, all patients should have a pre-discharge needs assessment to ensure a smooth transition from rehabilitation to the community: this should include the need	X		X	X	X	X

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	for a home visit, which many be carried out to ensure safety and provision of appropriate aids, support and community services						
2.4.10	Patients and families/carers have the opportunity to identify and discuss their post-discharge needs with relevant members of the multidisciplinary team	X	X	X	X		
2.4.11	Patients may be transferred back to the community, once appropriate specialized rehabilitation and support needed can be continued in that environment without delay		X	X			
2.4.12	To ensure a safe discharge process occurs, hospital services should ensure the following steps are completed prior to discharge: A) Stroke survivors and families/carers have the opportunity to identify and discuss their post-discharge needs	X	X	X			

Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
(physical, emotional, social, recreational, financial and community support) with relevant members of the multidisciplinary team. B) General practitioners, primary healthcare teams and community services are informed before or at the time of discharge. C) All medications, equipment and support services necessary for a safe discharge are organised. D) Any necessary continuing specialist treatment required has been organised. E) A documented post-discharge care plan is developed in collaboration with the stroke survivor and family and a copy provided to them. This discharge planning process may involve relevant community services, self-management strategies (i.e. information on medications and compliance advice, goals and therapy to continue at home), stroke support services, any further rehabilitation or outpatient appointments,						

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	and an appropriate contact number for any post-discharge queries.						
2.4.13	Upon transfer or discharge, there should be a written report which includes: A) The results of all recent assessments B) a summary of progress made and/or reasons for case closure C) Recommendations for future intervention D) Current needs E) Key contacts and referrals made F) Responsible services/professionals G) Sources of continued information, support and advice		X	X	X		●
2.5	Service improvement:						
2.5.1	A stroke service should agree on standard sets of data that should be collected and recorded routinely					X	

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2.5.2	All stroke services should be involved in quality improvement activities that include regular audit and feedback ('regular' is considered at least every two years).			X			
2.5.3	Indicators based on nationally agreed standards of care should be used when undertaking any audit			X			
2.5.4	Clinical services should take responsibility for all aspects of data collection: keeping a stroke register of all patients admitted to their organisation with a stroke and providing leadership in clinical audit.					X	
2.5.5	Clinicians in all settings should participate in national stroke audit so that they can compare the clinical and organisational quality of their services against national data and use the results to plan and deliver service improvements					X	

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2.5.6	General practitioners (GPs) should keep a register which enables audit and review of relevant stroke and TIA management			X			
2.5.7	Health care service providers for persons with moderate to severe ABI should be given specialized training to develop competencies in evaluation and management related to moderate to severe ABI. This should be provided on an ongoing basis.		X				
2.5.8	Educational programmes and information are provided for staff, patients and carers		X			X	
2.5.9	All members of a stroke service should work within their own knowledge, skills, competence and limits in handling patients					X	●

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	and using equipment, being taught safe and appropriate ways to move and handle specific patients if necessary						
2.5.10	Each specialist stroke rehabilitation service should have an education programme for all staff providing the stroke service and offer training for junior professionals in the specialty of stroke		X			X	
2.5.11	The views of stroke patients and their carers should be considered when evaluating a service; one method that should be used is to ask about their experiences and which specific aspects of a service need improvement					X	
2.5.12	The planning process for any service development should include active involvement of stroke patients and carers, with particular consideration of the views of patients who are					X	

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	unable to participate in the planning process directly (Stroke patients should be offered any support needed to enable participation)						
2.6	Patient / carer education and support:						
2.6.1	All stroke survivors and their families/carers should be offered information tailored to meet their needs using relevant language and common formats.		X	X			●
2.6.2	Information should be provided at different stages in the recovery process			X			●
2.6.3	Stroke survivors and their families/carers should be provided with routine, follow-up opportunities for clarification or reinforcement of the information provided.		X	X			

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2.6.4	Counselling services should be available to all Stroke survivors and their families/carers and can take the form of: an active educational counselling approach, information supplemented by family counselling, or a problem-solving counselling approach.			X			
2.6.5	Stroke survivors and their families/carers should have access to respite care options. The respite care may be provided in their own home or in an institution.			X			●
2.7	Processes / delivery of rehabilitation services						
2.7.1	Information shared across transitions should be complete, up-to-date, accurate and appropriate to the transition settings and information needs of the receiving healthcare providers				X		

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2.7.2	The routine implementation of integrated care pathways for acute stroke management or stroke rehabilitation is not recommended where a well organised multidisciplinary model of care exists		X				
2.7.3	Consultants with an interest in stroke, after adequate training and with appropriate continuing professional development, should be available to coordinate every stroke service or unit.		X				
2.7.4	Clinicians should use standardised, validated and reliable assessment tools or measures that meet the needs of the patient to guide clinical decision-making.			X	X		
2.7.5	The multidisciplinary stroke team should meet regularly (at least weekly) to discuss assessment of new patients, review patient management and goals, and plan for discharge.		X	X	X	X	

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	Individual rehabilitation plans should be regularly updated based on review of patient status.						
2.7.6	The stroke team should meet regularly with the patient and their family/carer to involve them in management, goal setting and planning for discharge.		X	X			
2.7.7	The patient should have an up-to-date care plan defining ongoing medical, rehabilitation, psychosocial, and functional needs. The care plan should be culturally appropriate and take into consideration the patient and family‘s preferences and goals. The care plan should be available to everyone involved in the patient‘s care across the continuum				X		●
3.0	REHABILITATION THERAPIES THEME						
3.1	Rehabilitation treatment approach						

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3.1.1	For stroke survivors in the acute, sub-acute or chronic phase post-stroke, acupuncture should not be used to improve ADL.	X		X		X	
3.1.2	All members of a stroke service should use an agreed consistent approach for each problem faced by a patient, ensuring the patient is given the same advice and taught the same technique to ameliorate or overcome it					X	
3.1.3	For any treatments that involve significant risk/discomfort to the patient and/or resource use, specific goals should be set and monitored using appropriate clinical measures such as numerical rating scales, visual analogue scales, goal attainment rating or a standardised measure appropriate for the impairment.					X	
3.2	Amount and Intensity						

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3.2.1	Adequate clinician resources to provide the recommended intensity of individualized therapies for stroke patients. Current estimates suggest the ratio of patients to therapists should be no more than 6:1 in order to achieve these targets.				X		
3.2.2	Stroke patients should receive, through an individualized treatment plan, a minimum of three hours of direct active task-specific therapy by the multidisciplinary team [minimum of 5 days per week] at a level that enables the patient to meet their rehabilitation goals for as long as they are continuing to benefit from the therapy and are able to tolerate it.	X	X	X	X	X	
3.2.3	The team should promote the practice of skills gained in therapy in the patient's daily routine in a consistent manner			X		X	

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	and patients should be enabled and encouraged to practise that activity as much as possible						
3.2.4	Therapy assistants and nurses should facilitate practice under the guidance of a qualified therapist					X	
3.2.5	Stroke survivors should be encouraged to continue with active task practice outside of scheduled therapy sessions. This could include strategies such as: a) self-directed, independent practice; b) semi-supervised and assisted practice involving family/friends, as appropriate.	X		X	X	X	●
3.3	Timing						
3.3.1	All patients admitted to hospital with acute stroke should start to be mobilized early (between 24 h and 48 h of stroke onset)	X	X	X	X		

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	if there are no contraindications. Contraindications to early mobilization include, but are not restricted to, patients who have had an arterial puncture for an interventional procedure, unstable medical conditions, low oxygen saturation, lower limb fracture or injury, palliation).						
3.3.2	All patients with stroke should receive rehabilitation therapy as early as possible once they are determined to be rehabilitation ready and they are medically able to participate in active rehabilitation, within an active and complex stimulating environment				X		
3.3.3	Frequent, out-of-bed activity in the very early time frame (within 24 h of stroke onset) is not recommended. Mobilization may be reasonable for some patients with acute				X		

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	stroke in the very early time frame and clinical judgment should be used						
3.3.4	For patients with mild and moderate stroke, frequent, short sessions of out-of-bed activity should be provided, but the optimal timing within the 48-hour post-stroke time period is unclear.	X					
3.3.5	Patients should receive a recommended three hours per day of direct task-specific therapy, five days a week, delivered by the interprofessional stroke team; more therapy results in better outcomes.				X		
3.3.6	Patients should receive rehabilitation therapies of appropriate intensity and duration, individually designed to meet their needs for optimal recovery and tolerance levels.				X		

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3.3.7	Persons with aphasia should have early access to a combination of intensive language and communication therapy according to their needs, goals and impairment severity	X		X	X		
3.3.8	Upper limb training should commence early. Upper limb training using constraint-induced movement therapy (CIMT) can commence within the first week of stroke for highly-selected patients, however, early high-intensity CIMT may be harmful (within the first 4 weeks).	X		X	X		
3.4	Loss of sensation						
3.4.1	All patients should be assessed for alteration in sensation (including hypersensitivity). If indicated, a more formal assessment of sensory loss should be undertaken. This			X		X	●

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	information should be shared with the person, their family/carers and the interdisciplinary team in order to implement specific strategies for optimising function and safety.						
3.4.2	Any patient who has sensory loss should be taught how to take care of the limb and avoid injury.					X	
3.4.3	For stroke survivors with sensory loss of the upper limb, sensory-specific training may be provided.	X		X		X	
3.5	Communication						
3.5.1	It is recommended that all health care providers working with persons with stroke across the continuum of care be trained about aphasia including the recognition of the impact of				X		

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	aphasia and methods to support communication such as Supported Conversation for Adults with Aphasia.						
3.5.2	It is recommended that all health care providers working with persons with stroke across the continuum of care be trained about other communication disorders that may result from stroke including: dysarthria, apraxia of speech and cognitive communication deficits				X		
3.5.3	All stroke survivors should be screened for communication deficits using a screening tool that is valid and reliable.	X					
3.5.4	Speech and language therapists should be involved in stroke management at all stages in the recovery process and should liaise closely with all related healthcare professionals, with		X				

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	outside agencies, both statutory and voluntary, with the individual who has had a stroke and with his/her carers						
3.5.5	Those patients with suspected communication difficulties should receive formal, comprehensive assessment by a specialist clinician using a simple, reliable and validated tool.	X	X	X	X	X	●
3.5.6	Patients with any suspected communication deficits should be referred to a Speech-Language Pathologist (SLP) for assessment in the following areas using valid and reliable methods: comprehension, speaking, reading, writing, gesturing, use of technology, pragmatics (e.g. social cues, turn-taking, body language, etc.) and conversation				X		
3.5.7	Aphasia: Where a stroke patient is found to have aphasia, the clinician should: a) Document the provisional diagnosis. B)	X		X	X	X	●

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	Explain and discuss the nature of the impairment with the patient, family/carers and treating team, and discuss and teach strategies or techniques which may enhance communication. C) Identify goals for therapy, and develop and initiate a tailored intervention plan, in collaboration with the patient and family/carer. D) Reassess the goals and plans at appropriate intervals over time. E) Use alternative means of communication (such as gesture, drawing, writing, use of augmentative and alternative communication devices) as appropriate.						
3.5.8	For stroke survivors with aphasia, intensive aphasia therapy (at least 45 minutes of direct language therapy for five days a week) may be used in the first few months after stroke	X					

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3.5.9	Aphasia: All written information on health, aphasia, social and community supports should be available in an aphasia-friendly format.	X	X	X	X		
3.5.10	Aphasia: Patients with aphasia whose first language is not English should be offered assessment and communication practice in their preferred language.					X	
3.5.11	Aphasia: A) Stroke survivors with chronic and persisting aphasia should have their mood monitored. B) Environmental barriers facing people with aphasia should be addressed through training communication partners, raising awareness of and educating about aphasia to reduce negative attitudes, and promoting access and inclusion by providing aphasia-friendly formats or other environmental adaptations. People with aphasia from culturally and linguistically diverse backgrounds	X		X	X	X	

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	may need special attention from trained healthcare interpreters. C) The impact of aphasia on functional activities, participation and quality of life, including the impact upon relationships, vocation and leisure, should be assessed and addressed as appropriate from early post-onset and over time for those chronically affected.						
3.5.12	For stroke survivors with apraxia of speech, individually tailored interventions incorporating articulatory-kinematic and rate/rhythm approaches may be used. In addition, therapy may incorporate: A) Use of modelling and visual cueing. B) Principles of motor learning to structure practice sessions. C) Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT) therapy. D) Self-administered computer programs that use multimodal sensory stimulation. E) For functional	X		X			

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	activities, the use of augmentative and alternative communication modalities such as gesture or speech-generating devices. The use of augmentative and alternative communication modalities such as is recommended.						
3.5.13	Dyspraxia and dysarthria: The use of augmentative and alternative communication modalities such as gesture or speech-generating devices is recommended for functional activities.			X		X	●
3.5.14	Dysarthria: Patients with unclear or unintelligible speech should be assessed to determine the nature and cause of the speech impairment.		X	X		X	
3.5.15	Dysarthria: For stroke survivors with dysarthria, individually tailored interventions provided by a speech and language	X		X		X	●

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	pathologist or a trained communication partner may be provided.						
3.5.16	For stroke survivors with dysarthria, non-speech oromotor exercises have not been shown to provide additional benefit to behavioural speech practice and are not recommended.	X					
3.5.17	Stroke survivors with cognitive involvement who have difficulties in communication should have input from a suitably trained health professional including: A) a comprehensive assessment, B) development of a management plan, and C) family education, support and counselling as required. Management may include: A) Motoric-imitative, cognitive-linguistic treatments to improve use of emotional tone in speech production. B) Semantic-based treatment	X		X			

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	connecting literal and metaphorical senses to improve comprehension of conversational and metaphoric concept.						
3.6	Visual / Perceptual Deficits						
3.6.1	All stroke survivors should have an: a) assessment of visual acuity while wearing the appropriate glasses, to check their ability to read newspaper text and see distant objects clearly; b) examination for the presence of visual field deficit (e.g. hemianopia) and eye movement disorders (e.g. strabismus and motility deficit).	X	X	X	X	X	●

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3.6.2	Any patient with suspected or actual neglect or impairment of spatial awareness should have a full assessment using validated assessment tools.	X		X	X		
3.6.3	Due to the fluctuating presentation of neglect, a standardised test battery such as the Behavioural Inattention Test should be used in preference to a single subtest, and the effect on functional tasks such as dressing and mobility should be determined					X	
3.6.4	Fresnel Prism glasses (15-diopter) can be used to improve visual function in people with homonymous hemianopia. This treatment should be used if it is supervised by someone with expertise in this treatment, the effects are evaluated and if the			X		X	

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	patient is aware of the limitations of the treatment (no evidence of benefit in activities of daily living).						
3.6.5	Remedial-based techniques could include prisms, eye patching, repetitive transcranial magnetic stimulation (rTMS), and neck muscle vibration				X		
3.6.6	Mirror therapy may be considered as an intervention for unilateral inattention				X		
3.6.7	Any patient shown to have impaired attention to one side should be: A) given a clear explanation of the impairment B) taught compensatory strategies to help reduce impact on functional activities such as reading C) given cues to draw attention to the affected side during therapy and nursing procedures D)	X	X	X	X	X	

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	monitored to ensure that they do not eat too little through missing food on one side of the plate E) offered interventions aimed at reducing the functional impact of the neglect (eg visual scanning training, limb activation, sensory stimulation, eye patching, prism wearing, prism adaptation training, mental imagery training, phasic alerting, cueing, virtual reality, trunk rotation or structured feedback)						
3.6.8	For stroke survivors with symptoms of unilateral neglect, mirror therapy may be used to improve arm function and ADL performance	X					
3.6.9	Healthcare professionals should ensure that patients have and correctly wear their prescribed eyewear		X				

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3.6.10	Stroke survivors with identified perceptual difficulties should have a formal perceptual (i.e. neurological and neuropsychological) assessment. Stroke survivors with an identified perceptual impairment and their carer should receive: • verbal and written information about the impairment; • an assessment and adaptation of their environment to reduce potential risk and promote independence; • practical advice/strategies to reduce risk (e.g. trips, falls, limb injury) and promote independence; • intervention to address the perceptual difficulties, ideally within the context of a clinical trial.	X					
3.7	Cognition						
3.7.1	All stroke survivors should be screened for cognitive and perceptual deficits by a trained person (e.g.	X		X		X	

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	neuropsychologist, occupational therapist or speech pathologist) using validated and reliable screening tools, ideally prior to discharge from hospital.						
3.7.2	Cognitive assessment may be carried out by occupational therapists with expertise in neurological care; patients with complex needs will require access to specialist neuropsychological expertise		X				●
3.7.3	Stroke survivors identified during screening as having cognitive deficits should be referred for comprehensive clinical neuropsychological investigations.	X		X		X	
3.7.4	Stroke survivors considered to have problems associated with executive functioning deficits should be formally assessed by a suitably qualified and trained person, using reliable and	X		X		X	●

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	valid tools that include measures of behavioural symptoms. For stroke survivors with impaired executive functioning, the way in which information is provided should be tailored to accommodate/compensate for the particular area of dysfunction.						
3.7.5	Stroke survivors who have suspected difficulties executing tasks but who have adequate limb movement and sensation should be screened for apraxia.	X		X		X	
3.7.6	The presence of agnosia should be assessed by appropriately trained personnel (using a standardized assessment) and communicated to the stroke team, patient and family/carer.			X		X	
3.7.7	Stroke patients should have a full assessment of their cognitive strengths and weaknesses when undergoing		X			X	

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	rehabilitation or when returning to cognitively demanding activities such as driving or work.						
3.7.8	Care should be taken when assessing patients who have a communication impairment. The advice from a speech and language therapist should be sought where there is any uncertainty about these individuals' cognitive test results					X	
3.7.9	The patient's cognitive status should be taken into account by all members of the multidisciplinary team when planning and delivering treatment					X	
3.7.10	For stroke survivors with attentional impairments or those who appear easily distracted or unable to concentrate, a formal neuropsychological or cognitive assessment should be performed.	X					

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3.7.11	For stroke survivors with attention and concentration deficits, cognitive rehabilitation may be used.	X		X		X	
3.7.12	For stroke survivors with attention and concentration deficits, exercise training and leisure activities may be provided.	X					
3.7.13	Persons with impaired attention should have cognitive demands reduced through: A) having shorter treatment sessions, B) taking planned rests C) reducing background distractions, D) avoiding work when tired.					X	
3.7.14	Any person with impaired attention should: A) be offered an attentional intervention (eg Time Pressure Management, Attention, Process Training, environmental manipulation),					X	

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	ideally in the context of a clinical Trial B) receive repeated practice of activities they are learning.						
3.7.15	Any stroke survivor found to have memory impairment causing difficulties in rehabilitation or adaptive functioning should: A) be referred to a suitably qualified healthcare professional for a more comprehensive assessment of their memory abilities; B) have their nursing and therapy sessions tailored to use techniques that capitalize on preserved memory abilities; C) be assessed to see if compensatory techniques to reduce their disabilities, such as notebooks, diaries, audiotapes, electronic organizers and audio alarms are useful; D) have therapy delivered in an environment as similar to the stroke survivor's usual environment as possible to encourage generalization; E) be taught strategies aimed at assisting their	X		X		X	

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	memory, e.g. using a notebook, diary, mobile phone/audio alerts, electronic calendars and/or reminders; F) be taught approaches aimed at directly improving their memory, e.g. computerized memory training games and learning mnemonic strategies						
3.7.16	For stroke survivors with cognitive impairment, meta-cognitive strategy and/or cognitive training may be provided.	X		X		X	
3.7.17	Information should be provided to individuals with impaired executive functioning in an appropriate way that supports their learning	X		X		X	
3.7.18	Any person found to have agnosia should be offered a perceptual intervention					X	

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3.7.19	For stroke survivors with limb apraxia, interventions such as gesture training, strategy training and/or errorless learning may be provided.	X		X		X	
3.7.20	Patients with suspected limb apraxia should be treated using errorless learning, gesture training and graded strategy training				X		
3.7.21	Cognitive rehabilitation may include: strategy training across all cognitive domains, the use of periodic, random auditory alerting tones to improve sustained attention, the use of self-instructional training/ internal training (e.g. self-cueing, self-talk), the use of errorless learning for task specific learning for people with severe memory impairment, the use of metacognitive strategy training (e.g. goal/ plan/ do/ review,					X	

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	goal management training) is recommended for people with executive dysfunction						
3.8	Psychosocial / Social Interaction						
3.8.1	Services should adopt a comprehensive approach to the delivery of psychological care after stroke, which should be delivered by using a 'stepped care' model from the acute stage to long-term management					X	
3.8.2	Any patient whose social interaction after stroke is causing stress or distress to others should be assessed by a clinical psychologist or other specialist and, if necessary, by others to determine the underlying causes (eg pain, infection, depression).					X	

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3.8.3	Assessment measures should be adapted for use with patients with expressive or minor receptive aphasia. In patients with more severe aphasia, an assessment tool designed specifically for this purpose, such as the Stroke Aphasic Depression Questionnaire (SAD-Q) or Depression Intensity Scale Circles (DISCS), should be used. In patients with aphasia or other impairments that complicate assessment, careful observations over time (including response to a trial of antidepressant medication if considered necessary) should be used.					X	
3.8.4	Patients identified as having symptoms of mood disorder should					X	

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	be offered a more detailed assessment, seeking information on past history, potential causes and impact, and treatment preferences						
3.8.5	Following the assessment: A) the nature of the problems and their causes should be explained to family, to other people in social contact and to the rehabilitation team B) the patient should be helped to learn the best way to interact successfully without causing distress C) all those involved in social interactions should be taught how best to respond to inappropriate or distressing behaviour D) psychosocial management approaches should be considered E) antipsychotic medicines may be indicated if other causes have been excluded and the patient is causing distress and is at possible risk of harm to self or others. Given the high rates of					X	●

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	adverse effects, including risk of stroke, the use of antipsychotics should be carefully considered. Treatment should be started on a low dose and increased slowly according to symptoms. Ideally treatment should be short-term (eg 1 week) and withdrawn slowly.						
3.8.6	Interventions for individual disorders of mood or cognition should be applied within the framework of a stepped care and comprehensive model					X	
3.8.7	Patients with continuing disorders should be considered for comprehensive interventions tailored towards developing compensatory behaviours and the learning of adaptive skills.					X	
3.8.8	In patients with mild or moderate symptoms of mood disorder, patients and carers should be provided with					X	

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	information, support and advice about the mood disorder as the first line of intervention. This may be from within the multidisciplinary team by nominated staff who are suitably trained and supervised, and may also involve the voluntary sector						
3.8.9	Patients with severe or persistent symptoms of mood disorder should be considered for referral to a specialist in the management of mood disorder in stroke					X	
3.8.10	Psychological or pharmaceutical treatment (or a combination) for mood disorder should be provided if: recommended by a clinician with expertise in managing mood disorder after stroke; or, as the second line of intervention, if the patient has not responded to information, support and advice. Any					X	

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	treatment should be monitored for effectiveness and kept under review.						
3.8.11	Patients identified as having cognitive impairment or mood disorder should be reassessed before discharge decisions are taken					X	
3.9	Activities of Daily Living (ADL)						
3.9.1	Every patient who has had a stroke should be assessed formally for their safety and independence in all personal activities of daily living by a clinician with the appropriate expertise, and results should be recorded using a standardised assessment tool.			X		X	
3.9.2	All patients who have problems with activities of daily living following stroke should have access to an occupational		X				●

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	therapist with specific knowledge and expertise in neurological care. Occupational therapy treatment should be based on an assessment of each patient's unique problems						
3.9.3	Every person should be asked about the work and/or leisure activities they undertook before their stroke					X	
3.9.4	Any patient who has limitations on any aspect of personal activities after stroke should: A) be referred to an occupational therapist with experience in neurological disability, *And* B) be seen for further assessment within 4 working days of referral, *and* C) have treatment of identified problems from the occupational therapist who should also guide and involve other members of the specialist multidisciplinary team.					X	

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3.9.5	Patients with confirmed difficulties in personal or extended ADL should have specific therapy (e.g. task-specific practice and trained use of appropriate aids) to address these issues		X	X		X	
3.9.6	For stroke survivors, virtual reality technology may be used to improve ADL outcomes in addition to usual therapy.	X					
3.9.7	The team should promote the practice and transfer of skills gained in therapy into the patient's daily routine, and in the community				X		
3.9.8	It is recommended that patients be given opportunities to repeat rehabilitation techniques learned in therapy and implement them while supervised by stroke rehabilitation nurses				X		

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3.9.9	All daily living tasks should be practiced in the most realistic and appropriate environment, with the opportunity to practice skills outside therapy sessions.					X	●
3.9.10	Any patient whose activities have been limited should be: A) assessed by an occupational therapist with expertise in neurological disability B) taught how to achieve activities safely and given as many opportunities to practice as reasonable under supervision, provided that the activities are potentially achievable C) assessed for, provided with and taught how to use any adaptations or equipment needed to perform activities safely.					X	●

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3.9.11	Where a patient cannot undertake a necessary activity safely themselves, then alternative means of achieving the goal must be put in place to ensure safety and wellbeing					X	
3.9.12	Patients who wish to return to work (paid or unpaid employment) should: A) have their work requirements established with their employer (provided the patient agrees) B) be assessed cognitively, linguistically and practically to establish their potential C) be advised on the most suitable time and way to return to work, if this is practical D) be referred to a specialist in employment for people with disability if extra assistance or advice is needed E) be referred to a specialist vocational rehabilitation team if the disability employment advisor is unable to provide the necessary rehabilitation	X				X	

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3.9.13	Patients who wish to return to or take up a leisure activity should have their cognitive and practical skills assessed, and should be given advice and help in pursuing their activity if appropriate.		X			X	
3.10	Weakness						
3.10.1	For stroke survivors with reduced strength in their arms or legs, strength training should be provided.	X	X				
3.10.2	For stroke survivors with reduced strength in their arms or legs (particularly for those with less than antigravity strength), electrical stimulation may be used.	X		X			
3.11	Motor Function/Control						
3.11.1	Patients should engage in training that is meaningful, engaging, progressively adaptive, intensive, task-specific and				X		

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	goal-oriented in an effort to improve transfer skills and mobility						
3.11.2	All patients should be assessed for motor impairment using a standardised approach to quantify the impairment.					X	
3.11.3	Assess the need for special equipment on an individual basis. Once provided, equipment should be re-evaluated on a regular basis. Equipment and aids should be appropriate to the patient's physical and social context and provided as soon as possible.		X		X	X	●
3.11.4	Recommend that wheelchair prescriptions be based on careful assessment of the patient and the environment in which the wheelchair will be used				X		

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3.11.5	Hypoxia inducing positions *(lying on the left side regardless of affected side or slumped in a chair)* should be avoided		X				
3.11.6	When planning a program to improve motor control, the following should be considered to improve motor control and general fitness: a) strength training focusing on functional tasks b) task-specific training c) exercise training to promote cardiorespiratory fitness d) gait re-education to improve mobility e) expertise should be available in specialized seating					X	●
3.11.7	For stroke survivors who have difficulty sitting, practicing reaching beyond arm's length while sitting with supervision/assistance should be undertaken.	X		X			
3.11.8	For stroke survivors who have difficulty in standing up from a chair, practice of standing up should be undertaken.	X					

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3.11.9	For stroke survivors who have difficulty standing, task-specific practice of standing balance should be provided. Strategies could include: a) practicing functional tasks while standing; b) walking training that includes challenge to standing balance (e.g. overground walking, obstacle courses).	X					
3.11.10	Any patient with significant impairment in maintaining their balance should receive progressive balance training. Therapists should consider both voluntary and reactive balance control within their assessment and treatment				X	X	
3.11.11	Effective interventions for balance retraining include trunk training/seated balance training (early and late), task oriented intervention with or without multisensory intervention (late), force platform biofeedback (early and late); Tai Chi (late), aquatic therapy (late), structured, progressive, physiologically				X		

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	based therapist-supervised home exercise program (early), cycling training (early), and partial body weight support treadmill training (early)						
3.11.12	For stroke survivors who have difficulty with standing balance, virtual reality including treadmill training with virtual reality or use of Wii Balance Boards may be used.	X					
3.11.13	Rehabilitation should include repetitive task training, where it is assessed to be safe and acceptable to the patient, when the aim of treatment is to improve gait speed, walking distance, functional ambulation or sit-to-stand-to-sit.	X	X	X	X	X	
3.11.14	Stroke survivors with difficulty walking should be given the opportunity to undertake tailored repetitive practice of walking (or components of walking) as much as possible. The	X	X	X	X		●

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	following modalities may be used: a) Circuit class therapy (with a focus on overground walking practice); b) Treadmill training with or without body weight support.						
3.11.15	Treadmill-based gait training (with or without body weight support) can be used to enhance walking speed, and distance walked when overground training is not available or appropriate. Treadmill training is suggested for 30 min, five days per week for two to three weeks		X		X	X	●
3.11.16	Electromechanical (robotic) assisted gait training devices could be considered for patients who would not otherwise practice walking. They should not be used in place of conventional gait therapy.				X		

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3.11.17	There is no conclusive evidence that body weight supported treadmill training (BWSTT) is superior to over ground training to enhance walking abilities. BWSTT could be considered when other strategies for walking practice are unsuccessful in those patients with low ambulatory function		X		X		
3.11.18	Biofeedback could be used as an adjunct to improve gait and balance				X		
3.11.19	Mental Practice could be considered as an adjunct to lower extremity motor retraining				X		
3.11.20	Rhythmic auditory stimulation (RAS) could be considered for improving gait parameters in stroke patients, including gait velocity, cadence, stride length and gait symmetry				X		

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3.11.21	For stroke survivors with difficulty walking, one or more of the following interventions may be used in addition to those listed above: • Virtual reality training. • Electromechanically assisted gait training. • Biofeedback. • Cueing of cadence. • Electrical stimulation.	X		X			
3.11.22	Virtual reality, including both immersive technologies such as head mounted or robotic interfaces and non-immersive technologies such as gaming devices can be used as adjunct tools to other rehabilitation therapies as a means to provide additional opportunities for engagement, feedback, repetition, intensity and task-oriented training				X		
3.11.23	For stroke survivors, individually fitted lower limb orthoses may be used to minimise limitations in walking ability.	X		X	X	X	●

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	Improvement in walking will only occur while the orthosis is being worn. Follow up to verify its effectiveness should occur.						
3.11.24	For stroke survivors, rehabilitation should include individually-tailored exercise interventions to improve cardiorespiratory fitness.	X		X	X	X	
3.11.25	All stroke survivors should commence cardiorespiratory training during their inpatient stay. Stroke survivors should be encouraged to participate in ongoing regular physical activity regardless of their level of disability.	X		X	X		
3.11.26	Lower extremity orthotic devices may be helpful if ankle or knee stabilization is needed to help the patient walk. Prefabricated bracing can be used initially, and more				X		

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	expensive customized bracing reserved for patients who demonstrate a long-term need						
3.11.27	Functional Electrical Stimulation (FES) should be used to improve strength and function (gait) in selected patients, but the effects may not be sustained				X		
3.11.28	Functional electrical simulation may be considered as a treatment for drop-foot, where the aim of treatment is the immediate improvement of walking speed and/or efficiency		X				
3.11.29	There is insufficient evidence to recommend for or against neurodevelopmental therapy (NDT) in comparison to other treatment approaches for motor retraining following an acute stroke				X		

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3.11.30	Therapy should include repetitive and intense use of novel tasks that challenge the patient to acquire the necessary motor skills to use the involved limb during functional tasks and activities.				X		
3.11.31	Electromechanical/robotic devices may be considered to improve arm motor function and motor strength in selected patients where the necessary equipment is already available and healthcare professionals are competent in the use of the equipment.		X			X	
3.11.32	Spasticity should not limit the use of strength training in the leg				X		
3.11.33	The need for gait aids, wheelchairs, and other assistive devices should be evaluated on an individual basis				X		●

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3.11.34	Prescription and/or acquisition of an assistive device should be based on anticipation of a long-term need				X		
3.11.35	Once provided, patients should be reassessed, as appropriate, to determine if changes are required or equipment can be discontinued				X		
3.12	Upper Limb Management						
3.12.1	Patients should engage in training that is meaningful, engaging, repetitive, progressively adapted, task specific and goal-oriented in an effort to enhance motor control and restore sensorimotor function				X		
3.12.2	Training should encourage the use of patients' affected limb during functional tasks and be designed to simulate partial or				X		

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	whole skills required in activities of daily living (e.g. folding, buttoning, pouring, and lifting)						
3.12.3	Initial standardized arm and hand function assessment performed by clinicians experienced in the field of stroke.				X		
3.12.4	Access to appropriate equipment (such as functional electrical stimulation, pillows and arm troughs for positioning)				X		
3.12.5	Robotics are an emerging and developing area and stroke rehabilitation programs should begin to build capacity to integrate robotic technology into stroke rehabilitation therapy to appropriate patients as the research evidence suggests, and in the future incorporate this therapy as part of comprehensive therapy where available.	X			X		

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3.12.6	For stroke survivors with mild to moderate arm impairment, virtual reality and interactive games may be used to improve upper limb function. Virtual reality therapy should be provided for at least 15 hours total therapy time and is most effective when used in the first six months after stroke.	X					
3.12.7	For stroke survivors with mild to severe arm or hand weakness, electrical stimulation in conjunction with motor training may be used to improve upper limb function.	X		X	X	X	
3.12.8	For stroke survivors with mild to moderate weakness of their arm, mental practice in conjunction with active motor training may be used to improve arm function.	X	X	X	X	X	
3.12.9	For stroke survivors with mild to moderate weakness, complex regional pain syndrome and/or neglect, mirror	X		X	X	X	

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	therapy may be used as an adjunct to routine therapy to improve arm function after stroke.						
3.12.10	For stroke survivors with at least some voluntary movement of the arm and hand, repetitive task-specific training may be used to improve arm and hand function.	X		X	X	X	
3.12.11	Bilateral arm training does not appear to be superior to unilateral arm training in improving upper extremity motor function.				X		
3.12.12	Repetitive task training for the upper limb, such as reaching, grasping and other functionally meaningful tasks, should be used to assist in rehabilitation of the arm post stroke. The program should include strength training to improve				X	X	

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	impairment and functional after stroke for upper limb (UL); spasticity is not a contra-indication to strength training						
3.12.13	Therapists should consider supplementary training programs aimed at increasing the active movement and functional use of the affected arm between therapy sessions, e.g. Graded Repetitive Arm Supplementary Program (GRASP) suitable for use during hospitalization and at home				X		
3.12.14	Intensive CIMT should not be used for individuals in the first month post stroke				X		
3.12.15	For stroke survivors with some active wrist and finger extension, intensive constraint-induced movement therapy (minimum 2 hours of active therapy per day for 2 weeks, plus restraint for at least 6 hours a day) should be provided to	X	X		X	X	

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	improve arm and hand use. Trunk restraint may also be incorporated into the active therapy sessions at any stage post-stroke.						
3.12.16	Adaptive devices designed to improve safety and function may be considered if other methods of performing specific functional tasks are not available or tasks cannot be learned				X		
3.12.17	It is uncertain whether sensory stimulation (e.g., transcutaneous electrical nerve stimulation (TENS), acupuncture, muscle stimulation, biofeedback improves upper extremity motor function				X		
3.12.18	Hand and wrist orthoses (splints) should not be used as part of routine practice as they have no effect on function, pain or range of movement.	X		X	X	X	

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3.12.19	The need for special equipment (such as wheelchair trays) should be evaluated on an individual basis. Once provided, patients should be reassessed as appropriate to determine if changes are required or equipment can be discontinued with the aim of achieving independent function				X		
3.12.20	Functional dynamic orthoses are an emerging therapy tool that may be offered to patients to facilitate repetitive task-specific training				X		
3.12.21	Repetitive Transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) may be considered as an adjunct to upper extremity therapy				X		
3.12.22	Brain stimulation (transcranial direct stimulation or repetitive transcranial magnetic stimulation) should not be used in	X					

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	routine practice for improving arm function, and only used as part of a research framework.						
3.12.23	All patients should be offered training in self-management skills, to include active problem-solving and individual goal setting					X	
3.13	Palliative Care						
3.13.1	Teams providing care for patients after stroke should be taught how to recognise patients who might benefit from palliative care					X	
3.13.2	An accurate assessment of prognosis or imminent death should be made for patients with severe stroke or those who are deteriorating			X			

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3.13.3	A pathway for stroke palliative care can be used to support Stroke survivors and their families/carers and improve care for people dying after stroke.						
3.13.4	Stroke survivors and their families/carers should have access to specialist palliative care teams as needed and receive care consistent with the principles and philosophies of palliative care			X		X	
3.13.5	After stroke, all end-of-life decisions to withhold or withdraw life-prolonging treatments (including artificial nutrition and hydration) should be in the best interests of the patient and take prior directives into consideration					X	

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3.13.6	All patients who are dying should be given the opportunity of timely/fast-track discharge home or to a hospice or care home according to wishes of the patient and/or carers.					X	
3.14	Carer / Family Training						
3.14.1	Where it is the wish of the person with stroke, carers should be actively involved in the recovery process by assisting with goal setting, therapy sessions, discharge planning, and long term activities.	X		X			●
3.14.2	Relevant members of the interdisciplinary team should provide specific and tailored training for carers/family before the stroke survivor is discharged home. This training should include, as necessary, personal care techniques, communication strategies, physical handling techniques,	X		X			●

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	information about ongoing prevention and other specific stroke-related problems, safe swallowing and appropriate dietary modifications, and management of behaviours and psychosocial issues.						
3.14.3	Caregiver education and training to assist the patient with activities of daily living and increasing the patient's level of independence				X		
3.15	Home Program / Self Practice						
3.15.1	Patients should be encouraged by staff members, with the help of family/friends, to continue to practice skills they learn in therapy sessions into the patient's daily routine in a consistent manner.	X			X	X	●
3.16	Inpatient / Family Education						

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3.16.1	During the rehabilitation phase, carers should be encouraged to participate in an educational programme that: A) explains the nature of stroke and its consequences; B) teaches them how to provide care and support; C) gives them opportunities to practise care with the patient; D) emphasises and reiterates all advice on secondary prevention, especially lifestyle changes.		X	X		X	●
3.16.2	Educational content should be specific to the phase of care or recovery and appropriate to the readiness and needs of the stroke survivor, family, and caregiver		X		X		
3.16.3	Stroke rehabilitation support initiatives for caregivers to increase patient/caregiver understanding of rehabilitation plans and improve adherence				X		

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3.16.4	The scope of the educational content should cover all aspects of stroke care and recovery				X		
3.16.5	Education should be interactive, up to date, ongoing, and provided in a variety of languages and formats (e.g., written, oral, group counselling approach), and ensure communicative accessibility for stroke survivors		X		X		
3.16.6	Specific team members should be designated to provide and document education				X		
3.16.7	Patient education should promote self-efficacy through mastering self-management skills, including action planning, modelling behaviours and problem-solving strategies, reinterpreting symptoms, and social persuasion through group support and guidance for individual efforts				X		

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3.16.8	Family and caregiver education should include training in personal care techniques, communication strategies, physical handling techniques and other daily living activity goals and preferences, how to access community services and resources, problem-solving techniques, health system navigation, and self-management				X		
3.17	Goal Setting						
3.17.1	Health professionals should initiate the process of setting goals, and involve stroke survivors and their families and carers throughout the process. Goals for recovery should be client-centred, clearly communicated and documented so that both the stroke survivor (and their families/carers) and other members of the rehabilitation team are aware of goals set.	X		X		X	●

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3.17.2	Goals should be set in collaboration with the stroke survivor and their family/carer (unless they choose not to participate) and should be well defined, specific and challenging. They should be reviewed and updated regularly	X		X		X	
3.17.3	Stroke survivors and their families/carers should be given help to understand the nature and process of goal setting, and be given help (eg using established tools) to define and articulate their personal goals					X	
3.17.4	Every patient involved in the rehabilitation process should have goals that: A) are meaningful and relevant to the patient; B) are challenging but achievable; C) include both short-term (days/weeks) and long-term (weeks/months) targets; D) include both single clinicians and also the whole team; E) are documented, with specified, time-bound measurable					X	

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	outcomes; F) have achievement evaluated using goal attainment; G) include carers where appropriate; H) are used to guide and inform therapy and treatment.						
3.17.5	Stroke survivors should be offered training in self-management skills that include active problem-solving and individual goal setting.	X		X			
3.17.6	Every patient should have their progress measured against goals set at regular intervals determined by their rate of change, for example using goal attainment scaling					X	
3.17.7	When a patient's goal is not achieved, the reason(s) should be established and: A) the goal should be adjusted, *or* B) the intervention should be adjusted, *or* C) no further intervention					X	

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	should be given towards that goal and a further goal set as appropriate.						
4.0	MANAGING COMPLICATIONS THEME						
4.1	Spasticity						
4.1.1	Any patient with motor weakness should be assessed for the presence of spasticity as a cause of pain, as a factor limiting activities or care, and as a risk factor for the development of contractures.					X	
4.1.2	Any patient who has increased tone sufficient to reduce passive or active movement around a joint should have their range of passive joint movement assessed and monitored					X	

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4.1.3	Specific goals should be set and monitored using appropriate clinical measures					X	
4.1.4	Spasticity and contractures may be prevented or treated by antispastic pattern positioning				X		
4.1.5	Routine use of splints is not recommended in the literature	X	X	X	X	X	
4.1.6	For stroke survivors with upper limb spasticity, Botulinum Toxin A in addition to rehabilitation therapy may be used to reduce spasticity, but is unlikely to improve activity or motor function. This should be in the context of a specialist multidisciplinary team service accompanied by rehabilitation therapy or physical maintenance strategies (eg splinting or casting) over the next 2–12 weeks following botulinum toxin injection.	X		X	X	X	●

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4.1.7	For stroke survivors with lower limb spasticity, Botulinum Toxin A in addition to rehabilitation therapy may be used to reduce spasticity but is unlikely to improve motor function or walking.	X					●
4.1.8	For stroke survivors with spasticity, acupuncture should not be used for treatment of spasticity in routine practice other than as part of a research study.	X					
4.1.9	For stroke survivors with spasticity, adjunct therapies to Botulinum Toxin A, such as electrical stimulation, casting and taping, may be used.	X					
4.1.10	For stroke survivors, the routine use of stretch to reduce spasticity is not recommended.	X					

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4.1.11	Spasticity and contracture should be treated or prevented by anti-spastic pattern positioning, active movement and monitoring range of movement for deterioration of function, passive movement and pain control	X			X	X	
4.1.12	Ankle splints used at night and during assisted standing may be considered for prevention of ankle contracture in the hemiparetic lower extremity				X		
4.2	Contracture						
4.2.1	For stroke survivors at risk of developing contracture, routine use of splints or prolonged positioning of upper or lower limb muscles in a lengthened position (stretch) is not recommended.	X	X	X	X	X	

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4.2.2	For stroke survivors, serial casting may be trialled to reduce severe, persistent contracture when conventional therapy has failed. For stroke survivors at risk of developing contracture or who have developed contracture, active motor training or electrical stimulation to elicit muscle activity should be provided.	X					
4.2.3	Overhead pulley exercise should not be used routinely to maintain range of motion of the shoulder		X	X	X		
4.3	Oedema						
4.3.1	For stroke survivors with severe weakness who are at risk of developing swelling of the extremities, management may include the following: A) dynamic pressure garments; B) electrical stimulation; C) elevation of the limb when resting	X		X	X		

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4.3.2	For stroke survivors who have swelling of the hands or feet management may include the following: A) dynamic pressure garments; B) electrical stimulation; C) continuous passive motion with elevation; D) elevation of the limb when resting	X		X			
4.3.3	Hand Oedema: For patients with hand edema, the following interventions may be considered: a. Active, active-assisted, or passive range of motion exercises in conjunction with arm elevation b. Retrograde massage c. Gentle grade 1–2 mobilizations for accessory movements of the hand and fingers				X		

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4.4	Complex Regional Pain Syndrome (CRPS) or Shoulder-Hand Syndrome						
4.4.1	Prevention: Active, active-assisted, or passive range of motion exercises should be used to prevent CRPS Diagnosis: should be based on clinical findings including pain and tenderness of metacarpophalangeal and proximal interphalangeal joints, and can be associated with edema over the dorsum of the fingers, trophic skin changes, hyperaesthesia, and limited range of motion				X		
4.4.2	A triple phase bone scan (which demonstrates increased periarticular uptake in distal upper extremity joints) can be used to assist in diagnosis				X		
4.5	Subluxation						

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4.5.1	For stroke survivors at risk of shoulder subluxation, electrical stimulation may be used in the first six months after stroke to prevent or reduce subluxation.	X	X	X	X	X	
4.5.2	For stroke survivors at risk of shoulder subluxation, shoulder strapping is not recommended to prevent or reduce subluxation.	X					
4.5.3	For stroke survivors at risk of shoulder subluxation, firm support devices (e.g. devices such as a laptray) may be used. A sling maybe used when standing or walking	X					
4.5.4	To prevent complications related to shoulder subluxation, education and training about correct manual handling and positioning should be provided to the stroke survivor, their	X	X	X	X	X	●

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	family/carer and health professionals, and particularly nursing and allied health staff.						
4.5.5	The shoulder should not be passively moved beyond 90 degrees of flexion and abduction unless the scapula is upwardly rotated and the humerus is laterally rotated				X		
4.5.6	For patients with a flaccid arm (i.e., Chedoke- McMaster Stroke Assessment <3) electrical stimulation should be considered				X		
4.6	Pain						
4.6.1	Every patient with stroke should be asked whether they have any pain, and its severity assessed using a validated score at onset and regular intervals thereafter		X			X	●

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4.6.2	All patients complaining of, or experiencing pain, should have the cause of the pain diagnosed					X	
4.6.3	Any patient with musculoskeletal pain should be carefully assessed to ensure that movement, posture and moving and handling techniques are optimised to reduce the pain.					X	
4.6.4	Pain management protocols should be in place, which include a) regular review and adjustment b) handling, support and pain relief appropriate to the individual needs and c) Staff and caregivers should be educated about appropriate handling of paretic upper limbs during transfers, hypersensitivity and neurogenic pain					X	
4.6.5	For stroke survivors with severe weakness who are at risk of developing shoulder pain, management may include: A)	X		X	X	X	

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	shoulder strapping; B) education of staff, carers and stroke survivors about preventing trauma; C) active motor training to improve function.						
4.6.6	Joint protection strategies to prevent or manage hemiplegic shoulder pain and subluxation should be used during the early or flaccid stage of recovery to prevent or minimize shoulder pain. These include: a. Positioning and supporting the arm during rest b. Protecting and supporting the arm during functional mobility c. Protecting and supporting the arm during wheelchair use by using a hemi-tray or arm trough				X		

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	d. The use of slings remains controversial beyond the flaccid stage, as disadvantages outweigh advantages (such as encouraging flexor synergies, discourages arm use, inhibiting arm swing, contributing to contracture formation, and decreasing body image)						
4.6.7	For stroke survivors with shoulder pain, shoulder strapping may be used to reduce pain.	X					
4.6.8	Consider using FES to increase pain free range of motion of lateral rotation of the shoulder				X		
4.6.9	Treatment of hemiplegic shoulder pain related to limitations in range of motion includes gentle stretching and mobilization techniques, and typically involves increasing external rotation and abduction				X		

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4.6.10	Active range of motion for shoulder pain should be increased gradually in conjunction with restoring alignment and strengthening weak muscles in the shoulder girdle				X		
4.6.11	For stroke survivors with shoulder pain, electrical stimulation is not recommended to manage pain.	X					
4.6.12	Any patient whose central pain-post stroke is not controlled within a few weeks should be referred to a specialist pain management team.		X	X		X	
4.6.13	An individualized patient-centered approach for management of central pain syndromes should be implemented by an interdisciplinary team that includes healthcare professionals with expertise in mental health and central pain management				X		
4.7	Fatigue						

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4.7.1	Fatigue in medically stable patients should be assessed particularly where engagement with rehabilitation, or quality of life is affected					X	
4.7.2	Patients with fatigue and their families should be given information and reassurance that the symptom is likely to improve with time.					X	
4.7.3	Continuous Positive Airway Pressure (CPAP) or oral devices should be used for stroke survivors with sleep apnea.			X			
4.7.4	A) Therapy for stroke survivors with fatigue should be organised for periods of the day when they are most alert. B) Stroke survivors and their families/carers should be provided with information and education about fatigue. C) Potential modifying factors for fatigue should be considered including	X		X			

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	avoiding sedating drugs and alcohol, screening for sleep-related breathing disorders and depression. D) While there is insufficient evidence to guide practice, possible interventions could include exercise and improving sleep hygiene.						
4.8	Mood						
4.8.1	Patients with suspected altered mood (eg, depression, anxiety, emotional lability) should be assessed by trained personnel using a standardised and validated scale. Screening for depression should be introduced in a way that is culturally appropriate		X	X			●
4.8.2	Any patient considered to have depression or anxiety should be assessed for other mood disorders.					X	

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4.8.3	Any patient whose motivation and engagement in rehabilitation seems reduced should be assessed for changes in self-identity, self-esteem and self-efficacy (as well as changes in mood)					X	
4.8.4	Any patient who persistently cries or laughs in unexpected situations or who is upset by their fluctuating emotional state should be assessed by a specialist or member of the stroke team trained in the assessment of emotionalism					X	
4.8.5	For stroke survivors, psychological strategies (e.g. problem solving, motivational interviewing) may be used to prevent depression.	X		X	X		

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4.8.6	Offering routine psychological therapies in one-to-one format following a stroke is not recommended to prevent post-stroke depression		X				
4.8.7	Patients with mild or moderate symptoms of depression should be given information, support and advice and considered for one or more of the following interventions: A) increased social interaction, B) increased exercise, C) goal setting, D)other psychosocial interventions					X	
4.8.8	Any patient with significant changes in self-esteem, self-efficacy or identity should be offered additional (to A) psychological interventions					X	
4.8.9	Those determined to be depressed should receive appropriate treatment, which can consist of a) non-pharmacological		X	X			

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	treatments, which may include a) psychological (cognitive and behavioural) intervention and/or exercise b) pharmacological treatments (Selective Serotonin Reuptake Inhibitors (SSRIs) are the first line of drug treatment)						
4.8.10	Brief, structured psychological therapy should be considered for patients with depression. Therapy will need to be adapted for use in those with neurological conditions.					X	
4.8.11	Any patient diagnosed with emotionalism should, when they show increased emotional behaviour, be appropriately distracted from the provoking stimuli					X	
4.8.12	Patients with severe, persistent or troublesome emotionalism should be given antidepressant drug treatment, monitoring the frequency of crying to check effectiveness. Patients should be		X			X	

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	monitored for known adverse effects. If the emotionalism has not improved 2–4 weeks after initiating treatment, check that the patient is taking the medicine as prescribed. If they are, then consider increasing the dose or changing to another antidepressant						
4.8.13	For stroke survivors with depression or depressive symptoms, structured exercise programs, particularly those of high intensity, may be used.	X					
4.8.14	For stroke survivors with depression or depressive symptoms, acupuncture may be used.	X					
4.9	Pressure care						
4.9.1	Hospitals should have up-to-date policies on risk assessment, pressure injury prevention and treatment		X				

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4.9.2	All stroke survivors at risk should have a pressure care risk assessment and regular evaluation completed by trained personnel.			X			
4.9.3	All stroke survivors assessed as high risk should be provided with appropriate pressure-relieving aids and strategies, including a pressure-relieving mattress as an alternative to a standard hospital mattress.			X			
4.10	Falls						
4.10.1	Screening for risk of falls should include identification of medical, functional, cognitive, and environmental factors associated with potential falls and fall injuries				X		
4.10.2	For stroke patients, a falls risk assessment, including fear of falling, should be undertaken on admission to hospital. A	X		X	X	X	

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	management plan should be initiated for all patients identified as at risk of falls. For stroke survivors at high risk of falls, a comprehensive home assessment for the purposes of reducing falling hazards should be carried out by a qualified health professional. Appropriate home modifications (as determined by a health professional) for example installation of grab rails and ramps may further reduce falls risk						
4.10.3	Those found to be at risk for falls should undergo a comprehensive interprofessional falls assessment that includes medical and functional history, and examination of mobility, vision, perception, cognition, and cardiovascular status				X		

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4.10.4	Based on the risk assessment findings, an individualized falls prevention plan should be implemented for each patient (patient education, family education)				X		
4.10.5	Topics addressed in patient, family, and caregiver education should include: education about falls risks, safe transfer skills, footwear, gait aids and/or wheelchair use.				X		
4.10.6	All patients who fall post-stroke should have an assessment of the circumstances surrounding the fall to identify precipitating factors, and the falls prevention plan should be modified to reduce the risk of further falls				X		
4.10.7	For stroke survivors who are at risk of falling, multifactorial interventions in the community, including an individually	X		X	X		

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	prescribed exercise program and advice on safety, should be provided.						
4.11	Nutrition						
4.11.1	Assessment of nutritional risk should be carried out within the first 48 hours (using a valid screening tool) with regular re-assessment thereafter during the patient's recovery and be recorded prior to discharge	X	X	X	X	X	
4.11.2	Assessment of a patient's nutritional risk should include an assessment of their ability to eat independently and a periodic record of their food consumption		X				
4.11.3	All stroke patients should have their hydration status assessed, monitored, and managed throughout their hospital admission. This should include regular weighing. Where fluid support is	X	X	X			

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	required, crystalloid solution should be used in preference to colloid solutions as the first option to treat or prevent dehydration.						
4.11.4	Stroke patients with suspected nutritional concerns, hydration deficits, dysphagia, or other comorbidities that may affect nutrition should be referred to a dietitian for recommendations: a) To meet nutrient and fluid needs orally while supporting alterations in food texture and fluid consistency recommended by a speech-language pathologist or other trained professional b) For enteral nutrition support in patients who cannot safely swallow or meet their nutrient and fluid needs orally.	X			X		

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	c) The decision to proceed with tube feeding should be made as early as possible after admission, usually within the first three days of admission in collaboration with the patient, family (or substitute decision maker), and interprofessional team						
4.11.5	Patients who are at risk of malnutrition, including those with dysphagia, should be referred to a dietitian for assessment and ongoing management.	X		X	X	X	
4.11.6	For stroke patients whose nutrition status is poor or deteriorating, nutrition supplementation should be offered.	X		X	X	X	
4.11.7	For stroke patients who do not recover a functional swallow, nasogastric tube feeding is the preferred method of feeding in the short term.	X		X			

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	For stroke patients, there is no preference with regard to continuous pump (meaning using a pump for greater than or equal to 16hrs out of 24hrs for less than or equal to 80ml/hr) feeding versus intermittent bolus feeding (meaning 250-400mls/hr for 4-5times/day) therefore practical issues, cost and patient preferences should guide practice.						
4.11.8	For stroke patients who are adequately nourished, routine oral nutrition supplements are not recommended.	X					
4.11.9	Fluid balance and nutritional intake should be monitored in all stroke patients who are at high risk of malnutrition, are malnourished and/or have swallowing problems			X		X	
4.12	Incontinence						

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4.12.1	All wards and stroke units should have established assessment and management protocols for both urinary and faecal incontinence, and for constipation in stroke patients		X			X	
4.12.2	The presence or absence of incontinence of urine should be documented for all patients after a stroke		X				
4.12.3	All stroke survivors with suspected urinary continence difficulties should be assessed by trained personnel using a structured functional assessment. For stroke survivors, a portable bladder ultrasound scan should be used to assist in diagnosis and management of urinary incontinence.	X	X	X		X	

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4.12.4	All stroke survivors with suspected faecal continence difficulties should be assessed by trained personnel using a structured functional assessment.	X		X			●
4.12.5	Stroke survivors with confirmed continence difficulties should have a continence management plan formulated, documented, implemented and monitored.	X		X		X	●
4.12.6	Patients with stroke who have continued loss of bladder control 2 weeks after diagnosis should be reassessed to identify the cause of incontinence, and have an ongoing treatment plan involving both patients and carers. The patient should: A) have any identified causes of incontinence treated; B) have an active plan of management documented; C) be					X	

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	offered simple treatments such as bladder retraining, pelvic floor exercises and external equipment first						
4.12.7	All stroke patients with a persistent loss of control over their bowels should: A) be assessed for other causes of incontinence, which should be treated if identified; B) have a documented, active plan of management					X	●
4.12.8	Stroke patients with troublesome constipation should: A) have a prescribed drug review to minimise use of constipating drugs B) be given advice on diet, fluid intake and exercise C) be offered oral laxatives					X	

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	D) be offered rectal laxatives only if severe problems remain.						
4.12.9	The use of indwelling catheters should be avoided as an initial management strategy except in acute urinary retention	X		X			
4.12.10	A community continence management plan should be developed with the stroke survivor and family/carer prior to discharge and should include information on accessing continence resources and appropriate review in the community	X		X		X	
4.12.11	If incontinence persists the stroke survivor should be re-assessed and referred for specialist review	X		X		X	
4.12.12	For people with urge incontinence: a) anticholinergic drugs can be trialled b) a prompted or scheduled voiding regime	X		X			●

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	program/bladder retraining should be trialled c) if continence is unachievable, containment aids can assist with social continence.						
4.12.13	For people with urinary retention: a) the routine use of indwelling catheters in NOT recommended. However, if urinary retention is severe, intermittent catheterization should be used to assist bladder emptying during hospitalization. If retention continues, intermittent catheterization is preferable to indwelling catheterization b) if using intermittent catheterization, a closed sterile catheterization technique should be used in hospital c) where management of chronic retention requires catheterization, consideration should be given to the choice of appropriate route, urethral or suprapubic d) if a stroke survivor is discharged with either	X		X			●

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	intermittent or in-dwelling catheterization, they and their family/carer will require education about management, where to access supplies and who to contact in case of problems.						
4.12.14	For people with functional incontinence, a whole-team approach is recommended.	X		X			
4.12.15	For stroke survivors, the use of indwelling catheters should be avoided as an initial management strategy except in acute urinary retention.	X					
4.12.16	All stroke survivors with suspected faecal continence difficulties should be assessed by trained personnel using a structured functional assessment. For stroke survivors with constipation or faecal incontinence, a full assessment (including a rectal examination) should be	X	X	X			

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	carried out and appropriate management of constipation, faecal overflow or bowel incontinence established and targeted education provided.						
4.12.17	For stroke survivors with bowel dysfunction, bowel habit retraining using type and timing of diet and exploiting the gastro-colic reflex should be used.	X		X			●
4.12.18	For stroke survivors with bowel dysfunction: A) Education and careful discharge planning should be provided. B) Use of short-term laxatives may be trialled. C) Increase frequency of mobilisation (walking and out of bed activity) to reduce constipation. D) Use of the bathroom rather than use of bed pans should be encouraged. E) Use of containment aids to	X		X			●

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	assist with social continence where continence is unachievable.						
4.13	Deep Vein Thrombosis (DVT)						
4.13.1	For acute stroke patients who are immobile, the use of intermittent pneumatic compression may be used, either as an alternative to low molecular weight heparin or in those with a contraindication to pharmacological DVT prophylaxis (including patients with intracerebral haemorrhage or within 24 hours of thrombolysis)	X					
4.13.2	Antithrombotic stockings are not recommended for the prevention of DVT or PE post stroke.	X	X	X			
4.14	Swallowing (Dysphagia)						

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4.14.1	Patients should be screened for swallowing deficits as soon as they are alert and ready for trialing oral intake (e.g. medications, food, liquid) using a valid screening tool by an expert in dysphagia, ideally a speech-language pathologist (SLP); if an SLP is not available this should be done by another appropriately trained professional	X		X	X	X	
4.14.2	Swallowing should be screened for as soon as possible but at lease within 24 hours of admission	X		X		X	
4.14.3	The gag reflex is not a valid screen for dysphagia and should NOT be used as a screening tool	X		X			
4.14.4	Abnormal results from the initial or ongoing swallowing screens should prompt a referral to a speech-language pathologist, occupational therapist, dietitian or other trained				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	dysphagia clinician for more detailed bedside swallowing assessment and management of swallowing, feeding, nutritional and hydration status						
4.14.5	Videofluoroscopic swallow study or fiberoptic endoscopic examination of swallowing, should be performed on all patients considered at risk for pharyngeal dysphagia or poor airway protection, based on results from the bedside swallowing assessment	X		X	X	X	
4.14.6	Restorative swallowing therapy and/or compensatory techniques to optimize the efficiency and safety of the swallow, with reassessment as required, should be considered for dysphagia therapy		X		X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
4.14.7	Restorative therapy may include lingual resistance, breath holds and effortful swallows. Compensatory techniques may address posture, sensory input with bolus, volitional control, texture modification and a rigorous program of oral hygiene based on specific impairments identified during comprehensive swallow assessment.	X		X	X	X	
4.14.8	Patients, family and caregivers should receive appropriate training / education on feeding and swallowing recommendations.	X		X	X		
4.14.9	To reduce the risk of pneumonia, patients should be permitted and encouraged to feed themselves whenever possible				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
4.14.10	All stroke patients, particularly those with swallowing difficulties, should have assistance and/or education to maintain good oral and dental (including dentures) hygiene.	X			X		
4.14.11	Staff and carers of stroke patients (in hospital, in residential care and home settings) should be trained in assessment and management of oral hygiene.	X					
4.14.12	For stroke patients, chlorhexidine in combination with oral hygiene instruction, and/or assisted brushing may be used to decrease dental plaque and gingiva bleeding. Caution should be taken, however, for patients with dysphagia.	X					
4.14.13	All stroke patients with swallowing problems should have written guidance for all staff/carers to use when feeding or providing liquid					X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
4.14.14	Stroke patients with difficulties self-feeding should be assessed and provided with the appropriate equipment and assistance (including physical help and verbal encouragement) to promote independent and safe feeding as far as possible.					X	
4.14.15	Dysphagic patients on modified diets should have their intake and tolerance to diet monitored. The need for continued modified diet should be regularly reviewed.	X		X		X	
4.14.16	Patients with persistent weight loss and recurrent chest infections should be urgently reviewed	X		X			
4.14.17	Nutrition support should be initiated for people with stroke who are at risk of malnutrition which should incorporate specialist dietary advice and may include oral nutritional supplements, and/or tube feeding		X			X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
4.14.18	One or more of the flowing methods can be provided to facilitate resolution of dysphagia: therapy targeting specific muscle groups, thermos-tactile stimulation, and/or electrical stimulation.	X		X			
4.14.19	Gastrostomy feeding should be considered for stroke patients who: need but are unable to tolerate nasogastric tube feeding; are unable to swallow adequate amounts of food and fluid orally by 4 weeks; are at long-term high risk of malnutrition.					X	
4.14.20	Any stroke patient discharged from specialist care services with continuing problems with swallowing food or liquid safely should: A) be trained, or have carers trained, in the identification and management of swallowing difficulties; B) should have regular reassessment of their dysphagia beyond the initial acute assessment to enable accurate diagnosis and					X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	management; C) should have their nutritional status and dietary intake monitored regularly by a suitably trained professional.						
4.14.21	All patients, particularly those with swallowing difficulties, should have assistance and/or education to maintain good oral and dental hygiene (brushing of teeth and removal of excess secretions).	X		X		X	
4.14.22	Staff or carers responsible for the care of patients disabled by stroke can be trained in assessment and management of oral hygiene	X		X		X	
4.15	Nursing Neurological Assessments						
4.15.1	Stroke inpatients should be treated 24 hours a day by nurses specialising in stroke and based in a stroke unit		X				

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
4.15.2	The key elements of good stroke unit nursing care are: removing the competition for nursing time, recognition of stroke nursing as a specialisation, eg swallow screening, empowering nurses to become facilitators of rehabilitation, therapeutic interventions and enabling independence, knowledge, clinical skill, confidence and interest, multidisciplinary team working and collaboration; enabling nurses to coordinate patient care; nursing assessment of the care needs of the patient, including a formal scoring of pressure sore risk and swallow screening; nursing management of the patient's care needs, maintaining the patient in a correct posture and position and regular observation of key characteristics, such as airway,		X				

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	swallowing, nutritional status, continence and skin integrity; active patient and family contact and interaction						
5.0	COMMUNITY MANAGEMENT THEME						
5.1	Organisation of community management						
5.1.1	Median length of time between referral for outpatient rehabilitation to commencement of therapy (Target is within 30 days)				X		
5.1.2	Mechanisms to periodically re-evaluate those patients with severe stroke who are admitted to nursing homes, continuing care, or other settings to ensure that they have access to rehabilitation as appropriate, if the patient progresses sufficiently and has goals amenable to rehabilitation.				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.1.3	Coordination and development of strong partnerships in the community, and adequate resources to ensure access to comprehensive stroke rehabilitation. This is especially important in more rural and remote geographic locations where telehealth technologies should be optimized.				X		
5.1.4	Processes for patients and caregivers to re-access the rehabilitation system as required. Financial barriers should not limit access to rehabilitation services.				X		
5.1.5	Timely access to stroke rehabilitation services in the community following discharge. Outpatient and/or community based rehabilitation services should be available and provided by a specialized interprofessional team, when				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	needed by patients, within 72 hours of discharge from inpatient rehabilitation						
5.1.6	Availability of skilled clinicians who have experience practicing in outpatient and community rehabilitation				X		
5.1.7	Long-term rehabilitation services widely available, and without financial barriers, in nursing and continuing care facilities, and in outpatient and community programs, including in-home visits				X		
5.1.8	Therapy should be provided for a minimum of 45 minutes per day (Evidence Level B) per discipline, 2 to 5 days per week, based on individual patient needs and goals for at least 8 weeks.				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.1.9	Patients and families should be involved in their management, goal setting, and transition planning				X		
5.2	Self-Management						
5.2.1	Patients and families should be introduced to resources which will enable self-management and the ability to navigate through the health care system				X		
5.2.2	Stroke survivors who are cognitively able and their carers should be made aware of the availability of generic self-management programs before discharge from hospital and be supported to access such programs once they have returned to the community. Stroke-specific self-management programs may be provided for those who require more specialised programs.	X		X			

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	A collaboratively developed self-management care plan may be used to harness and optimise self-management skills.						
5.2.3	Community-based rehabilitation programmes can use self-management approaches to optimise recovery and social reintegration			X			
5.3	Driving						
5.3.1	All patients admitted to hospital should be asked if they intend to drive again	X		X		X	
5.3.2	Any person wishing to drive again after a stroke or TIA should be provided with information about how stroke may affect his/her driving and the requirements and processes for returning to driving. Information should be consistent with the national and state guidelines.	X		X		X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.3.3	For private licenses, stroke survivors should be instructed not to return to driving for a minimum of four weeks post stroke. People who have had a TIA should be instructed not to drive for two weeks. For commercial licenses, stroke survivors should be instructed not to return to driving for a minimum of 3 months post stroke. People who have had a TIA should be instructed not to drive for four weeks.	X					
5.3.4	The person or team responsible for any stroke patient who wishes to drive should: A) ask about and identify any absolute bars to driving, B) consider the patient's capacity to drive safely, C) discuss driving and give advice to the patient, D) document the findings and conclusions, inform the GP and give a written record to the patient.					X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.3.5	If a stroke survivor is deemed medically fit but has residual motor, sensory or cognitive changes that may influence driving, they should be referred for an occupational therapy driving assessment. This may include clinic based assessments to determine on-road assessment requirements (for example modifications, type of vehicle, timing), on-road assessment and rehabilitation recommendations.	X	X	X	X	X	
5.3.6	Patients can be referred to training programs, such as simulator based training, to help prepare for a road test or the resumption of driving. Health professionals using driving simulation need to receive training and education to deliver intervention effectively and appropriately, and mitigate driving simulator sickness.	X			X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.3.7	On-road driving rehabilitation may be provided by health professionals specifically trained in driving rehabilitation.	X					
5.4	Return to vocation / volunteer						
5.4.1	Patients, especially those <65 years of age, should be asked about vocational interests (i.e., work, school, volunteering) and be assessed for their potential to return to their vocations. This initial screening should take place early in the rehabilitation phase, and become included in the individualized patient goal setting and planning for rehabilitation needs	X	X	X	X		●
5.4.2	All stroke survivors should be asked about their employment (paid and unpaid) prior to their stroke and if they wish to return to work. For stroke survivors who wish to return to	X					●

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	work, assessment should be offered to establish abilities relative to work demands. In addition, assistance to resume or take up work including worksite visits and workplace interventions, or referral to a supported employment service should be offered.						
5.4.3	A detailed cognitive assessment including a neuropsychological evaluation, where appropriate, is recommended to assist in vocational planning				X		
5.4.4	Psychological wellbeing should be a focus for intervention in working-age stroke patients as it is a predictor of return to work.			X			

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.4.5	Resumption of vocational interests should be encouraged where possible. A gradual resumption should occur when appropriate				X		
5.4.6	People wishing to return to work should have access to advice on benefits, employment and legal rights and referral to social work if appropriate		X		X		
5.4.7	Employers should be encouraged to provide work modification and flexibility to people returning to work after a stroke		X		X		
5.5	Leisure						
5.5.1	Patients should be given the opportunity to discuss pre-stroke leisure pursuits and be assessed for rehabilitative needs to				X	X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	resume these activities. Participation in leisure activities should be encouraged						
5.5.2	For stroke survivors, targeted occupational therapy programs including leisure therapy may be used to increase participation in leisure activities.	X		X	X		
5.5.3	Patients with difficulty undertaking leisure activities of their choice should be offered a goal directed community-based program aimed at increasing participation in leisure and social activities, in liaison with local volunteer organizations.				X	X	●
5.6	Sexuality						
5.6.1	Stroke survivors and their partners should be offered: A) the opportunity to discuss issues relating to sexual intimacy with an appropriate health professional; and B) written information	X		X	X	X	●

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	addressing issues relating to sexual intimacy and sexual dysfunction post stroke. Any interventions should address psychosocial as well as physical function						
5.6.2	Any patient who has a limitation on sexual functioning and who wants further help should: A) be assessed for treatable causes; B) be reassured that sexual activity is not contraindicated after stroke and is extremely unlikely to precipitate a further stroke ; C) if suffering from erectile dysfunction, be assessed for the use of sildenafil or an equivalent drug; D) avoid the use of sildenafil or equivalent drug for 3 months after stroke and until blood pressure is controlled; E) be referred to a person with				X	X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	expertise in psychosexual problems if the problems remain unresolved.						
5.7	Peer Support						
5.7.1	Stroke survivors and their families/carers should be given information about the availability and potential benefits of a local stroke support group and/or other sources of peer support before leaving hospital and when back in the community.	X		X			
5.8	Carer Support						
5.8.1	Comprehensive assessment of the individual and their family needs should be undertaken to facilitate access to appropriate secondary prevention and rehabilitation resources after stroke, including identification of any enablers and barriers			X			

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.8.2	Patients, families and caregivers should be assessed to determine their needs and readiness for information and education, training, psychosocial support, and health and social services				X		
5.8.3	Carers of stroke survivors should be provided with tailored information and support during all stages of the recovery process. This support includes (but is not limited to) information provision and opportunities to talk with relevant health professionals about the stroke, stroke team members and their roles, test or assessment results, intervention plans, discharge planning, community services and appropriate contact details. Support and information provision for carers should occur prior to discharge from hospital and/or in the	X		X	X	X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	home and can be delivered face-to-face, via telephone or computer.						
5.8.4	Carers should be provided with information about the availably and potential benefits of local stroke support groups and services, at or before the persons return to the community.	X		X		X	
5.8.5	Carers should receive psychosocial support throughout the stroke recovery continuum to ensure carer wellbeing and the sustainability of the care arrangement. Carers should be supported to explore and develop problem solving strategies, coping strategies and stress management techniques. The care arrangement has a significant impact on the relationship between caregiver and stroke survivor so psychosocial support	X	X	X		X	

Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
should also be targeted towards protecting relationships within the stroke survivors support network. Where it is the wish of the stroke survivor, carers should be actively involved in the recovery process by assisting with goal setting, therapy sessions, discharge planning, and long-term activities. Carers should be provided with information about the availability and potential benefits of local stroke support groups and services, at or before the person's return to the community. Assistance should be provided for families/carers to manage stroke survivors who have behavioural problems.						

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.8.6	Patients, families and caregivers should be prepared with appropriate and realistic expectations regarding role changes, and the availability of services and resources within changing care environments				X		
5.8.7	Carer support should include: A) Written discharge instructions from care providers that identify action plans, follow-up care, and goals, provided to the patient, family, and primary care giver. B) Access to a contact person in the hospital or community (designated case manager or system navigator) for post-discharge queries				X		●

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	C) Access to and advice from health and social service organizations (e.g., through single points of access to all organizations						
	D) referrals to community agencies such as stroke survivor groups, peer survivor visiting programs, and other services and agencies						
5.8.8	Stroke survivors and their caregivers should have their individual psychosocial and support needs reviewed on a regular basis		X		X		
5.8.9	Advice about the financial support available should be provided for family/carers of people with stroke prior to discharge and as needs emerge and circumstances change			X			

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.8.10	Efforts to reduce the effects of socioeconomic disadvantage on stroke should be aimed at the pre-hospital stage in primary and secondary prevention, and in rehabilitation services post discharge			X			
5.9	Care after hospital discharge:						
5.9.1	Any patient whose situation changes (eg new problems or changed environment) should be offered further assessment by the specialist stroke rehabilitation service.					X	
5.9.2	Contact and education by trained staff should be offered to all stroke survivors and their families/carers after stroke.	X		X			
5.9.3	Interdisciplinary community rehabilitation services and support services should be made available whenever possible	X	X	X			

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	to enable early supported discharge to be offered to all people with stroke who have mild to moderate disability						
5.9.4	Health services with a stroke unit should provide comprehensive, experienced multidisciplinary team community rehabilitation and adequately resourced support services for stroke survivors and their family/carers.	X	X	X			
5.9.5	Rehabilitation in the home setting should be offered to all stroke survivors as needed. Where home rehab is unavailable, patients requiring rehab should receive centre-based care.	X	X	X	X		
5.9.6	People who have difficulty in activities of daily living, including self-care, productivity and leisure, should receive occupational therapy or inter-professional interventions targeting activities of daily living				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.9.7	Stroke survivors can be managed using a case management model after discharge. If used, case managers should be able to recognize and manage depression and help to coordinate appropriate interventions via a medical practitioner	X		X			
5.9.8	Stroke survivors should have regular and ongoing review by a member of a stroke team, including at least on specialist medical review. The first review should occur within 3 months, then again at 6 and 12 months' post discharge (at least for the first 3 years).	X			X	X	
5.9.9	Stroke survivors and their carers/families should be provided with contact information for the specialist stroke service and a contact person for any post-discharge queries for at least the first year following discharge.	X		X		X	

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.9.10	All people following stroke should take sufficient physical exercise to achieve national levels of physical activity					X	
5.9.11	The prescription of equipment should take account of any cognitive and behavioural deficits and their constraints on the person's ability, or their family/ caregiver's ability, to use the equipment safely and appropriately. Where this in doubt, arrangements should be in place for regular review					X	●
5.9.12	Patients and their family/caregivers should be given clear written information on who to contact for repairs, replacement or future help and advice regarding the equipment. The ongoing effectiveness of equipment should be reviewed on a regular basis and in accordance with the manufacturers' guidelines.					X	●

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.10	Long Term Rehabilitation						
5.10.1	Stroke survivors who have residual impairment at the end of the formal rehab phase of care should be reviewed annually, usually by the GP or rehab provider to consider whether access to further interventions is needed. A referral for further assessment should be offered for relevant allied health professionals or general rehabilitation services if there are new problems not present when undertaking initial rehabilitation, or if the person's physical or social environment has changed.	X		X	X		
5.10.2	Community-dwelling stroke survivors who have difficulties performing daily activities should be assessed by a trained clinician.	X			X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	Community-dwelling stroke survivors with confirmed difficulties in personal or extended ADL should have specific therapy from a trained clinician (e.g. task-specific practice and training in the use of appropriate aids) to address these issues.						
5.10.3	Stroke survivors who have difficulty with outdoor mobility in the community should set individualised goals and get assistance with adaptive equipment, information and referral on to other agencies. Escorted walking practice may be of benefit to some individuals and if provided, should occur in a variety of community settings and environments, and may also incorporate virtual reality training that mimics community walking.	X					

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.10.4	For older stroke survivors living in a nursing home, routine occupational therapy is not recommended to improve ADL function.	X					
5.10.5	Stroke survivors with residual impairment identified as having further rehabilitation needs should receive therapy services to set new goals and improve task-orientated activity	X		X			
5.10.6	Any stroke survivor with declining physical activity, activities of daily living or mobility at six months or later after stroke should be assessed for appropriate targeted rehabilitation				X		
5.10.7	The duration of the formal rehabilitation phase of care should be tailored to the individual patient based on their response to interventions, not on an arbitrary time limit.			X			

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.10.8	Stroke survivors with confirmed difficulties in performance of personal tasks, IADLs, vocational activities or leisure activities should have a documented management plan updated and initiated to address these issues.	X		X			
5.10.9	People with difficulties in mobility should be offered an exercise program specific to those difficulties and monitored throughout the program				X		
5.10.10	Patients with aphasia should be taught supportive conversation techniques				X		
5.10.11	Patients with dysphagia should be offered swallowing therapy and opportunity for reassessment as required				X		
5.10.12	Stroke survivors should be provided with a cardiovascular fitness program to maximize functional outcomes after stroke				X		

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
	(and as part of overall vascular risk reduction). Patients should be prescribed modified activities to allow age appropriate target heart rates to be achieved for 20 to 30 minutes three times per week						
5.10.13	Stroke survivors should be encouraged to participate long term in appropriate community exercise programs.	X		X	X		
5.10.14	At any point in their recovery, stroke survivors who have experienced a change in functional status and who would benefit from additional rehabilitation services should be offered a further trial of outpatient rehabilitation if they meet the requirements				X		
5.11	Mood disturbance						

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.11.1	Stroke survivors with suspected altered mood (e.g. depression, anxiety, emotional lability) should be assessed by trained personnel using a standardised and validated scale. Diagnosis should only be made following clinical interview.	X			X	X	
5.11.2	Patients and their caregivers should have their psychosocial and support needs reviewed on a regular basis as part of long-term stroke management				X		
5.11.3	All patients with stroke should be considered to be at high risk for depression. During the first assessment, the clinical team should determine whether the patient has a history of depression or risk factors for depression				X		
5.11.4	Psychological strategies can be used to prevent depression after stroke	X					

	Domain and Guideline Recommendation Theme	Stroke Foundation (2017)	SIGN (2010b)	SFNZ & NZGG (2010)	CSS (Blacquiere et al., 2017; Hebert et al., 2016)	ISWP (2016)	NZGG (2006)
5.11.5	Routine use of antidepressants to prevent post-stroke depression is NOT recommended	X	X	X	X	X	
5.11.6	Antidepressants can be used for stroke patients who are depressed and for those with emotional lability	X	X				
5.11.7	Patients should be given information and advice about the impact of stroke, and the opportunity to talk about the impact on their lives				X		
5.11.8	Patients with marked anxiety should be offered psychological therapy				X		

SIGN= Scottish Intercollegiate Guidelines Network, SFNZ&NZGG= Stroke Foundation of New Zealand and New Zealand Guideline Group, CSS= Canadian Stroke Strategy, ISWP= Intercollegiate Stroke Working Party, NZGG=New Zealand Guideline Group, X= presence of guideline recommendation, • = presence of guideline recommendation for both vascular and trauma condition.

Note: Recommendations that are out dated have been excluded. Recommendations that are inconsistent with other clinical practice guidelines have been excluded.

APPENDIX E: SUPPLEMENTARY DOCUMENT FOR STUDY TWO

Survey to clinical trialists

Implementation in stroke rehabilitation; a survey of clinical trialists

The following questions relate to your Randomised Controlled Trial (please refer to your email invitation)

1. Do you consider the findings of your trial to have been clinically significant / important?

- ◯ Yes
- ◯ No
- ◯ Unsure

And why?:

2. Are there economic implications from your trial (for example, was the study-intervention cost-effective, or did you find out you should cease providing the study-intervention)?

- ◯ Yes, based on economic data collected and findings produced
- ◯ Yes, however we did not collect specific economic data
- ◯ No, we collected health economic data but didn't find a clinically important economic finding
- ◯ No, we did not have health economic data nor aims for this trial
- ◯ Unsure

Other or Comment:

3. Have you undertaken any "implementation" interventions about your study?

(Please tick all that apply) *Implementation is defined as: interventions to support the implementation of new clinical knowledge into healthcare practices*.

○ Presented findings at a conference Presented results of RCT in published paper

○ Published intervention details [beyond the main publication of RCT results] (e.g. published a companion paper with intervention details, or a process evaluation paper)

○ Created a brief summary of research findings / report, either in hard copy or electronically, and made this available to research participants

○ Created a brief summary of research findings / report, either in hard copy or electronically, and made this available to stroke patients more widely

○ Created a brief summary of research findings / report, either in hard copy or electronically, and made this available to relevant clinical staff

○ Created a brief summary of research findings / report, either in hard copy or electronically, and made this available to management / administration staff

○ Created an internally available brief summary of research findings (e.g organisational website / newsletter / update) Created an externally available brief summary of research findings via website and/or public media

○ Created a full report of research findings, either in hard copy or electronically and made this available to research participants (via post or email)

○ Created a full report of research findings, either in hard copy or electronically and made this available to stroke patients more widely (e.g. via post / email / copies in hospitals)

○ Created a full report of research findings, either in hard copy or electronically and made this available to clinical staff (e.g. via post/ email)

○ Created a full report of research findings, either in hard copy or electronically and made this available to management / administration staff (e.g. via post / email)

◯ Created an internally available full report of research findings (e.g. placed on your organisational intranet / library) Created an externally available full report of research findings (e.g. placed on your organisational website) ◯ Spent time with specific target audiences presenting the research findings (e.g. presentations to Stroke Clubs, or Hospital Managers, or Department of Health) ◯ Spent time with specific target audiences discussing ideas for possible actions ◯ Provided skill building sessions (e.g. ran a workshop) among clinicians / target audiences Held informal conversations with clinicians to discuss research findings ◯ Social Media No, we have not undertaken any implementation interventions; Other (Please list):
4. Did you plan any of these interventions BEFORE you commenced your trial, i.e. did you develop an implementation plan alongside your clinical trial protocol? ◯ No, we did not pre-plan any of these implementation interventions. ◯ Yes, we pre-planned some or all of these implementation interventions *(Please tell us which interventions were pre-planned in the comment box)* Which implementation interventions were pre-planned (please specify):
5. Are the study-intervention materials (such as any information materials used with participants or in training intervention providers) available to others or sufficiently detailed in the trial paper that others would be ableto replicate the study-intervention? ◯ Yes – publicly available (if yes, where from?)

◯ Yes – available on request from author

◯ No

Other/ Comment:

Practice and / or Policy Changes

We acknowledge that individual studies rarely provide sufficient evidence for practice and policy change; however we remain keen to understand any changes that have occurred followingyour trial

6. Do you perceive that there have been any practice changes as a result of your trial? *Please tick all that apply*

◯ Yes; in sites that participated in my study

◯ Yes; within Australia and/or New Zealand

◯ Yes; internationally (beyond Australia and/or New Zealand)

◯ Unsure

◯ No

Comment (please specify):

7. Do you perceive that there have been any policy changes as a result of your trial? (including Clinical Practice Guidelines, professional policies, organisational policies) *Please tick all that apply*

◯ Yes; in sites that participated in my study

◯ Yes; within Australia and/or New Zealand

◯ Yes; internationally (beyond Australia and/or New Zealand)

◯ Unsure

◯ No

Comment (please specify):

8. Do you perceive that there have been any funding changes as a result of your trial? *Please tick all that apply.*

- ◯ Yes; in sites that participated in my trial
- ◯ Yes; within Australia and/or New Zealand
- ◯ Yes; internationally (beyond Australia and/or New Zealand)
- ◯ Unsure
- ◯ No

Stakeholders

9. Whom did you target in your implementation interventions *(Please tick all that apply)*

- ◯ People living with stroke
- ◯ Carers of people living with stroke
- ◯ Policy makers in federal, state or local government/s Service providers / clinicians
- ◯ Managers of service-providing organisations (e.g. hospitals, workplaces) General Public
- ◯ Advocacy groups (e.g. Stroke Foundation) Media (including social media)
- ◯ Research funders
- ◯ Other researchers

Other (please specify):

10. Did you invest financial resources specifically in implementation interventions to implement the findings of your trial? *(please tick all that apply)*

- ◯ Yes, we dedicated part of trial budget to implementation interventions
- ◯ Yes, we employed dedicated staff with implementation duties

- ◯ Yes, we created explicit incentives for research staff to engage in implementation interventions
- ◯ No investment of resources in implementation interventions

Yes, other: (please list)

11. Did you invest non-financial resources specifically into implementation interventions to implement thefindings of your trial? *(e.g. volunteer support, use of equipment/facilities, access to protocols)*

- ◯ No investment of non-financial resources into implementation interventions
- ◯ Yes

Please indicate the type of non-financial resources you provided:

Implementation of the intervention

12. Thinking about the implementation (or lack) of your study findings in the time since the trial was completed, would you *design your study interventions differently*?

- ◯ No
- ◯ Don't know / Haven't considered it
- ◯ Yes

If yes, please specify:

13. Thinking about the implementation (or lack) of your study findings in the time since the trial was completed, would you *select different study outcomes?*

- ◯ No
- ◯ Don't know/ Haven't considered it
- ◯ Yes

If yes, please specify:

14. Thinking about the implementation (or lack) of your study findings in the time since the trial was completed, would you *select different time points*?

- ◯ No
- ◯ Don't know / Haven't considered it
- ◯ Yes

If yes, please specify:

15. Thinking about the implementation (or lack) of your study findings in the time since the trial was completed, would you *alter how you reported / disseminated the findings?*

- ◯ No
- ◯ Don't know / Haven't considered it
- ◯ Yes

If yes, please specify:

16. Thinking about all implementation strategies, are there additional strategies you wish you had used?

APPENDIX F: CODE BOOK FOR STUDY THREE

Appendix Table 3. Theoretical Domains Framework codebook for upper limb rehabilitation stroke guidelines

TDF Domain	Construct	Guidance/rule	Classified Quotes
Knowledge An awareness of the existence of something *What do they know and how does that influence what they do?* *Clinician knowledge of upper limb rehabilitation CPGs*	Knowledge (including knowledge of condition/scientific rationale): *An awareness of the existence of something* Procedural knowledge: *Knowing how to do something* Knowledge of task environment: *Knowledge of the social and material context in which a task is undertaken*	Appropriate coding to this domain: Knowledge/Lack of knowledge of: ▪ Nature of post-stroke arm/hand impairment ▪ Scientific rationale for arm/hand rehabilitation ▪ Clinical practice guidelines ▪ Procedure of arm/hand rehabilitation ▪ Equipment and materials needed ▪ Anecdotal evidence related to upper limb rehabilitation & component interventions	"I think that's something we've recognised is a practice that both OT and physio can - that's the focus we've chosen for this year (UL rehab), so I think it is a realisation that we need to improve in that area" "Are the clinicians themselves aware that they don't know how to do [UL rehab]? Yeah, quite often at the moment it's the grade 1 clinicians but it doesn't have to be, it can be a 2 or 3 that's used to working in burns and amputees that have got stroke patients on their wards and are less familiar with the UL guidelines to be able to administer it" "I would say I'm very frustrated that we don't spend enough time of upper limb. So even if we haven't given up on the UL, it's not that we've stopped treating it completely. It might be that were touching base with it now and then, but its nowhere near enough for it to

TDF Domain	Construct	Guidance/rule	Classified Quotes
		(CIMT, Mirror Therapy, Mental Imagery, Task-specific Motor Training, Robotics) *Inappropriate coding to this domain:* ▪ *Discussion of who provides arm/hand rehabilitation (code to Social Professional Role and Identity)*	make a change" [KNOWLEDGE OF GUIDELINE RECOMMENDATION] "I guess it's hard - actual PDs - like when I started this rotation the upper limb course was provided at the end of last year and it's not happening until the end of this year, so I guess external PDs that would be really helpful for me probably won't happen within my rotation." "I've been told that I can't go to courses before because of staffing reasons, so you have patients that you potentially can't give upper limb rehab to because you haven't had the experience. You also can't necessarily see all of your 12 patients in that day because of staffing. Then you're told that you can't do any more PD because of that same reason. It can be a bit of a kick in the face." "UL group was started after the identification of not enough therapy [being provided to patients in line with guidelines]"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"Yep and we went to the Stroke Conference in Canberra. One of the other physios and I where they were talking about this high rep group. So it started from that, but it evolved to not just the sit-to-stands rep group, but to incorporate - because we - yeah - could see that identification for the need of more and the collaborative nature as well, I think we really thought that, that was quite useful" I think a barrier - for me personally - I haven't had any training in e-stim. So I don't feel confident. I wouldn't put it on someone just because I don't have that background for those, which is a barrier for using it. "So it all sort of stemmed from - so we've got two students from Monash Uni, who were doing a bit of a research project here." IRS – "GOLD STANDARD" comment and listening to a masters students project Canberra PD

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"I've attended another PD session around evidence-based management of the hemiplegic upper limb. So those have helped me – just sort of like remind you what you should be doing" "I've actually moved away from doing that impairment level and I have moved more towards the motor assessment scale and other functional [assessments] – and that has been a big change. But that was because I was exposed to this other PD opportunity, I think" "I went to that Annie McCluskey and Karl Schurr workshop and that was just three days of awesomeness [laughs]. I really believe from what they presented to me and I have that workbook. I have it at my desk and I refer to it if I have a patient that's appropriate for specific things, I will read that and use that" "But yeah, basically I think the main issue has been like that what helps people get on board is that education to people learning. So I guess more in-services, that sort of stuff, tends to help people get on

TDF Domain	Construct	Guidance/rule	Classified Quotes
			board or at least the awareness of it. I think it at Rosebud, it's a smaller team so it's easier to get things implemented. But definitely that like, yeah, in-service type stuff helps people get on board." "Physio, we have Neuro Australia in-services four times a year, which depending on what the topic is, can be education based on something. It's not always. It's not until I go to a conference or somewhere, where I'm like, you must read this. It's amazing. It changes it." "National Stroke - yeah - went to that in Sydney. I don't know if there's one on the Gold Coast this year. Yeah, that was good We've also started a journal club in physio, but yeah it's probably the first time we'll be running it this year. It's a start." "certainly the course I did here recently opened my eyes to the realistic dosages that need to be achieved"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			“Yeah, but again, most recent research says amount of practice isn’t the key” “need rehab knowledgeable nursing staff” “the level of knowledge here is actually quite low or they don’t even understand the reasoning why it has been applied, even the reasoning behind positioning to prevent further injuries or pain” “Yeah, in in-patient rehab I definitely was a lot more - and because you also knew the progression, like you might have a flaccid upper limb and then you know it's going to develop. You might have tone. That sort of thing. You sort of know the route it's going to go down. But now you sort of - someone will be - you don't know how long down the track they've been or what treatment they've been having. Yeah, so it can be - yeah, definitely don't have as much confidence as I used to”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"And so it could be that the current research says volume by itself isn't sufficient. So it's more nuanced than that" [re: interpreting of the guidelines] "But that's tricky because once again we go back to the National Stroke Foundation Guidelines and they don't give much guidance about that [contracture]" "Evidence throughout conversation that clinicians were misunderstanding the meaning of task specific functional re-training." "[areas of difficulty include] Splinting. Even though it's not a lot of evidence to support it in Australia at the moment"
Skills An ability or proficiency acquired through practice	Skills development: *The gradual acquisition or advancement through progressive stages of an ability or proficiency acquired through training*	Appropriate coding to this domain: ▪ Development of arm/hand rehabilitation skills ▪ Competence and ability in	"The difficulties were motivating the patients during the sessions. I think they often the repetitive tasking in itself a boring task and if they don't have maybe the concentration of us or the understanding of why they're doing the task they would often stop performing it"[skills in being able to motivate]

TDF Domain	Construct	Guidance/rule	Classified Quotes
	and practice Competence: *One's repertoire of skills, and ability especially as it is applied to a task or set of tasks* Ability: *Competence or capacity to perform a physical or mental act. Ability may be either unlearned or acquired by education and practice* Interpersonal skills: *An aptitude enabling a person to carry on effective relationships with others, such as an ability to cooperate, to assume appropriate social responsibilities or to exhibit adequate flexibility* Practice: *Repetition of an*	arm/hand rehabilitation ▪ Practice of arm/hand rehabilitation skills ▪ Evaluation of quality of arm/hand rehabilitation practices ▪ Discussion of how relationship/rapport between clinician and patient may promote use of arm/hand rehabilitation *Inappropriate coding to this domain:* ▪ *How clinicians feel about current skill level (Code to Emotion)*	"Understanding when to progress and regress became a bit of a skill. When I was a new grad I didn't have the confidence I would have now to change an exercise to actually challenge the patient correctly" "Increasing my own competence as an experienced clinician I don't feel like I have had that exposure regularly enough to build my confidence and competence" "the course I guess was great, but then you have to be able to have that exposure to go and practice and learn and repeat it regularly enough to be someone who becomes an expert in delivering that" "I haven't done it often enough recently and I haven't got the practical skill of doing it regularly to be able to administer it and feel really confident that I've actually done a good program and this person is going to benefit from it"

TDF Domain	Construct	Guidance/rule	Classified Quotes
	act, behaviour, or series of activities, often to improve performance or acquire a skill Skills assessment: *A judgment of the quality, worth, importance. Level or value of an ability or proficiency acquired through training and practice*		"It doesn't mean that just because I am a grade 4 that I'm highly competent in delivering FES, that the grade 1 actually might be much better at it because she's been doing it every day for the last 6 months" "But I do feel that when our grade 1's leave, they don't have a bag of tricks for upper limbs because we don't spend much time on them, yep" "It's mainly though, just practice and having other people teach me when I was a junior and up-and-coming" "for me it's more exposure and having the right patients to come in to – exposure on our wards" "I just think that patient experiences is what consolidates your skills, so you could go to a course but you still wouldn't be confident in providing the therapy...unless I had a number of patients that I had to provide the therapy for and saw their outcomes and had feedback from other physios"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"you just feel a bit rusty, because it's not something we're doing all the time, because I know - let's say that both of us who are working with him have worked for a long time, but we still were both like, we better just… Just check and make sure everything is covered. Because you're not doing it regularly so you feel a bit rustier, yeah " "My role is less direct contact, but I guess training staff around some of this stuff and I think we target them more – the areas with more evidence around the estim and task specific retraining first – perhaps" "…then I guess it depends on where you work [in relation to training you receive for UL rehab]". "I think as well some of the intensity of e-stim as well could be progressed, but perhaps we need to increase our competency in how to progress" "If I don't have the experience in it, I think I've got the knowledge to know what's available out there and try

TDF Domain	Construct	Guidance/rule	Classified Quotes
			and seek someone who is experienced in it as a resource to support me to deliver it" "I do find the task specific training can be really hard when there's just nothing there though...and just trying to get any movement at all" "…as a student we have a lot of practice in terms of task analysis and then setting up exercises and repetitive task practice…" "I guess constraint-induced movement therapy, I really don't have a lot of experience with" "Yeah, that tends to be useful and then maybe reading about it or calling someone who may be doing it more like a senior or something just double checking or practicing on a therapist." "I think probably what would be of benefit is training around coaching, so actually learning to be a good coach [to patients]"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"Do you think patients respond well to that coaching? Do you think that you get more out of them when you actively coach throughout a session than whether you - yeah - getting nods" Response "Yep, I definitely think so." "so when you say believe the evidence, I believe the evidence. It's just how I put it into practice with an individual, is where I guess I need to do that in practice to know that the evidence (intervention) is going to work with that individual, that person, that type of impairment. But I would always push hard on that" "I guess constraint-induced movement therapy, I really don't have a lot of experience with" "you just feel a bit rusty, because it's not something we're doing all the time, because I know - let's say that both of us who are working with him have worked for a long time, but we still were both like, we better just… Just check and make sure everything is covered.

TDF Domain	Construct	Guidance/rule	Classified Quotes
			Because you're not doing it regularly so you feel a bit rustier, yeah” “I think there is a lot of education required, to other staff [for CIMT]” I think a barrier - for me personally - I haven't had any training in e-stim. So I don't feel confident. I wouldn't put it on someone just because I don't have that background for those, which is a barrier for using it.” “But from an organisation perspective, OTs only really quite recently became a bit more formally involved in e-stim, so with their CPGs and things like that, around OTs being more involved in it, I think it was probably only in the last 2 years maybe. And a lot of work went into that, so it has historically just been a physio domain and we didn't have any OTs trained or assessed on competencies and how to use them. The numbers of staff from an OT perspective, who are trained is very low across the board, so they're doing some work on that now. But I certainly wouldn't be alone in saying…I haven't been trained. I don't feel comfortable using it”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"If I don't have the experience in it, I think I've got the knowledge to know what's available out there and try and seek someone who is experienced in it as a resource to support me to deliver it" "It's mainly though, just practice and having other people teach me when I was a junior and up-and-coming" "There is a good set up in terms of every grade 1 has a grade 2 or 3 physio. So if it was required, it would be able to be upskilled on the spot" "for me it's just more observing and getting support from seniors and supervisors" "observing other people and picking up new ideas and getting other people's experiences definitely helps" When I was in my earlier days, I'd practice on another Grade 1 or I'd get my supervisor and we'd do it in our supervision sessions, so that helps.

TDF Domain	Construct	Guidance/rule	Classified Quotes
			I always feel like there's someone there. You can just pick up the phone and say… can I just talk through this patient with you? What are your thoughts? Come over and help me "But then there's the question, do we comply sufficiently with giving enough amount of practice, enough e-stims…" I would say that [the provision of UL rehab] in very inconsistent and clinician dependent" "I am aware of them, not specifically [recommendations] for all upper limb" "I think it's really dependent on what resources you have available to you as well. I know personally I've been lucky to work at places where we've just had amazing upper limb resources, like for example I remember at one place we had a Connect 4 kit and we could do upper limb therapy with Connect 4 with clients"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			“constraint-induced movement therapy, which I started with someone the other day, that I know the research isn't amazing, but it can be useful or helpful. I don't think I remember everything like what's mandatory and what's not” “One of the key components about being capable in upper limb rehab is around seeing patients regularly” “the course I guess was great, but then you have to be able to have that exposure to go and practice and learn and repeat it regularly enough to be someone who becomes an expert in delivering that” “I just think that patient experiences is what consolidates your skills, so you could go to a course but you still wouldn’t be confident in providing the therapy” “I know what’s meant to happen with the patient, but in terms of setting up parameters and really giving the

TDF Domain	Construct	Guidance/rule	Classified Quotes
			encouragement and guidelines, I don't think I was, I don't think I was good enough"
Social/professional role and identity A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting *How does who they are as an occupational clinician or physiotherapist*	Professional identity: *The characteristics by which an individual is recognised relating to, connected with or befitting a particular profession* Professional role: *The behaviour considered appropriate for a particular kind of work or social position* Social identity: *The set of behavioural or personal characteristics by which an individual is recognizable [and portrays]*	Appropriate coding to this domain: ▪ Who provides arm/hand rehabilitation ▪ Link between profession and tasks of arm/hand rehabilitation ▪ Boundaries between clinicians in providing arm/hand rehabilitation ▪ Organisational commitment	"Here at [site name], we are expected to provide e-stim – a hundred percent" "The likelihood of me using an intervention is somewhat overseen by the expectation of the organisation" "patients were coming to that organisation with that expectation and that's what we were expected to provide [CIMT]" "I don't think physios are very good at the objective measures for UL. We tend to leave that to you guys [OT's]. We're more impairment based and observation function and normal movement, rather than the objectivity assess/reassess"

TDF Domain	Construct	Guidance/rule	Classified Quotes
influence whether they do something or not?	*as a member of a social group* Identity: *An individual's sense of self defined by a) a set of physical and psychological characteristics that is not wholly shared with any other person and b) a range of social and interpersonal affiliations (e.g., ethnicity) and social roles.* Professional boundaries: *The bounds or limits relating to, or connected with a particular profession or calling* Professional confidence: *an individual's belief in his or her repertoire of skills and ability especially as it is*		"I think it is quite siloed at the moment in terms of rehab, that the upper limb work is done over in the OT department and there is upper limb work going on in the gym, but we don't probably see what each other is doing very much"

TDF Domain	Construct	Guidance/rule	Classified Quotes
	applied to a task or set of tasks. Group identity: *the set of behavioural or personal characteristics by which an individual is recognizable [and portrays] as a member of a group* Leadership: *The processes involved in leading others, including organising, directing, coordinating and motivating their efforts toward achievement of certain group or organization goals* Organizational commitment: *An employee's dedication to an organisation and wish to remain part of it.*		
		Appropriate coding to this	

TDF Domain	Construct	Guidance/rule	Classified Quotes
Beliefs about capabilities Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use	Self-confidence: *Self-assurance or trust in one's own abilities, capabilities and judgement* Perceived competence: *An individual's belief in their ability to learn and execute skills* Self-efficacy: *An individual's capacity to act effectively to bring about desired results, as perceived by the individual* Perceived behavioural control*: an individual's perception of the ease or difficulty of performing the behaviour of interest* Beliefs: *The thing believed; the proposition/set of propositions held true* Self-esteem: *The degree to*	domain: ▪ Perceived behavioural control in delivery of arm/hand rehabilitation ▪ Clinician confidence in delivering arm/hand rehabilitation ▪ How easy or difficult clinicians view delivery of arm/hand rehabilitation ▪ Self-efficacy and beliefs regarding arm/hand rehabilitation *Inappropriate coding to this domain:* ▪ *Expectations of outcomes of using arm/hand rehabilitation (code to Beliefs about consequences)*	"I rarely go towards the mirror therapy or the mental practice, because there is less evidence. Again, its bout my time that I have but also somewhat to what the patient responds to"

TDF Domain	Construct	Guidance/rule	Classified Quotes
	which the qualities and characteristics contained in one's self-concept are perceived to be positive Empowerment: *The promotion of the skills, knowledge and confidence necessary to take great control of one's life as in certain educational or social schemes; the delegation of increase decision-making powers to individuals or groups in a society or organization* Professional confidence*: An individual's beliefs in his or her repertoire of skills, and ability, especially as it is applied to a task or set of tasks.*		

TDF Domain	Construct	Guidance/rule	Classified Quotes
Optimism The confidence that things will happen for the best or that desired goals will be attained	Optimism: *The attitude that outcomes will be positive and that people's wishes or aims will be ultimately fulfilled* Pessimism: *The attitude that things will go wrong and that people's wishes or aims are unlikely to be fulfilled* Unrealistic optimism: *the inert tendency for humans to over-rate their own abilities and chances of positive outcomes compared to those of other people*	Appropriate coding to this domain: ▪ Clinician discussion of optimism or pessimism related to use of arm/hand rehabilitation ▪ Positive or negative view towards process of change in study *Inappropriate coding to this domain:* *Feeling of anxiety, stress or burnout (code to Emotion)*	"you read a study and it's the 50 to 70 year olds included in this study, the classic group. Is that going to do anything good for me? But at the same time, you see something, you see amazing outcomes and it might have been that group and you think, God they did so well, we better give it a go. You've got to just see the work, even though there's some elements of this study that you think doesn't necessarily fit who I'm working with, but gee it did so well. We've got to at least try." "medical staff as well and nursing staff. The number of times I've heard staff say to a client, oh look, there's nothing much to be done about [your hand]" "Happens all the time. It's a massive barrier" "I think I used to [patients plateaued], but I think the evidence is changing, so my perceptions have changed now… people with ABI are still making functional improvements in their upper limb a long time in, and we know that with stroke as well".

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"It depends on their motivation as well, I think, or their expectations. If it's something they prioritise or they think they're going to get quite a few gains in their function, then they're probably much happier to sit and work on their upper limb, versus, as you said, if they've got quite a flaccid or a non-functional upper limb, they've not got much activity there, they're just [unclear] doing anything"
Beliefs about consequences Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation	Beliefs: *The thing believed; the proposition or set of propositions held true* Outcome expectancies: *Cognitive, emotional, behavioural, and affective outcomes that are assumed to be associated with future or intended behaviour. These assumed outcomes can either promote or inhibit future*	Appropriate coding to this domain: ▪ Positive or negative expectancies of use of arm/hand rehabilitation ▪ Beliefs regarding treatment outcomes ▪ Potential long-term outcomes for patients ▪ Anticipated regret in not using arm/hand rehabilitation	"the task specific stuff that we do practice, it tends to work, because the patient is motivated because they're working towards a goal that they want." "I think when someone has got a goal, when you're being more goal focused on that task, they are more motivated to do those things, rather than just say adjunctive exercises, so I do think it works and I've seen some of that work" "But again, that [patient] motivation might be a little harder [in a patient with no active movement of UL]

TDF Domain	Construct	Guidance/rule	Classified Quotes
	behaviours. Characteristics of outcome expectancies: *Characteristics of the cognitive, emotional and behavioural outcomes that individuals believe are associated with future or intended behaviours and that are believed to either promote or inhibit these behaviours. These include whether they are sanctions/rewards, proximal/distal, valued/not valued, probable/improbable. Salient/not salient, perceived risks or threats.* Anticipated regret: *A sense of the potential negative consequences of a decision*	*Inappropriate coding to this domain:* *Beliefs about whether clinicians can provide arm/hand rehabilitation (code to Beliefs about Capabilities)*	and sometimes when you've got cognitively impaired patients, in combination with that adds another layer of complexity and difficulty." "if they're so far down the line and you've come in as a new therapist and you say you want to try this, and they're a bit like, 10 years down the line what are you talking about?" "Increasing my own competence as an experienced clinician I don't feel like I have had that exposure regularly enough to build my confidence and competence" "..because if my patient's questioning me or if I have to explain why I want them to do something, I might not be willing to do it if I didn't feel like I could confidently provide that therapy for them" I'm probably not that comfortable. Purely that's through lack of experience because previous services I've worked on have been very cognitive behavioural

TDF Domain	Construct	Guidance/rule	Classified Quotes
	that influences the choice made: for example an individual may decide not to make an investment because of the feelings associated with an imagined loss Consequents: *An outcome behaviour in a given situation*		focused and we didn't do the physical work, so it's only recently - so I guess I - did I avoid it? Possibly I did avoid patients like that" "I suppose it's - in a way I'm more comfortable with the proximal - so a little bit of the [skeleton] thoracic stuff in the shoulder rather than the fine motor tasks." "E-stim - like I think you've helped me with e-stim for shoulder, but still [distally], yeah, I would like to improve my confidence in e-stim" "I was put into a role where the project was to implement e-stim….so I learnt the ins and outs of it really….[I] had that expectation that [I] needed to know what [I] was doing, because [I] was training others. So I think that's how I became confident in e-stim myself" "So probably a lot more e-stim and task-specific [retraining]. Its probably what I am more confident with"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"I feel confident with e-stim and the functional retraining. The one hour is something I would always focus on, but it's hard to necessarily achieve it with your patients. Then constraint-induced therapy, I am confident with what I would be looking for in a client - if they were appropriate - and then I would have to review the guidelines about how long they should be wearing it for - be restrained for" "I'm comfortable with them all [mandatory recommendations]" "How confident are you that you would pick up a problem in an upper limb if you were looking at a patient?...pretty confident" Not always. Again, depending on what they've got to start with is - for me - always the - when it's the - again. I feel fine. When we've got something to work with, no worries. When I've got nothing to work with, that's where I think, how am I going to get started?

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"I think movement problems is easier to pick up than sensation - definitely. I feel like movement problems is a little bit easier, because you can see it. It's right there. But then in terms of what you know the patient may or may not feel or where or how tiny monofilament can you get? Those sorts of things, I find I wouldn't be confident that I have a hundred per cent accuracy with that at all. Yeah, definitely not that." "No, [I don't feel that I am good] at setting up an upper limb training program" "I know what's meant to happen with the patient, but in terms of setting up parameters and really giving the encouragement and guidelines, I don't think I was, I don't think I was good enough" "I also probably need to be seeing patients more regularly in order to feel really confident that I'm doing it well"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"I think CIMT, there is quite a lot to learn to apply it correctly and probably the knowledge isn't there to be able to apply it to the standards that it should, to enable it to be effective. So I think that plays a role in why maybe I wouldn't consider it"
Reinforcement Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Rewards (proximal/distal, valued/ not valued, probable/improbable): *Return or recompense made to, or received by a person contingent on some performance.* Incentives: *An external stimulus, such as condition or object, that enhances or serves as a motive for behaviour* Punishment: *The process in which the relationship between as response and some stimulus*	Appropriate coding to this domain: ▪ Rewards or incentives for using arm/hand rehabilitation ▪ Perceived punishments, consequents, reinforcements, contingencies, sanctions related to arm/hand rehabilitation *Inappropriate coding to this domain:* *Opportunities to reinforce or consolidate skills in arm/hand rehabilitation, code to Skills*	"But when I do remember to do it, the patient always comments. It's really nice to compare the numbers and get that feedback" "for that reason, I wish I did it more frequently". "[Unclear] baseline and show progression, but also it does assist funding having outcome measures." "I think for the patients as well. I think a lot of the time you can show them objectively something is changing [unclear]. So it's always worth having it there" "I think though as well is that the patients also need to kind of have it reinforced a little bit as well as to why they're doing - why we're asking them to do particular things because I have had clients say, if I'd have known

TDF Domain	Construct	Guidance/rule	Classified Quotes
	or circumstance results in the response becoming less probable; a painful, unwanted or undesired event or circumstance imposed as a penalty on a wrongdoer Consequents: *An outcome of behaviour in a given situation* Reinforcement: *A process in which the frequency of a response is increased by a dependent relationship or contingency with a stimulus* Contingencies: *A conditional probabilistic relation between two events. Contingencies may be arranged via dependencies or they may emerge by accident*	*instead (Construct: Practice/Skill development)*	the consequences then I would've done this a lot sooner."e"

TDF Domain	Construct	Guidance/rule	Classified Quotes
	Sanctions: *A punishment or other coercive measure, usually administered by a recognized authority, that is used to penalise and deter inappropriate or unauthorized actions.*		
Intentions A conscious decision to perform a behaviour or a resolve to act in a certain way	Stability of intentions: *ability of one's resolve to remain in spite of disturbing influences* Stages of Change model*: A model that proposes that behaviour change is accomplished through five specific stages* Transtheoretical model and stages of change: *a five-stage theory to explain changes in people's health*	Appropriate coding to this domain: ▪ Discussion of how motivated/unmotivated clinicians are to provide arm/hand rehabilitation ▪ Description of inclination to use arm/hand rehabilitation and in what situation ▪ Stability of intentions regarding arm/hand rehabilitation, stages of change model, transtheoretical model	"I do feel in physio, upper limb takes a backseat to lower limb and functional walking goals". "The patient wants to work on walking in physio and in OT they want to work on their upper limb" "if the person says to me my upper limb is not as important as being able to wash and dress myself, then I'm going to prioritise their goals for them" "sometimes they don't want to work on their arm, they just see that they want to be able to walk and that's what they - their priority is even though we educate them about things"

TDF Domain	Construct	Guidance/rule	Classified Quotes
	behaviour. It suggests that change takes time, that different interventions are effective at different stages, and that there are multiple outcomes occurring across the stages	and stages of change *Inappropriate coding to this domain:* *Practical plans to use arm/hand rehabilitation (code to Goals instead)*	and maybe this is just my physio hat on - sometimes it's the, I want to get walking… more, because that's what's going to get me - maybe - home. So the focus drops off a little bit on arm. It becomes a bit more just, I just want to walk first and then I'll deal with it. "Some patients will only want to walk. That's what they think you're there for. That's all they want to do. So lots of patient and family education and just trying to work with what you can" "But reading a [journal article] is not enough. You have to agree and be comfortable that you need to change"
Goals Mental representations of outcomes or end states that an	<u>Goals (distal/proximal):</u> *Desired state of affairs of a person or system, these may be closer (proximal) or further away (distal)* <u>Goal priority</u>*: Order of*	Appropriate coding to this domain: ▪ Goal priority, action planning and implementation intention related to arm/hand rehabilitation	"…and we know the pushes to get patients up and on their feet and out the door, so our priorities are a bit different as physios, in terms of upper limb" "so from a time perspective, we are probably spending a lot more time getting people up on their feet and not enough time on arms"

TDF Domain	Construct	Guidance/rule	Classified Quotes
individual wants to achieve	*importance or urgency of end state toward which one is striving* Goal/target setting: *A process that establishes specific time based behavioural targets that are measureable, achievable and realistic* Goals (autonomous/controlled): *The end state toward which one is striving: the purpose of an activity or endeavour. It can be identified by observing that a person ceases or changes their behaviour upon attaining this state; proficiency in a task to be achieved within a set period of time.* Action planning: *The action*	▪ Description of whether or not providing arm/hand rehabilitation is a priority ▪ Practical plans to apply arm/hand rehabilitation or not *Inappropriate coding to this domain:* *Discussion of readiness to change behaviour in arm/hand rehabilitation (Code to Intentions instead)*	"so I think that's an area that maybe isn't as much of a focus, in terms of the outcomes of rehab program that walking is" "when walking is a bit better then we get more time to spend on the arm, but perhaps have missed the vital time when we should have been working on the arm…" "physically, I don't have time to do everything" "It depends on what the balance was between their goal and what was going to get them home fast an what was better for them as a whole person. So some might get no upper limb – yeah – so just depends on the individual patient" "we need to address a whole heap of other issues that I guess we've prioritised as higher, that the arm comes later – that it is neglected"

TDF Domain	Construct	Guidance/rule	Classified Quotes
	or process of forming a plan regarding a thing to be done or a deed <u>Implementation intention:</u> *The plan that one creates in advance of when, where an how one will enact a behaviour*		"yeah, because like I've said from the start, the priority is often to get home and often to get walking" "Yes [we would set upper limb goals with patients] but I think they are single discipline [goals] at the moment" "I think it is a little but siloed at the moment. I don't think that there is probably enough joint goal setting to know what other people are doing" "How does your rehab fit with the rehab being performed by other allied health clinicians and the rehab, or the education, that you're giving families?" response "Not great" "I don't think it's all very well" "So I think lots of different things we've tried to implement, whether it's timetabling, whether it's this new therapy group, all those sorts of things, It's so challenging to get buy in and to make it, well this is the way that we do it now, everyone get on board. There's

TDF Domain	Construct	Guidance/rule	Classified Quotes
			always barriers and we're always coming against resistance to that change" "I guess we've got the other aspects that we are needing to provide in terms of discharge planning, looking at their functional goals as well" "as an OT I didn't even - I wouldn't be able to do upper-limb therapy because I was so busy getting ramps built and getting wheelchairs hired that - and that's because that was more of a higher level, this is - this person's got to go and it doesn't matter if they can't do anything else"
Memory, attention and decision processes The ability to retain information, focus selectively on aspects and choose	Memory: *The ability to retain information or a representation of a past experience, based on the mental processes of learning or encoding retention across some interval of time, and*	Appropriate coding to this domain: ▪ Retaining information on how to deliver arm/hand rehabilitation ▪ Deciding between the use of different arm/hand	"I think we learnt it all and we do know what the guidelines are, but it's just that constant reminder that you need to continue to put it into practice" "It's probably my own clinical reasoning that I decide which I think are most important to take on" "I take what I need from them, and then apply them as

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between two or more alternatives	*retrieval or reactivation of the memory; specific information of a specific task* Attention*: A state of awareness in which the senses are focused selectively on aspects of the environment and the central nervous system is in a state of readiness to respond to stimuli* Attention control: *The extent to which a person can concentrate on relevant cues and ignore all irrelevant cues in a given situation* Decision making: *The cognitive process of choosing between two or more alternatives, ranging*	assessments ▪ Cognitive overload/fatigue related to delivering arm/hand rehabilitation *Inappropriate coding to this domain:* *Discussion of system pressures that impact on decisions to use arm/hand rehabilitation (Code to Environmental Context and Resources: e.g. Environmental Stressors)*	intensively as I think it should be" "Yep. I'm hearing that coaching is really important, so that constant reminding someone" "… within this organisation we probably rely a little bit on clinical experience… This therapist works here. We'll ask her [laughs]…" "taking photos of it or putting pictures up to – you know, because sometimes it can be easy to forget what [they're] supposed to do" "my impression in [HOSPITAL] is that they [UL standardised assessment] are perhaps not being done as routinely as would be beneficial" "I think where I fall down is not remembering to do formal assessments repeatedly through patient stays" "I don't think we do it very well" [REMEMBERING TO USE STANDARDISED MEASURES]

TDF Domain	Construct	Guidance/rule	Classified Quotes
	from the relatively clear-cut to the complex <u>Cognitive overload/tiredness:</u> *The situation in which the demands placed on a person by mental work are greater than a person's mental abilities*		"I've come back into doing some upper limb having had quite a big break from doing it, so yeah, I'm definitely referring to the manuals and the policies that we have within the department" "I have pictures… yeah, even in a book so you can see if you're doing a shoulder where to put them or if you're doing it, down. Yeah, so I find pictures in a manual quite helpful and I got that manual a long time ago, so I just keep it with me." "access to resources – the cheat sheets - the e-stim cheat sheets on positioning, for example...they're good" [REMINDERS USED] "I'm a visual person, so I find the videos helpful" "I often find the patient finds it difficult, because it's hard to focus on that…fatigue impacts them massively…" "15, 20 minutes and then falling asleep. and they're

TDF Domain	Construct	Guidance/rule	Classified Quotes
			done for the day" [OLDER PATIENTS]
Environmental context and Resources Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour	Environmental stressors: *External factors in the environment that cause stress* *Resources/material resources: Commodities and human resources used in enacting a behaviour* Organizational culture/climate: *A distinctive pattern of thought and behaviour shared by members of the same organization and reflected in their language, values, attitudes, beliefs and customs* Salient events/critical incidents: *Occurrences that*	Appropriate coding to this domain: ▪ Availability of equipment to deliver arm/hand rehabilitation ▪ Setting in which arm/hand rehabilitation will be delivered ▪ Organisational culture/climate, impacting on delivery of arm/hand rehabilitation ▪ Description of how more time will be required to deliver arm/hand rehabilitation ▪ Patient factors that would influence whether arm/hand rehabilitation was offered or	"I would say I'm very frustrated that we don't spend enough time of upper limb. So even if we haven't given up on the UL, it's not that we've stopped treating it completely. It might be that were touching base with it now and then, but its nowhere near enough for it to make a change" " I think a large factor is culture. This is the way we've always done it, so this is the way we're always going to do it. You feel like you're bashing your head against the wall sometimes, when you try to introduce something new...There's always barriers and we're always coming against resistance to that change" "In the gym environment if there are other patients being seen then a lot of the clients would get distracted, their attention would be drawn away from what they are doing. So there are pros and cons"

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	one judges to be distinctive, prominent or otherwise significant Person x environment interaction: *Interplay between the individual and their surroundings* Barriers and facilitators: *In psychological contexts, barriers/facilitators are mental, emotional or behavioural limitations/strengths in individuals or groups*	provided	"The place where the upper limb group is on the ward is actually a dining room, so there's no other cues around that it is for upper limb or any other - it doesn't look like a gym and the table in there are from people to eat from, they're not necessarily suitable for patients in wheelchairs, if we have a few - even two or three in a wheelchair in the room it can become an entire - you have to re-arrange people to get other people in and then the tables don't work because of the arm rests. So it can be logistics - you can spend potentially up to half the session trying to actually sort everything out so that people are in the right position to work, and then you've lost of a lot of your time." "but we just absolutely don't have any space on Rehab B [for rehab]" "the ward space on rehab B is – yea – awful too – overcrowded and there's risks involved in treating patients on the ward" Well, you've got limited resources as well and time constraints et cetera, so you just have to try and make it work for your site or your patient at that time.

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			"Certainly in terms of getting a high number of people together and getting the dosages done, it [UL group] was effective I think" We do, here now [have an UL group]. That has been a reasonably new introduction, trying to help manage caseloads and increase the therapy and between us as well, a bit more collaboratively, which has been really good "but that group has really provided the time and the space to provide it." "If they're attending an arm and hand group, that would be 60 minutes, but that may not be me actually there providing that. So some days, it might not be any additional that I'm personally providing or it might be up to an extra hour, depending on their progress. But with the arm and hand group, there is a safety net I think"

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			" I guess I feel worried that if I don't have all the details there of how to progress them during that arm and hand group, that they won't get the [therapy] plan I had" "The downside is - hopefully you'll back me up on this - is that I think it could be that then staff can say, ah, well that person's receiving their input in that setting…that's all that is needed" "Like you've got the upper-limb group, you're pushed for time, you may not do that extra maybe one-on-one session with someone because you just don't have the time to go and do it." "If my patient was in the gym doing upper limb [rehab with family/AHA] I would be watching what they were doing. I'd be going over and check it out, and encouraging" "because we don't have an upper limb group and we actually don't have an OT space at all. We don't have one space where we can take a patient, so it always has

TDF Domain	Construct	Guidance/rule	Classified Quotes
			to be at the bedside. So I'm having to constantly swap between giving this patient this equipment to do at their bedside and then quickly taking it back and giving it to this other patient and cleaning it in the meantime” “over bed tables rarely actually fit over a wheelchair and its really difficult to get a workspace for a patient to work on their own in their room” “but we just absolutely don’t have any space on Rehab B [for rehab]” “the ward space on rehab B is – yea – awful too – overcrowded and there’s risks involved in treating patients on the ward” “The therapy space is so separate. It’s like therapy versus ward” “I do wonder about that end part of the session as well, where you wheel them [patient] back to their room and if they did want to stay and they could do more self-practice, could you leave them in an area semi-supervised, to continue if they had capacity?”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			Some enriched environment stuff, just having that environment set up, so that is accessible “from lots of studies that have had huge amounts of time - scarily huge amounts of time - 75 per cent of the time, people are sitting in their room, inactive and alone. That just makes me go, oh God. If that was my family, the last place I'd want them to be is in a rehab unit. That's awful. So that was able to support that [unclear] in the room, or they're in bed or they're not doing a great deal, which is not a nice feeling for us as therapists, but unfortunately that's the situation we've got. So they're looking at trying to set the environment up so that it enables people and families to be able to engage in something outside of therapy times” it would be really lovely to have stuff where people can, after hours, take their loved ones, say, look let's do some just in case - say…something. Yes – anything. In a sense, anything can be therapy outside of the therapist's time”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			“I wonder about the whole concept of enriched environments as well and about whether you - just thinking - I don't work on the ward, but whether for example on the ward is there an area that's upper-limb focused and people can go and do some stuff there in their own time sort of thing, for example. Or other kind of concepts like that - just something I'm wondering about about how easy we make it for people to do these things” “The groups I think are a nice way of having access to the allied health assistants as well, and family members of the ward as well. If they’re heavily involved it makes everything so much easier” “There is a large number of people that could benefit from the group and it starting to get quite full, so frequency could be morning and an afternoon session just to increase that intensity”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			“I think sometimes if there are staffing issues [AHA’s] are used instead of the OT [for UL therapy]” “ There's not as many staff members and when someone's away, you feel a lot. That person's absence is much more missed and parts of another side, I'm not sure. But yeah, getting one hour for patients a day, say with the therapist or even with an OTA, can be tough but definitely task specific retraining would be the highest one that we tend to do with those patients.” “in another site there was three OTs for 30 patients and now we're down to two. You make do. You do it and you get through, so maybe it's seen as getting by and managing it things like that really” “I was going to say, for us what helps is the OTA being available and having an OTA to follow up and we just write what our program was, the first day we did it and then hopefully they can do it every second or third day, when we don't see them for our therapy. That helps us

TDF Domain	Construct	Guidance/rule	Classified Quotes
			offer it more. But, yeah, we don't get times of that anyway at the moment” “I think having resources of OTA enables you to also do what you need to do. We don't get an OTA all the time and they're not full time.” “I think everyone in the hospital is so busy, at the moment we can’t see people every day, so we struggle to fit everything in” “It might be easy, but then the mental therapy, you’ve actually got to think of a script that they can do, so that’s a lot more time in preparation for them to implement” “It would be the time pressure and what you need to do in terms of discharge planning versus the amount of time you have for usually the upper-limb stuff would be once you sort out the other stuff. That's a big thing in inpatient. It's always aimed at discharge…”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			…you're not managing it as you should be. The therapy time is often the first thing to go, because you're ticking all these boxes [for patient discharge planning]. It's another thing you have to get through, so that would be interesting. “A hard aspect about that as well is again the 15 patients each, how long that you've got to spend to actually do it. “ “I guess we’ve got the other aspects that we are needing to provide in terms of discharge planning, looking at their functional goals as well” “definitely there are times when the pressure from the organisation is around getting people out and getting people home, they don’t care if [the patient] can’t use their arm to drink. As long as they can go home, that seems to be the priority”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			“when you say ticking boxes, are you talking mostly between the safety assessments and doing the reporting…” reply: “yes… Yeah, discharge plan - making sure they've got the equipment” “Sometimes too - even from a team perspective - to ask for the extra time for rehab, from an upper limb point of view. It's more the, well they're walking. They can speak. They can swallow. Get them out. “ “so there is equipment here and there are lots to use, but nothing that we as physios would set up to go to automatically” “Yeah I think there are sufficient resources within the OT department. We recently purchased some extra e-stims” “we don’t have clinical standards (internal) for what upper limb therapies and stuff should be being done”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"There are more resources in place for some of the guideline activities that other, is that correct? Yes, that's correct" "By having these resources in place they enable you to implement the guidelines easier because you don't have to make them up from scratch? Yep, that's right. Yep absolutely" "we often need more estim machines" "We don't have enough e-stims" "we have them, we just don't always have the access to them" [as they're in use] "Same with the GRASP kits, I don't think we've ever had any on the shelf" "we've got the GRASP manual. We don't have the resources for it, but we can put them together" (no made up kits)

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			No patient handouts / exercises on a shared drive. “No. I just create them for their own individual program” We only have one of everything as well, in terms of what people can use – equipment they can use for upper rehab. “ We don't even have an upper limb group, because we don't get enough strokes to have that regularly. But we have two or three at the moment and I'm going - because we don't have an upper limb group and we actually don't have an OT space at all. We don't have one space where we can take a patient, so it always has to be at the bedside. So I'm having to constantly swap between giving this patient this equipment to do at their bedside and then quickly taking it back and giving it to this other patient and cleaning it in the meantime. It's just difficult and then you have to say to them, on the weekend just try and share with that person there”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			“A big room, like a gym size type room, with (Seward et al.) so we can actually work on upper limb stuff that's not in the normal plane of movement, with gravity eliminated. That would be awesome and with balls and weights and exercise stuff and more than one of each item so more than one patient can use it. Yep, that would be great and little side rooms where you can do your OT apps type of stuff or more private type assessments, so cognitive type stuff would be amazing, yep.” “Another big enabler is family. It makes such a big difference to how much [the patient] gets and what can be provided [re: UL rehab]” “and family members on the ward as well. If they're heavily involved it makes everything so much easier” “I think there is untapped potential in nursing staff for inpatients [re: who should be doing UL therapy]

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"…in terms of patients' families and carers, from what I've found of handing over an upper limb program or I'm telling them what they can do with their patient, I'm finding patients' families are really on board and they really want to do anything they can to help. I think sometimes they're hesitant to help, because they're unaware. They're not sure - don't know what's going to happen." But I also think that they'd be more than - usually they're more than happy to help. Other times, there's one or two cases where they're like, oh it's just playing children's games, why would I want to do that? So I think in that case, you have to just adjust what you're doing to make it seem more adult to them, but - yeah "From an admission process patients with stroke are being allocated to a lot of different wards. So I think that's a challenge for some of the staff that aren't used to doing and delivering UL rehab, so the clinicians that are more experienced are being asked to go and consult on other wards and upskill people"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"Nursing staff of other wards aren't aware of the stroke guidelines, aren't aware of upper limb guidelines, so you do find patients who have been in their collar and cuff all day, despite trying to educate, because there is high staff turnover or people aren't aware" "So the resources and everything for the group are already in place, and my experience with the e-stim home programs and things that are there are home programs that are already templates. So that's fairly straightforward." "Yeah, I think I guess we'd be going from scratch in that we'd be going to the gym space and grabbing equipment from there. So there is equipment there and there are lots to use, but nothing that we as physios would set up automatically" There is a noticeable difference I think if you've worked in different teams or across different sides. I talk about this. The [OT] talks about this as well. We're having that dedicated, committed team who have

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			expertise and interest makes a phenomenal difference, compared to the team who maybe doesn't have those attributes but are still working… dedicated team makes a difference, yeah "I needed the buy in [from other staff] and I didn't get it, so the patient ended up only wearing a constraint mitten for 90mins a day and then only some lunchtimes, because it had to be me who enforced it. I didn't get the carryover from the patient or from staff, so it didn't work on the ward as well as the protocol states" "I guess, actually, it's probably the same as any other upper limb intervention. It's not really being followed through by nursing staff currently, so I guess were then asking for CIMT to be followed through" "yep, its not that culture of, rehab is 24/7" "I think with CIMT – I've done it at different workplaces and a lot of it is the culture and knowledge

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			of the staff….its their knowledge and their skills and confidence in carrying it through for that extended period of time that makes a big difference in its success as well” “If someone's wheeled into the speech session and their arm's up like this when it should be like something else then that would be great if the whole team - a team approach could be developed.” “You need that one person who's a real champion for it and they want to run with it, but then they're not here one day and it falls flat and you have to start fresh. So I think lots of different things we've tried to implement, whether it's timetabling, whether it's this new therapy group, all those sorts of things, It's so challenging to get buy in and to make it, well this is the way that we do it now, everyone get on board. “ I heard someone say the other day, persistence beats resistance

TDF Domain	Construct	Guidance/rule	Classified Quotes
			I think that's what it is here. It's kind of you've got to wear them down. we talk about [UL Group] every single morning after handover. Signs up in their rooms. But it's daily. It's every single day you're having to promote and whilst I just referred to it as one of our greatest successes, we're only halfway there and it's still very much ongoing. With the group, it has been much better because we're taking away some ward patients... If you take 15 people off the ward, that gets noticed……and supported I think we've got a really supportive team……and that's a really big enabler and the group definitely helps Look, this new therapy group that we've been running effectively this year, it has probably been one of our greatest successes…It was - to be very blunt, we kind of just went, this is what we're doing. Everyone get on board, because this is what happens "I said can we get one of those [UL edu] posters and out it up over this person's bed as well, because otherwise their arm was left in awful positions"

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"taking photos of it or putting picutres up to – you know, because sometimes it can be easy [for the patient] to forget what [they're] supposed to do" "The likelihood of me using an intervention is somewhat overseen by the expectation of the organisation" "patients were coming to that organisation with that expectation and that's what we were expected to provide [CIMT]" "Here at [site name], we are expected to provide e-stim – a hundred percent" "Yeah. I think workplaces in particular, because some places are very Bobath and some places are very task specific training, so - and then, I think in this job you sort of have to then pick and choose what you do" "From an OT perspective we have challenges with e-stims with training and competency to allow us to use them here at Peninsula Health. So that's a barrier."

TDF Domain	Construct	Guidance/rule	Classified Quotes
			“but it's more important to try and get processes and all of that across the organisation, but that involves more staff with varied experience and confidence and varied interest and varied beliefs and staffing resources” “we don’t have clinical standards (internal) for what upper limb therapies and stuff should be being done” There's not going to be attention paid to it until somebody kicks up a stink. I mean if you had - if you sort of led clients to say, I'm really disappointed with the outcomes I've had with my upper-limb and that was fed back to the exec or whoever would say to us principally and then through us to exec. It's the only way in my opinion because there are so many other imperatives that are associated with [unclear] that the only way people respond in many organisations these days is to hear something bad. “Like with those long-term patients, because there's funding - the funding to train someone to use that piece of equipment plus obtaining a piece of equipment and things like that, so there's lots of things to consider.”

TDF Domain	Construct	Guidance/rule	Classified Quotes
			"it depends on funding [as to how much UL rehabilitation/ number of sessions I do with a patient]"
Social influences Those interpersonal processes that can cause individuals to change their thoughts, feelings or behaviours	<u>Social pressure:</u> *the exertion of influence on a person or group by another person or group* <u>Social norms:</u> *Socially determined consensual standards that indicate a) what behaviours are considered typical in a given context and b) what behaviours are considered proper in the context* <u>Group conformity:</u> *The act of consciously maintaining a certain degree of similarity to those in your general social*	Appropriate coding to this domain: ▪ Impact of others on whether or not arm/hand rehabilitation is provided ▪ Discussing importance of patient engagement/buy-in ▪ Social pressure to deliver or not deliver arm/hand rehabilitation ▪ Social support to provide arm/hand rehabilitation ▪ Modelling of deliver of arm/hand rehabilitation ▪ Patient emotion regarding arm/hand rehabilitation	"One of the barriers I think as well as being perceived as an experienced clinician, you're expected to have those skills already when perhaps you don't necessarily have those skills, given that you haven't done it, maybe even as much as the grade 1's because they are seeing patients, you know they have a bigger caseload of patients". "So sometimes we automatically just refer to the lower limb and do walking work with them" (negative) "I was put into a role where the project was to implement e-stim….so I learnt the ins and outs of it really….[I] had that expectation that [I] needed to know what [I] was doing, because [I] was training others. So I think that's how I became confident in e-stim myself"

TDF Domain	Construct	Guidance/rule	Classified Quotes
	circles *Social comparisons: The process by which people evaluate their attitudes, abilities or performance relative to others* Group norms: *Any behaviour, belief, attitude or emotional reaction held to be correct or acceptable by a given group in society* Social support: *The apperception or provision of assistance or comfort to others, typically in order to help them cope with a variety of biological, psychological and social stressors. Support may arise from any interpersonal relationship in an individual's social network,*		"I've definitely been motivated in the past when I was working in the in-patient rehab unit and there was one stroke client who came in and needed upper limb rehab and the fifth year he just came on to work for the team, was really, really passionate about it. So we did a lot of joint sessions and I learned so much from her, and she was - [unclear] share resources and I suppose kind of set her expectations from me as well, which was a big motivator" "The expectation. The culture. I think its working with link-minded clinicians that are motivated as well – is a big factor [enabler of best practice]" "But I guess - and physio-wise we often think, yeah, physiological before function" "I think OTs in general, we're probably more functionally orientated, and especially in the community. I think that's where we probably start from really"

TDF Domain	Construct	Guidance/rule	Classified Quotes
	involving friends, neighbours, religious institutions, colleagues, caregivers of support groups Power: *The capacity to influence others, even when they try to resist this influence* *Intergroup conflict: Disagreement or confrontation between two or more groups and their members. This may involve physical violence, interpersonal discord, or psychological tension.* Alienation: *Estrangement from one's social group; a deep seated sense of dissatisfaction with one's personal experiences that*		"Depending on the impairments that they present with, maybe a physio might be involved with more say soft tissue work, and maybe the OTs role would be around sort of e-stim – it doesn't have to be, but maybe that. Maybe if it's more a retraining of a task specific practice, such as face washing an OT might be more involved than a physio" "A lot of the upper limb mandatory stuff like electrical stimulation falls more toward the OTs, so we [PT's] see it as not necessarily something we need to implement, but we understand that the OTs do" "I don't think physios are very good at the objective measures for UL. We tend to leave that to you guys [OT's]. We're more impairment based and observation function and normal movement, rather than the objectivity assess/reassess" "I feel stronger about the shoulder management from a PT point of view. In my background the OTs did more

TDF Domain	Construct	Guidance/rule	Classified Quotes
	can be a source of lack of trust in one's social or physical environment or in oneself; the experience of separation between thoughts and feelings Group identity: *the set of behavioural or personal characteristics by which an individual is recognizable [and portrays] as a member of a group* Modeling: *In developmental psychology the process in which one or more individuals or other entities serve as examples (models) that a child will copy*		of the other sensory stuff, so more electrical stimulation and things like that" "I think [upper limb goals] are single discipline at the moment…I don't think that they are shared across each disciplinary team in the way that perhaps they should be" "…and we know the pushes to get patients up and on their feet and out the door, so our priorities are a bit different as physios, in terms of upper limb. So we know you guys are doing a lot of OT upper limb work and we would look at what's already being done…from a time perspective were probably spending a lot more time on getting people up on their feet and not enough time on arms" "I think it's – in my personal opinion – is that it's an ongoing issues that physios aren't treating upper limbs enough" "I think one big barrier is I suppose when different disciplines think of work as being - this is our work, this is your work. Not this is all kind of our work.

TDF Domain	Construct	Guidance/rule	Classified Quotes
			That's the hard - that's one barrier that I think is really hard to break, but if you break it it will make a big difference" "But I do feel that when our grade 1's leave, they don't have a bag of tricks for upper limbs because we don't spend much time on them, yep" "In our setting, I think [OT's] do a lot of [UL Rehab], but physios do a lot as well….physios will manage the walking, the bottom half, but they do a lot of upper limb if that's something that is important to the patient" "I [OT] have always been involved [in UL rehab] but the physios may or may not have been depending on their experience levels" "we had an OT and a physio there [in UL group] and I think that's a great combination, because we both pick up on different things as professionals" "As OTs it's perceived as being our role, but I think we'd get better outcomes if we can do it jointly. I think

TDF Domain	Construct	Guidance/rule	Classified Quotes
			we’ve both got a lot to contribute and I think the patient would benefit from having joint [treatment]” “I think a team approach, like if you're not just the sole therapist. If you've got that joint approach it helps.” “usually [UL management] comes down to the OT and PT, but it’s certainly everyone’s business to make sure that’s happening” The physios don't just go, oh well the upper limb is all yours, good luck. So it's really nice, because we share that The other issue we have on our program, we're a home based rehab, is that often they have exercises from every discipline and then you're trying to get them to do lower-limb, upper-limb, speech and other things and they're saying, no, I'm not doing any of them

TDF Domain	Construct	Guidance/rule	Classified Quotes
			We do, here now [have UL groups]. That has been a reasonably new introduction, trying to help manage caseloads and increase the therapy and between us as well, a bit more collaboratively, which has been really good I'm like, can we just do a joint because - and I can see you get them up. I can see you sitting up and we can do it all in one step. [RE: JOINT INITIAL AX] "but I think MDT assessment and treatment of the UL doesn't happen on [site], so that is something that would benefit patient and staff, yep" "I think it's – in my personal opinion – is that it's an ongoing issues that physios aren't treating upper limbs enough"
Emotion A complex reaction pattern, involving experiential, behavioural and	<u>Fear:</u> *An intense emotion aroused by the detection of imminent threat, involving an immediate alarm reaction*	Appropriate coding to this domain: ▪ Discussion of emotions experienced by clinicians	

TDF Domain	Construct	Guidance/rule	Classified Quotes
physiological elements, by which the individual attempts to deal with a personally significant matter or event	*that mobilizes the organism by triggering a set of physiological changes* Anxiety: *A mood state characterized by apprehension and somatic symptoms of tension in which an individual anticipates impending danger, catastrophe or misfortune.* Affect: *An experience or feeling of emotion, ranging from suffering to elation, from the simplest to the most complex sensations of feelings, and from the most normal to the most pathological emotional reactions.* Stress: *A state of physiological or*	towards providing arm/hand rehabilitation ▪ Description of when clinicians would be worried/concerned about providing arm/hand rehabilitation *Inappropriate coding to this domain:* *Description of patients' emotions regarding arm/hand rehabilitation (code to Social Influences instead)*	

TDF Domain	Construct	Guidance/rule	Classified Quotes
	psychological response to internal or external stressors Depression: *A mental state that presents with depressed mood, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration* Positive/negative affect: *the internal feeling/state that occurs when a goal has/has not been attained. A source of threat has/has not been avoided, or the individual is/is not satisfied with the present state of affairs* Burn-out: *Physical, emotional or mental exhaustion, especially in*		

TDF Domain	Construct	Guidance/rule	Classified Quotes
	one's job or career, accompanied by decreased motivation, lowered performance and negative attitudes towards oneself and others		
Behavioural regulation Anything aimed at managing or changing objectively observed or measured actions	Self-monitoring: *A method used in behavioural management in which individuals keep a record of their behaviour, especially in connection with efforts to changes or regulate the self; a personality trait reflecting an ability to modify one's behaviour in response to a situation* Breaking habit: *to discontinue a behaviour or sequence of behaviours that is automatically activated*	Appropriate coding to this domain: ▪ Discussion regarding habits and breaking old habits to allow for arm/hand rehabilitation ▪ Self-regulatory strategies that would influence provision of arm/hand rehabilitation ▪ Descriptions of auditing recommended for implementation	"We do know what the guidelines are, but it's just that constant reminder that you need to continue to put it into practice" "yeah, no one is checking what I am doing" "There is no reporting coming back about what I'm doing, what everyone's doing, what's happening in the arm and hand room" "I think it has to be you as a clinician to be driven to work hard to meet your patient goals" [lack of accountability to anyone external means that motivation need to be internal]

TDF Domain	Construct	Guidance/rule	Classified Quotes
	by relevant situational cues Action planning: *The action or process of forming a plan regarding a thing to be done or a deed.*		So for me, I think I automatically know when I go see a stroke patient, just as the basic screen, I don't need a sheet of paper to tell me what I need to screen. I just can do it" "Yeah, it's a stroke checklist. So yeah, there's a checklist-y thing that we all tick off and the team meeting goes around and we have to make sure that we have followed all these things. I think, from a specific upper limb point of view though… It doesn't really [include] upper limb. But it has got the general pathway for a stroke patient. It's general." "I know that we've done some audits in physio of how many people have an independent practice, not just upper limb, but generally speaking. Those percentages aren't as good as we would like." "we wanted to know what our gaps were" [Audit]

CPG=Clinical Practice Guideline

Code Book structure guided by:

Presseau, J., Mutsaers, B., Al-Jaishi, A. A., Squires, J., McIntyre, C. W., Garg, A. X. & Grimshaw, J. M. (2017). Barriers and facilitators to healthcare professional behaviour change in clinical trials using the Theoretical Domains Framework: a case study of a trial of individualized temperature-reduced haemodialysis. *Trials*, *18*(1), 227.

Additional domain descriptions:

Bosch, M., McKenzie, J. E., Ponsford, J. L., Turner, S., Chau, M., Tavender, E. J., ... & Pearce, A. (2019). Evaluation of a targeted, theory-informed implementation intervention designed to increase uptake of emergency management recommendations regarding adult patients with mild traumatic brain injury: results of the NET cluster randomised trial. *Implementation science*, *14*(1), 4.

APPENDIX G: SUPPLEMENTARY DOCUMENTS FOR STUDY FOUR

Supplementary document one: Standards for Reporting Implementation Studies (StaRI) checklist.

Appendix Table 4. Standards for Reporting Implementation Studies (StaRI): the completed checklist for Study Four

Checklist item		Reported on page #	Implementation Strategy	Reported on page #	Intervention
			"Implementation strategy" refers to how the intervention was implemented		"Intervention" refers to the healthcare or public health intervention that is being implemented.
Title and abstract					
Title	**1**	#130	Identification as an implementation study, and description of the methodology in the title and/or keywords		
Abstract	**2**	#131	Identification as an implementation study, including a description of the implementation strategy to be tested, the evidence-based intervention being implemented, and defining the key implementation and health outcomes.		
Introduction					
Introduction	**3**	#132-133	Description of the problem, challenge or deficiency in healthcare or public health that the intervention being implemented aims to address.		

Rationale	**4**	#135-136	The scientific background and rationale for the implementation strategy (including any underpinning theory/framework/model, how it is expected to achieve its effects and any pilot work).	#135-136	The scientific background and rationale for the intervention being implemented (including evidence about its effectiveness and how it is expected to achieve its effects).
Aims and objectives	**5**	#133	The aims of the study, differentiating between implementation objectives and any intervention objectives.		
Methods: description					
Design	**6**	#134, Fig 6.1	The design and key features of the evaluation, (cross referencing to any appropriate methodology reporting standards) and any changes to study protocol, with reasons		
Context	**7**	#134-135	The context in which the intervention was implemented. (Consider social, economic, policy, healthcare, organisational barriers and facilitators that might influence implementation elsewhere).		
Targeted 'sites'	**8**	#134	The characteristics of the targeted 'site(s)' (e.g locations/personnel/resources etc.) for implementation and any eligibility criteria.	#134-135, Table 6.1	The population targeted by the intervention and any eligibility criteria.
Description	**9**	#140	A description of the implementation strategy	#135-136, Table 6.2	A description of the intervention
Sub-groups	**10**	N/A	Any sub-groups recruited for additional research tasks, and/or nested studies are described		
Methods: evaluation					

Outcomes	**11**	#140	Defined pre-specified primary and other outcome(s) of the implementation strategy, and how they were assessed. Document any pre-determined targets	#141	Defined pre-specified primary and other outcome(s) of the intervention (if assessed), and how they were assessed. Document any pre-determined targets
Process evaluation	**12**	#136	Process evaluation objectives and outcomes related to the mechanism by which the strategy is expected to work		
Economic evaluation	**13**	n/a	Methods for resource use, costs, economic outcomes and analysis for the implementation strategy	n/a	Methods for resource use, costs, economic outcomes and analysis for the intervention
Sample size	**14**	#136	Rationale for sample sizes (including sample size calculations, budgetary constraints, practical considerations, data saturation, as appropriate)		
Analysis	**15**	#141	Methods of analysis (with reasons for that choice)		
Sub-group analyses	**16**	n/a	Any a priori sub-group analyses (e.g. between different sites in a multicentre study, different clinical or demographic populations), and sub-groups recruited to specific nested research tasks		
Results					
Characteristics	**17**	#142	Proportion recruited and characteristics of the recipient population for the implementation strategy	Table 6.3	Proportion recruited and characteristics (if appropriate) of the recipient population for the intervention

Outcomes	**18**	#143, Table 6.4	Primary and other outcome(s) of the implementation strategy	#143	Primary and other outcome(s) of the Intervention (if assessed)
Process outcomes	**19**	#142	Process data related to the implementation strategy mapped to the mechanism by which the strategy is expected to work		
Economic evaluation	**20**	n/a	Resource use, costs, economic outcomes and analysis for the implementation strategy	n/a	Resource use, costs, economic outcomes and analysis for the intervention
Sub-group analyses	**21**	Nil	Representativeness and outcomes of subgroups including those recruited to specific research tasks		
Fidelity/ adaptation	**22**	#143	Fidelity to implementation strategy as planned and adaptation to suit context and preferences	n/a	Fidelity to delivering the core components of intervention (where measured)
Contextual changes	**23**	Nil	Contextual changes (if any) which may have affected outcomes		
Harms	**24**	Nil	All important harms or unintended effects in each group		
Discussion					
Structured discussion	**25**	#191-195	Summary of findings, strengths and limitations, comparisons with other studies, conclusions and implications		

Implications	**26**	#195	Discussion of policy, practice and/or research implications of the implementation strategy (specifically including scalability)	n/a	Discussion of policy, practice and/or research implications of the intervention (specifically including sustainability)
General					
Statements	**27**	#134, Appendix C	Include statement(s) on regulatory approvals (including, as appropriate, ethical approval, confidential use of routine data, governance approval), trial/study registration (availability of protocol), funding and conflicts of interest		

Supplementary document two: Proportion (% 95% CI) of clinical practice guideline indicator adherence

Appendix Table 5. Proportion (%) (95% CI) of clinical practice guideline indicator adherence (n=114) across measurement points

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
	0-2 months (baseline)	13-15 months (post intervention)	18-19 months (follow-up)	13-15 months minus 0-2 months	18-19 months minus 13-15 months
Behavioural support plans, 1	100 (100 to 100)	100 (100 to 100)	50 (12 to 88)	0 *	-50 (-175 to 75)
Behavioural support plans, 2	38 (-6 to 81)	100 (100 to 100)	95 (84.5 to 106)	62.5 (19.2 to 105.8)	-5 (-21.4 to 11.4)
Behavioural support plans, 3	40 (-28.0 to 108.0)	100 (100 to 100)	100 (100 to 100)	60 (-19.9 to 139.9)	0 *
Behavioural support plans, 4	50 (-42 to 142)	100 (100 to 100)	100 (100 to 100)	50 (-37.8 to 137.8)	0 *
Behavioural support plans, 5	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Behavioural support plans, 6	67 (-77 to 210)	33 (-110 to 117)	83 (59 to 108)	-33 (-164.2 to 97.5)	50 (-9.1 to 109.1)
Care Plan, 1	60 (-8 to 128)	100 (100 to 100)	67 (35 to 98)	40 (-25.7 to 105.7)	33.3 (-87.4 to 20.7)
Care Plan, 2	14 (-21 to 49)	88 (58 to 117)	60 (36 to 84)	73.2 (32.4 to 114)	-27.5 (-67.7 to 12.7)
Care Plan, 3	80 (24 to 136)	86 (51 to 121)	63 (19 to 106)	5.7 (-47.4 to 58.8)	-23.2 (-74.5 to 28)
Care Plan, 4	63 (19 to 106)	75 (36 to 114)	85 (68 to 102)	12.5 (-40.2 to 65.2)	10 (-23.9 to 43.9)
Care Plan, 5	25 (-14 to 64)	100 (100 to 100)	70 (48 to 92)	75 (36.3 to 113.7)	-30 (-64.6 to 4.6)
Care Plan, 6	88 (58 to 117)	100 (100 to 100)	65 (42 to 88)	12.5 (-14.3 to 39.3)	-35 (-71.0 to 1.0)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Continuity of care, 1	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *
Continuity of care, 2	33 (-21 to 88)	100 (100 to 100)	90 (76 to 104)	66.7 (12.5 to 120.9)	-10 (-32.6 to 12.6)
Continuity of care, 3	70 (48 to 92)	100 (100 to 100)	70 (48 to 92)	30 (8 to 52)	-30 (-64.6 to 4.6)
Continuity of care, 4	100 (100 to 100)	100 (100 to 100)	80 (61 to 99)	0 *	-20 (-50.2 to 10.2)
Continuity of care, 5	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *
Continuity of care, 6	17 (-26 to 60)	100 (100 to 100)	95 (84 to 106)	83.3 (40.5 to 126.2)	-5.3 (-23.4 to 12.9)
Continuity of care, 7	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Continuity of care, 8	63 (19 to 106)	100 (100 to 100)	100 (100 to 100)	37.5 (-5.8 to 80.8)	0 *
Continuity of care, 9	25 (-14 to 64)	100 (100 to 100)	83 (59 to 108)	75 (36.3 to 113.7)	-16.7 (-54.5 to 21.2)
Discharge planning, 1	71 (26 to 117)	86 (51 to 121)	47 (18 to 75)	14.3 (-36.5 to 65.1)	-39 (-84.8 to 6.7)
Discharge planning, 2	100 (100 to 100)	100 (100 to 100)	*	0 *	*
Discharge planning, 3	0 *	100 (100 to 100)	67 (12 to 121)	100 (100 to 100)	-33 (-86.1 to 19.4)
Discharge planning, 4	*	100 (100 to 100)	0 *	*	100 *
Discharge planning, 5	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Discharge planning, 6	0	33	100	33.3	66.7
	*	(-110 to 177)	(100 to 100)	*	(-220 to 353.5)
Discharge planning, 7	*	75	100	*	25
		(-5 to 155)	(100 to 100)		(-152.9 to 202.9)
Equipment use, 1	88	100	93	12.5	-6.7
	(58 to 117)	(100 to 100)	(79 to 108)	(-14.3 to 39.3)	(-25.9 to 12.5)
Equipment use, 2	50	100	75	50	-25
	(-585 to 685)	(100 to 100)	(-5 to 155)	(-35 to 135)	(-86.2 to 36.2)
Equipment use, 3	100	86	100	-14.3	14.3
	(100 to 100)	(51 to 121)	(100 to 100)	(-45.4 to 16.8)	(-2.5 to 31.0)
Equipment use, 4	100	100	100	0	0
	(100 to 100)	(100 to 100)	(100 to 100)	*	*
Family Education, 1	38	88	89	50	1.4
	(-6 to 81)	(58 to 117)	(73 to 105)	(1.9 to 98.1)	(-27.8 to 30.5)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Family Education, 2	25 (-14 to 64)	0 *	7 (-8 to 23)	-25 (-71.3 to 21.3)	7.1 (-18.5 to 32.8)
Family Education, 3	13 (-17 to 42)	88 (58 to 117)	79 (59 to 99)	75 (37.1 to 112.9)	-8.6 (-43.4 to 26.3)
Family Education, 4	0 *	40 (-28 to 108)	18 (-9 to 45)	40 (-126.6 to 206.6)	-21.8 (-73.9 to 30.3)
Family Education, 5	*	100 (100 to 100)	100 (100 to 100)	*	0 *
Family Education, 6	38 (-6 to 81)	100 (100 to 100)	84 (66 to 102)	62.5 (19.2 to 105.8)	-15.8 (-43.4 to 11.8)
Family Education, 7	13 (-17 to 42)	88 (58 to 117)	58 (33 to 82)	75 (37.1 to 112.9)	-29.6 (-70.3 to 11.1)
Family Education, 8	25 (- 14 to 64)	100 (100 to 100)	89 (74 to 105)	75 (36.3 to 113.7)	-10.5 (-33.7 to 12.7)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Family Education, 9	13 (-17 to 42)	75 (36 to 114)	84 (66 to 102)	62.5 (18 to 107)	9.2 (-25.6 to 44)
Family Education, 10	13 (-17 to 42)	13 (-17 to 42)	37 (13 to 61)	0 (-37.9 to 37.9)	24.3 (-15.6 to 64.3)
Family Education, 11	13 (-17 to 42)	100 (100 to 100)	53 (28 to 77)	87.5 (57.9 to 117.1)	-47.4 (-72.1 to -22.6)
Family Education, 12	0 *	88 (58 to 117)	42 (18 to 67)	87.5 (57.9 to 117.1)	-45.4 (-81.2 to -9.6)
Family Education, 13	13 (-17 to 42)	88 (58 to 117)	33 (9 to 57)	75 (37.1 to 112.9)	-54.2 (-89.7 to -18.6)
Family Education, 14	0 *	38 (-6 to 81)	6 (-7 to 20)	38 (-1.7 to 76.7)	-31.3 (-63.47 to 0.9)
Family Education, 15	0 *	0 *	26 (5 to 48)	0 *	26.3 (-7.0 to 59.6)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Family Education, 16	13 (-17 to 42)	100 (100 to 100)	64 (36 to 93)	87.5 (57.9 to 117.1)	-35.7 (-72.8 to 1.3)
Goal setting, 1	100 (100 to 100)	100 (100 to 100)	78 (57 to 99)	0 *	-22.2 (-53.8 to 9.4)
Goal setting, 2	0 *	100 (100 to 100)	65 (42 to 88)	100 (100 to 100)	-35 (-71 to 1)
Medical management, 1	33 (-110 to 177)	100 (100 to 100)	100 (100 to 100)	66.7 (-5.0 to 138.4)	0 *
Medical management, 2	57 (8 to 107)	75 (36 to 114)	78 (57 to 99)	17.9 (-37.7 to 73.5)	2.8 (-35.7 to 41.2)
Medical management, 3	0 *	*	*	*	*
Medical management, 4	0 *	*	*	*	*
Medical management, 5	0 *	*	*	*	*

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Medical management, 6	33	*	*	*	*
	(-21 to 88)				
Medical management, 7	100	100	100	0	0
	(100 to 100)	(100 to 100)	(100 to 100)	*	*
Medical management, 8	67	100	86	33.3	-14.3
	(-77 to 210)	(100 to 100)	(51 to 121)	(-38.4 to 105)	(-58 to 29.5)
Medical management, 9	100	100	67	0	-33.3
	(100 to 100)	(100 to 100)	(12 to 121)	*	(-106.3 to 39.6)
Medical management, 10	0	100	100	100	0
	*	(100 to 100)	(100 to 100)	(100 to 100)	*
Medical management, 11	50	100	100	50	0
	(585 to 685)	(100 to 100)	(100 to 100)	(-68.6 to 168.6)	*
Medical records, 1	13	100	100	87.5	0
	(-17 to 42)	(100 to 100)	(100 to 100)	(57.9 to 117.1)	*
Medical records, 2	88	100	100	12.5	0
	(58 to 117)	(100 to 100)	(100 to 100)	(-14.3 to 39.3)	*

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Medical records, 3	50 (5 to 95)	100 (100 to 100)	100 (100 to 100)	50 (5.3 to 94.7)	0 *
Minimally conscious care, 1	*	100 (100 to 100)	100 (100 to 100)	*	0 *
Minimally conscious care, 2	*	100 (100 to 100)	100 (100 to 100)	*	0 *
Minimally conscious care, 3	*	100 (100 to 100)	100 (100 to 100)	*	0 *
Safety, 1	0 *	50 (5 to 95)	76 (54 to 99)	50 (-41.2 to 141.2)	26.5 (-15.1 to 68.1)
Safety, 2	88 (58 to 117)	100 (100 to 100)	100 (100 to 100)	12.5 (-14.3 to 39.3)	0 *
Safety, 3	88 (58 to 117)	100 (100 to 100)	100 (100 to 100)	12.5 (-14.3 to 39.3)	0 *

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Safety, 4	100 (100 to 100)	67 (12 to 121)	82 (62 to 103)	-33 (-127.5 to 60.8)	15.7 (-26.3 to 57.7)
Safety, 5	*	100 (100 to 100)	100 (100 to 100)	*	0 *
Safety, 6	*	100 (100 to 100)	100 (100 to 100)	*	0 *
Safety, 7	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *
Personal care regime, 1	*	100 (100 to 100)	100 (100 to 100)	*	0 *
Personal care regime, 2	0 *	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *
Personal care regime, 3	*	75 (36 to 114)	75 (54 to 96)	*	0 (-38.6 to 38.6)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Personal care regime, 4	14 (-21 to 49)	0 *	22 (-12 to 56)	-14.3 (-80.6 to 52.1)	22.2 (-51.3 to 95.7)
Personal care regime, 5	14 (-21 to 49)	71 (26 to 117)	88 (69 to 106)	57.1 (6.0 to 108.3)	16.1 (-20.6 to 52.7)
PTA Management, 1	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *
PTA Management, 2	*	0 *	100 (100 to 100)	*	100 *
PTA Management, 3	50 (-585 to 685)	100 (100 to 100)	67 (35 to 98)	50 (-35.0 to 135.0)	-33 (-87.4 to 20.7)
PTA Management, 4	0 *	100 (100 to 100)	83 (59 to 108)	100 (100 to 100)	-16.7 (-59.4 to 26.1)
PTA Management, 5	100 (100 to 100)	100 (100 to 100)	80 (24 to 136)	0 *	-20 (-66.1 to 26.1)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Roles and responsibilities, 1	0	100	67	100	-33.3
	*	(100 to 100)	(35 to 98)	(100 to 100)	(-81.2 to 14.5)
Roles and responsibilities, 2	100	100	82	0	-18.2
	(100 to 100)	(100 to 100)	(55 to 109)	*	(-57.7 to 21.4)
Roles and responsibilities, 3	100	100	92	0	-8.3
	(100 to 100)	(100 to 100)	(73 to 110)	*	(-33.7 to 17)
Roles and responsibilities, 4	0	88	60	87.5	-27.5
	*	(58 to 117)	(36 to 84)	(57.9 to 117.1)	(-67.7 to 12.7)
Roles and responsibilities, 5	0	100	75	100	-25
	*	(100 to 100)	(51 to 99)	(100 to 100)	(-60.6 to 10.6)
Roles and responsibilities, 6	63	100	95	37.5	-5
	(19 to 106)	(100 to 100)	(85 to 105)	(-1.7 to 76.7)	(-21.4 to 11.4)
Therapy, 1	100	100	90	0	-10
	(100 to 100)	(100 to 100)	(76 to 104)	*	(-32.6 to 12.6)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Therapy, 2	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *
Therapy, 3	88 (58 to 117)	100 (100 to 100)	95 (84 to 106)	12.5 (-17.1 to 342.1)	-5.3 (-22.2 to 11.6
Therapy, 4	50 (-585 to 685)	100 (100 to 100)	100 (100 to 100)	50 (4.4 to 95.6)	0 *
Therapy, 5	71 (26 to 117)	100 (100 to 100)	95 (85 to 105)	28.6 (-16.6 to 73.7)	-5 (-21.4 to 11.4)
Therapy, 6	0 *	88 (58 to 117)	88 (69 to 106)	87.5 (57.9 to 117.1)	0 (-31 to 31)
Therapy, 7	17 (-26 to 60)	100 (100 to 100)	100 (100 to 100)	83.3 (40.5 to 126.2)	0 *
Therapy, 8	50 (5 to 95)	25 (-14 to 64)	53 (28 to 77)	-25 (-78.6 to 28.6)	27.6 (-15.7 to 71.0)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Therapy, 9	57 (8 to 108)	100 (100 to 100)	100 (100 to 100)	42.9 (-6.6 to 92.3)	0 *
Therapy, 10	20 (-36 to 76)	100 (100 to 100)	100 (100 to 100)	80 (24.5 to 135.5)	0 *
Therapy, 11	0 *	67 (12 to 121)	67 (28 to 105)	66.7 (12.5 to 120.9)	0 (-57.7 to 57.7)
Therapy, 12	0 *	25 (-14 to 64)	17 (-20 to 36)	25 (-13.7 to 63.7)	-8.3 (-44.1 to 27.5)
Therapy, 13	75 (36 to 114)	100 (100 to 100)	95 (85 to 105)	25 (-13.7 to 63.7)	-5 (-21.4 to 11.4)
Therapy, 14	50 (5 to 95)	88 (58 to 117)	53 (28 to 77)	37.5 (-11.8 to 86.8)	-34.9 (-76.0 to 6.3)
Therapy, 15	43 (-7 to 92)	100 (100 to 100)	100 (100 to 100)	57.1 (7.7 to 106.6)	0 *

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Therapy, 16	33 (-21 to 88)	86 (51 to 121)	95 (84 to 106)	52.4 (-2.3 to 107)	9 (-16 to 34)
Therapy, 17	0 *	50 (-42 to 142)	57 (27 to 87)	50 (-41.9 to 141.9)	7.1 (-56.1 to 70.4)
Therapy, 18	14 (-21 to 49)	100 (100 to 100)	0 *	85.7 (-13.2 to 184.6)	-100 *
Therapy, 19	100 (100 to 100)	100 (100 to 100)	100 (100 to 100)	0 *	0 *
Therapy, 20	67 (12 to 121)	100 (100 to 100)	100 (100 to 100)	33.3 (-20.9 to 87.5)	0 *
Ward round, 1	25 (-14 to 64)	0 *	0 *	-25 (-63.7 to 13.7)	0 *
Ward round, 2	0 *	0 *	5 (-5 to 15)	*	5 (-11.4 to 21.4)

Clinical practice guideline indicator	Percent (%) of clinical practice adherence obtained at three time points			Difference between groups (mean, 95% CI)	
Ward round, 3	0	100	100	100	0
	*	(100 to 100)	(100 to 100)	(100 to 100)	*
Ward round, 4	0	0	5	*	5
	*	*	(-5 to 15)		(-11.4 to 21.4)

* = Unable to compute as some items responses are ‘not applicable’ or contain a score of ‘0’, CI = Confidence Interval

APPENDIX H: SUPPLEMENTARY DOCUMENTS FOR STUDY FIVE

Supplementary document one: Standards for Reporting Implementation Studies (StaRI): the completed checklist for Study Five

Appendix Table 6. Standards for Reporting Implementation Studies (StaRI): the completed checklist for Study Five

Checklist item		Reported on page #	Implementation Strategy	Reported on page #	Intervention
			"Implementation strategy" refers to how the intervention was implemented		"Intervention" refers to the healthcare or public health intervention that is being implemented.
Title and abstract					
Title	**1**	#196	Identification as an implementation study, and description of the methodology in the title and/or keywords		
Abstract	**2**	#197	Identification as an implementation study, including a description of the implementation strategy to be tested, the evidence-based intervention being implemented, and defining the key implementation and health outcomes.		
Introduction					
Introduction	**3**	#198	Description of the problem, challenge or deficiency in healthcare or public health that the intervention being implemented aims to address.		
Rationale	**4**	#198-199	The scientific background and rationale for the implementation strategy (including any	#198	The scientific background and rationale for the intervention being implemented (including evidence

			underpinning theory/framework/model, how it is expected to achieve its effects and any pilot work).		about its effectiveness and how it is expected to achieve its effects).
Aims and objectives	**5**	#199-200	The aims of the study, differentiating between implementation objectives and any intervention objectives.		
Methods: description					
Design	**6**	#200	The design and key features of the evaluation, (cross referencing to any appropriate methodology reporting standards) and any changes to study protocol, with reasons		
Context	**7**	#200	The context in which the intervention was implemented. (Consider social, economic, policy, healthcare, organisational barriers and facilitators that might influence implementation elsewhere).		
Targeted 'sites'	**8**	#200	The characteristics of the targeted 'site(s)' (e.g locations/personnel/resources etc.) for implementation and any eligibility criteria.	#200	The population targeted by the intervention and any eligibility criteria.
Description	**9**	#202-203, Table 7.1	A description of the implementation strategy	#202, Table 7.1	A description of the intervention
Sub-groups	**10**	N/A	Any sub-groups recruited for additional research tasks, and/or nested studies are described		
Methods: evaluation					

Outcomes	**11**	#203	Defined pre-specified primary and other outcome(s) of the implementation strategy, and how they were assessed. Document any pre-determined targets	#203	Defined pre-specified primary and other outcome(s) of the intervention (if assessed), and how they were assessed. Document any pre-determined targets
Process evaluation	**12**	#203	Process evaluation objectives and outcomes related to the mechanism by which the strategy is expected to work		
Economic evaluation	**13**	n/a	Methods for resource use, costs, economic outcomes and analysis for the implementation strategy	n/a	Methods for resource use, costs, economic outcomes and analysis for the intervention
Sample size	**14**	#200	Rationale for sample sizes (including sample size calculations, budgetary constraints, practical considerations, data saturation, as appropriate)		
Analysis	**15**	#208	Methods of analysis (with reasons for that choice)		
Sub-group analyses	**16**	#208	Any a priori sub-group analyses (e.g. between different sites in a multicentre study, different clinical or demographic populations), and sub-groups recruited to specific nested research tasks		
Results					
Characteristics	**17**	#208, Table 7.2	Proportion recruited and characteristics of the recipient population for the implementation strategy	#208, Table 7.2	Proportion recruited and characteristics (if appropriate) of the recipient population for the intervention

Outcomes	**18**	#208, 210, 217, Table 7.4	Primary and other outcome(s) of the implementation strategy	Table 7.4	Primary and other outcome(s) of the Intervention (if assessed)
Process outcomes	**19**	Fig 7.2	Process data related to the implementation strategy mapped to the mechanism by which the strategy is expected to work		
Economic evaluation	**20**	n/a	Resource use, costs, economic outcomes and analysis for the implementation strategy	n/a	Resource use, costs, economic outcomes and analysis for the intervention
Sub-group analyses	**21**	Table 7.2, Table 7.4	Representativeness and outcomes of subgroups including those recruited to specific research tasks		
Fidelity/ adaptation	**22**	#217	Fidelity to implementation strategy as planned and adaptation to suit context and preferences	n/a	Fidelity to delivering the core components of intervention (where measured)
Contextual changes	**23**	#217	Contextual changes (if any) which may have affected outcomes		
Harms	**24**	Nil	All important harms or unintended effects in each group		
Discussion					
Structured discussion	**25**	#221-226	Summary of findings, strengths and limitations, comparisons with other studies, conclusions and implications		

Implications	**26**	#226	Discussion of policy, practice and/or research implications of the implementation strategy (specifically including scalability)	#223	Discussion of policy, practice and/or research implications of the intervention (specifically including sustainability)
General					
Statements	**27**	#200-201, Appendix C	Include statement(s) on regulatory approvals (including, as appropriate, ethical approval, confidential use of routine data, governance approval), trial/study registration (availability of protocol), funding and conflicts of interest		

Supplementary document two: Feasibility focus group themes and sub-category responses from facilitator-mediated implementation group clinician participants

Appendix Table 7. Feasibility focus group themes and sub-category responses from facilitator-mediated implementation group clinician participants

Sub-category theme	Example
Theme: Provision of tailored and accessible resources were valuable	
Materials provided were frequently used	"I have gone back to it time and time again, particularly for the FES. I found that that was very helpful"
Tailored resources (i.e. patient handouts) useful	"It was great having the handouts that you could just give, rather than having to keep reinventing – they are definitely resources that I would use again"
	"It wasn't just, I was looking for a sheet and I found it. It was in response to a need that was there. That was useful"
The method of resource provision is important	"I relied on the email. I wouldn't necessarily automatically think, oh, I'll go onto the [Trello] site"

	(readily available i.e. email preferred)	
Theme: Equipment and resource availability allowed timely best-practice intervention provision		
	Availability of equipment facilitated best practice	“The adjustable table in the community was helpful, being able to get that”.
		“The equipment trolley, extra estim machines, and weekly education sessions were very helpful”
		“There were community resource boxes as well, that just had little bits of the things that were on the trolley, because we couldn't take a trolley out. So, I didn't get to use the trolley so much, but those boxes were really helpful because it meant that you didn't - you could just grab it, and you knew that there was stuff in there that we could use”
	Availability of equipment increased patient motivation in therapy	“I know I've used the upper limb trolley a lot, and not just individually but also varying things within groups, to keep patients more motivated.”

	Resource availability saved time	“It's definitely helped time-wise, having things printed, where you can just grab them when you need. I know that I've made a hell of a lot more independent practice books and also given things for patients to take home. I don't think I was doing that as well before, to continue their therapy after here”
		“[equipment availability allowed] taking bits and pieces to a patient's room to see what works and what doesn't work. Rather than having to create them all, there were a lot of ideas there that were quick and easy to try”
	Upper limb therapy was provided faster to the patient	“I think it means that you can start it - the programs earlier as well. Rather than going, okay, I've seen their arm, I'll go make a thing and give it to them tomorrow, or the start of next week, you could be prepared or just run and grab something, and start someone instantly on those activities”
		“I think I can be more efficient, because I know where I can go quickly to grab things, and yeah, start things earlier.”
Theme: Skilled behaviour monitoring was valued and incentivised EBP		
	Audit and feedback was helpful to monitor	“I actually found - I don’t know if it's under the education session, but the audits of the documentation, I actually found really helpful”

behaviour	
	“[Audit and feedback] was almost like a reminder process. It’s motivating as well. Plus I’m competitive…I always wanted to be that 100% one”
	“I think it's a nice chance to stop and reflect on your practice and where you're up to, because sometimes you do just get into the same habits, and then thinking about, well actually how am I going to change my practice to make sure that you are providing the best practice you can”
Positive behavioural support method of audit and feedback is important for acceptance	“I think it's also a credit to how [facilitator] provided that audit information. It was never like, you're awful, you can do better”
	“[the facilitator] is like, I can see that information is there. It was very encouraging and I think that's what helped that motivation”
Providing guided solutions in feedback sessions is important	“[Facilitator] broke it down really well, as well, and what parts our documentation was increasing in, what parts might have stayed the same, so you could go back and have a look and go, oh yeah, all right, in my notes it's this part that I need to put a little bit more information in, or something like that. It identified that [gap], which was helpful.”

Theme: Direct mentorship and coaching prioritised and facilitated optimal learning	
Mentor-led joint patient sessions increased confidence and skill	"I hadn't used CIMT before, and I think I used it on three patients and want to use it on more. I think it was really helpful to have [facilitator] there at the start, to help me start up the program and give me an idea of the sort of exercise and grading and the things like that, so then when I implemented the next one or changed it, I felt confident"
	"From my perspective, I like to observe something being done, and then that increases my confidence, and I guess my knowledge in being able to implement it. That's the way that I learn. I found it really helpful using [facilitator], to be able to help"
In person training/education sessions are the preferred learning method	"It means you can have a go, like hands-on, someone there to support you. Rather than just watching [a video]. Because sometimes with patients, there are those slight changes, so you can problem solve with the [facilitator]. I think having the face-to-face sessions is good"
	"[Handouts] were always pitched in a way that the clients were able to understand. Easy language, and then supplementing it with the face-to-face [clinician training], I think that's what increased the confidence"
In person training	"I think a big advantage of face-to-face is you actually block out that time to spend to do it. I think if it's

	prioritizes new learning and time is made for the activity	honestly on a video somewhere…it just drops down your priority list"
Theme: Study participation increased clinician skills, knowledge and confidence		
	Clinicians believe participating in the study was time-feasible	"I think it saved time. You knew where it was, and it saved time in the end, I reckon. I think you left feeling motivated to either try something, or more confident in trying something"
		"I purposely made time for it, so it didn't really - I could just plan my day around it. I wouldn't say it was a bother or anything - because you got a lot out of it, which then helped you practice."
	Clinician participants would recommend this study to others.	"I would recommend this study to others for sure, absolutely"
		"I think it was one of the more practical projects that I've been involved with. You can just see the application, and it was just - all the barriers, or most of the barriers, were just taken away. So, in a way that just motivated me to…It was very responsive to what we were saying at the start."
	Clinicians believed that their	"It was - yeah, it was significant improvement after the first two weeks. Maybe the structure and the level

patients' upper limb recovered better during the study (from their changed ways of practice)	of effort and having those resources made it easier for me to implement and try and maintain." "I think that's one of the things [facilitator] mentioned as well, that I took away, was that in terms of upper limb, as OTs we can have such a big impact on recovery, and then that's such a predictor for functional outcomes. Particularly again, back to the constraint-induced, but giving that real structured program and the reps, you were able to see the improvement as well from a therapist's point of view as well, which is motivating too, to continue with them."
Clinicians believe they are now providing best practice interventions	"I think I probably would have said yes [I am providing EBP] before [this study], but my yes is much different now. It's more confident I think…we really are providing much more evidence-based interventions. A lot of that is around knowledge about what that looks like, and actually doing it"
Clinicians believe they complete upper limb rehabilitation differently post study	"[I have changed what I do with a patient's upper limb]. I think I am more efficient in time as well" "It's 100 per cent changed my practice, and it's still - the study is still very much at the forefront of my mind when I'm doing things. It's absolutely had a flow-on effect and a really positive one. I was probably a little bit apprehensive about it at the start, about the time commitment and about things like auditing and not knowing what was involved. Yeah, I think it was brilliant and it's definitely had a really positive

	impact on me and my patients.”
Clinicians felt their behaviour did change despite not always having the caseload to ‘practice on’.	“I only had one patient who was in [the study], so I wasn't using all the resources as often [others]. I still found all the sessions very beneficial, and knowing that if I had a patient come in, those resources were available there. I [now know] how to do the Fugl-Meyer because I'd been to that session, for when they come in. It didn't really matter if I had a patient or not [to practice with at the time]”

Supplementary document three: Focus group interview guide

General

- Which clinical practice guidelines you are familiar with in relation to upper limb recommendations.
- How much do you know about the mandatory and non-mandatory components of these guidelines?
- How comfortable do you feel with delivering upper limb guideline recommendations?
- Which components of the upper limb guidelines do you perform? *Task specific motor training, constraint-induced movement training, electrical stimulation, maximising amount of therapy (home programs)*
- Do you think upper limb rehabilitation and the approaches you use are worthwhile? Do you think any component should be removed?
- What do you think about measuring upper limb performance using scales? Which scales would you use?
- What do you think about the evidence base behind upper limb rehabilitation?
- Who do you think should be doing upper limb rehabilitation?
- What do you currently do about upper limb rehabilitation?
- How often do you offer upper limb rehabilitation in people with stroke? *What helps you offer it this much? What stops you offering more?*
- How does your rehab fit in with the rehab being performed by other allied health clinicians? Family members?
- How good are we at identifying the main movement problems in people who have had a stroke?
- How good do you feel you are in delivering guideline interventions?

Training and skill development

- How have you learned how to do upper limb rehabilitation? Have you had any training for upper limb rehabilitation?
- Are there any specific areas of difficulty?
- How easy or difficult is it to use constraint-induced movement therapy?
- What are some of the key criteria necessary to be able to use constraint induced movement therapy? (test knowledge- eligibility)

Organisation / System

- Are there procedures or ways of working that encourage you to implement the upper limb rehabilitation guidelines?
- In your experience of doing upper limb rehabilitation, do you come across problems in implementing the guidelines?

Skills / Confidence

- Do you think that you have the skills to train someone to learn to move their arm again?
- Do you fear that you might miss something? How confident are you that you can pick up a problem?
- How confident are you with the assessment of upper limb deficits?

Resources / Environment Related

- Do you use any prompts to implement any of the interventions? If so, what (video? Manuals? Textbooks?)
- Has anyone decided NOT to train someone's upper limb during rehab?
- Do you have any systems in place to develop and run an upper limb rehabilitation program- groups, home programs?
- Do you have the equipment you need? What do you use to help with implementing an evidence-based program?
- Is anyone using any upper limb pathways (questionnaires, checklists or tools?)
- Is there anything specific about where you practice your upper limb program? Does the environment matter?

Motivation

- Why do you do certain upper limb rehabilitation approaches / interventions / techniques? Why don't you do some others?
- How do you think patients and families view upper limb rehabilitation?
- Is doing upper limb rehabilitation something you usually do?
- How do you feel about upper limb rehabilitation with stroke survivors? Does it give you any particular feelings or emotions?

Conclusion questions

- What are some of the things that stop you from applying the upper limb ABI/stroke clinical practice guidelines?
- What are some of the things that enable you to apply the upper limb ABI/stroke clinical practice guidelines?
- Are there any other issues that we have not touched upon that you would like to discuss?

APPENDIX I: COPIES OF PUBLISHED MANUSCRIPTS

Study One

Jolliffe, L., Lannin, N. A., Cadilhac, D. A., & Hoffmann, T. (2018). Systematic review of clinical practice guidelines to identify recommendations for rehabilitation after stroke and other acquired brain injuries. *British Medical Journal Open, 8*(2). doi:10.1136/bmjopen 2017-018791

Study Three

Jolliffe, L., Hoffmann, T., & Lannin, N. A. (2019). Increasing the uptake of stroke upper limb guideline recommendations with occupational therapists and physiotherapists. A qualitative study using the Theoretical Domains Framework. *Australian Occupational Therapy Journal*. doi:10.1111/1440-1630.12599

Study Four

Jolliffe, L., Morarty, J., Hoffmann, T., Crotty, M., Hunter, P., Cameron, I. D., Li., X. Lannin, N. A. (2019). Using audit and feedback to increase clinician adherence to clinical practice guidelines in brain injury rehabilitation: A before and after study. *PLoS ONE,* 14(3), e0213525. doi:10.1371/journal.pone.0213525

BMJ Open

Systematic review of clinical practice guidelines to identify recommendations for rehabilitation after stroke and other acquired brain injuries

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ABSTRACT

Objectives Rehabilitation clinical practice guidelines (CPGs) contain recommendation statements aimed at optimising care for adults with stroke and other brain injury. The aim of this study was to determine the quality, scope and consistency of CPG recommendations for rehabilitation covering the acquired brain injury populations.

Design Systematic review.

Interventions Included CPGs contained recommendations for inpatient rehabilitation or community rehabilitation for adults with an acquired brain injury diagnosis (stroke, traumatic or other non-progressive acquired brain impairments). Electronic databases (n=2), guideline organisations (n=4) and websites of professional societies (n=17) were searched up to November 2017. Two independent reviewers used the Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument, and textual syntheses were used to appraise and compare recommendations.

Results From 427 papers screened, 20 guidelines met the inclusion criteria. Only three guidelines were rated high (>75%) across all domains of AGREE-II; highest rated domains were 'scope and purpose' (85.1, SD 18.3) and 'clarity' (76.2%, SD 20.5). Recommendations for assessment and for motor therapies were most commonly reported, however, varied in the level of detail across guidelines.

Conclusion Rehabilitation CPGs were consistent in scope, suggesting little difference in rehabilitation approaches between vascular and traumatic brain injury. There was, however, variability in included studies and methodological quality.

PROSPERO registration number CRD42016026936.

Strengths and limitations of this study

- A large comprehensive review of 20 clinical practice guidelines across all acquired brain injury conditions, which identified 2088 separate recommendations for best practice rehabilitation.
- The first review to summarise evidence for individual rehabilitation interventions for acquired brain injury conditions—12 guidelines were related to stroke, 4 were related to traumatic brain injury, the remaining 4 guidelines were discipline specific (occupational therapy n=2, nursing n=1, pharmacological treatment n=1).
- Low Appraisal of Guidelines for Research and Evaluation II applicability rating of included guidelines—poor identification of barriers/facilitators to guideline implementation and resource implications.
- Guideline development groups applied different methods to generate recommendations which led to variability in both quality and scope; universal, international guideline may overcome such limitations.

INTRODUCTION

Acquired brain injury from both vascular and traumatic causes is a major health issue, being a leading cause of disability.[1] Acquired brain injury (brain damage occurring after birth) is an umbrella term that encompasses many aetiologies and includes vascular causes (stroke) and traumatic causes.[2] Within rehabilitation, clinicians commonly treat impairments and functional limitations rather than according to a specific diagnosis, with little observable difference in rehabilitation approaches between vascular versus traumatic brain injury. Provision of care based on evidence is known to improve patient outcomes[3–6]; however, there are documented gaps between the generation of stroke and other health research and its use in clinical practice.[7] For example, a recent Australian audit of stroke rehabilitation services found that only 20% of patients are discharged without a care plan[8] despite strong evidence for their routine use.[9–11] Clinical practice guidelines (CPGs) aim to facilitate clinicians' use of evidence.[12 13]

In addition to supporting proven interventions, CPGs also assist to raise awareness of ineffective practices.[14] While CPGs are developed with the aim of bridging the research–clinical practice gap, issues regarding their

use and implementation still remain. Many countries produce their own national guidelines, updates occur at varying intervals, and CPG content and scope differs with context (eg, country and guideline developer/sponsor). The level of evidence underpinning recommendation statements and the detail of these recommendations also differ across guidelines.[15 16] Finally, despite rehabilitation approaches often being consistent clinically between vascular and traumatic brain injury, these diagnostic groups are separated in rehabilitation CPGs published to date. From clinicians' perspective, having multiple guidelines that are inconsistent based on differences in assessments of evidence or scope may be overwhelming and confusing.

Therefore, the research questions for this study were to:

1. examine the methodological quality of rehabilitation CPGs for acquired brain injury (vascular and/or traumatic);
2. explore the scope of CPGs (ie, what do they include in terms of target population, clinical questions and topics covered);
3. examine the consistency of CPG recommendation across guidelines;
4. compare CPG recommendations across both diagnoses (vascular and/or traumatic);
5. present synthesised recommendations of the five guidelines rated as being of highest methodological quality.

METHODS

Identification and selection of guidelines and their recommendations

Eligible guidelines focused on moderate to severe acquired brain injury rehabilitation (inpatient and community rehabilitation settings). The definition of acquired brain injury used "includes traumatic brain injuries, strokes, brain illness, and any other kind of brain injury acquired after birth. However, acquired brain injury does not include degenerative brain conditions such as Alzheimer's disease or Parkinson's disease".[17] Only recommendations pertaining to adults with a moderate or severe acquired brain injury, as defined by the source study's authors, were included (ie, recommendations pertaining to transient ischaemic attack, mild stroke or brain injury were excluded). Guidelines not published in English were ineligible.

Search for guidelines

Medline and Embase databases were searched from the earliest record until November 2017; guideline repositories including Guidelines International Network, National Guideline Clearinghouse, Intercollegiate Guidelines Network (SIGN), National Collaborating Centre for Chronic Conditions[18] and professional rehabilitation society websites were also searched. Search terms included words related to brain injury, stroke, rehabilitation, guidelines, therapy and practice guidelines. Reference lists of included articles were also reviewed. Titles and abstracts were screened (LJ) and full-text papers retrieved and reviewed independently by two reviewers (LJ and NAL) using predetermined criteria (box 1). Disagreements were adjudicated by an independent reviewer (TH). In instances where guideline development groups updated their guidelines in a modular format (ie, update of specific topic areas) and published these over separate papers, we recognise this as 'one guideline' (inclusive of update) and Appraisal of Guidelines for Research and Evaluation (AGREE) rated both papers as one. The search strategy is available in online supplementary appendix 1, and list of the excluded papers with reasons for exclusion is available in online supplementary appendix 2.

Appraisal of guidelines

The AGREE-II instrument[19] was used to assess the methodological quality of the included guidelines across six domains: scope and purpose, stakeholder involvement, rigour of development, clarity and presentation, applicability and editorial independence. Additionally, an overall guideline assessment score was assigned by the rater and recommendation decision made (options were yes, yes with modifications or no). The 23-item AGREE-II tool uses a 7-point agreement scale from 1 (strongly disagree) to 7 (strongly agree). Each guideline was independently rated by two authors (LJ and NAL). Major discrepancies in the scores (where assigned scores differed by more than two points) were discussed and independently reassessed by the third author (TH). Domain scores were calculated, whereby a total quality score was obtained for each domain by summing the score of each item.[20] The mean domain score (between the two raters) was used to standardise the domain score as a percentage. To measure interobserver agreement across the ordinal categories of

Box 1 Guideline inclusion criteria

- Systematic literature searches and review of existing scientific evidence published in peer-reviewed journals were performed during the guideline development or the guidelines were based on a systematic review published in 4 years preceding the publication of the guideline (PEDro, 2016).
- The clinical practice guideline was produced under the support of a health professional association or society, public or private organisation, healthcare organisation or plan, or government agency (PEDro, 2016).
- The clinical practice guideline contains systematically developed statements that include recommendations, strategies or information to guide decisions about appropriate healthcare.
- Refer to inpatient rehabilitation and/or community rehabilitation of patients with acquired brain injury diagnosis.
- Guidelines focus on more than one single component of rehabilitation (eg, memory and attention retaining).
- Are published in English, from 1 January 2006 onwards.

Note: PEDro Physiotherapy Evidence Database. Criteria: PEDro, Criteria for inclusion of clinical trials, 2016, https://www.pedro.org.au/english/downloads/criteria/ (accessed Feb 2018).

the AGREE-II ratings, a weighted kappa was calculated using SPSS V.24.0. This takes into account the degree of disagreement between assessors by assigning less weight to agreement as categories are further apart.[21 22] An overall kappa was also calculated across all guidelines. A kappa value of <0.2 indicates poor agreement: 0.21–0.4 fair; 0.41–0.6 moderate; 0.61–0.8 good and 0.81–1.0 very good agreement.[23]

Synthesis of guideline recommendations

Textual descriptive synthesis was used to analyse the scope, context and consistency (ie, similar or conflicting messaging) of the CPG recommendations. Initially, each guideline was read to gain an overall knowledge of content, one author (LJ) then independently coded the CPG to identify domains covered by the guidelines. Initial codes were identified and refined through constant comparison of each CPG's recommendations as data collection proceeded. For each domain, guideline recommendations were compared across CPGs to identify similarities and discrepancies. Within each theme, the recommendations were further coded into discrete categories where appropriate (eg, 'motor therapy', 'patient/family education').

Where a guideline had a generic recommendation without providing details on time frame, approach or assessment or discipline responsible, that is, 'all patients should be assessed for pressure injury', these were not included within the relevant category of the scope table. All included guidelines' levels of evidence and grades have been converted to a unified level of evidence grading of National Health and Medical Research Council (NHMRC)[24] for ease of comparison (indicated on table 1 by an double dagger symbol (‡)). Authors (LJ and NAL) compared guidelines for consistency (congruence in content and recommendations), scope (number of different categories of recommendations) and depth (number of recommendations per category). Finally, recommendations from the guidelines rated highest in quality (AGREE-II rating) were synthesised to provide an overview of all recommendations.

RESULTS

Search and guideline characteristics

The electronic search strategy identified 427 publications with 48 duplicates. After screening and review, 23 documents containing 20 guidelines were included in the review (figure 1 shows Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow chart).[25] Included guidelines covered stroke (n=12) and traumatic brain injury (n=4); and some were discipline specific (occupational therapy n=2, nursing n=1, pharmacological treatment=1).

The characteristics and the development processes of each guideline are provided in table 1. Guideline development groups were from Australia/New Zealand (4), Europe (6), USA (6) and Canada (4). All guideline developers conducted a systematic literature search; however, methods used to extract the data and synthesise the evidence varied. Some guideline developers (n=7) graded the level of study evidence included for review, while most graded both the level of study evidence and strength of the recommendations (n=13).

Methodological quality

The AGREE-II domain scores for each guideline (n=20) are shown in table 2. The mean scores (range; SD) for the domains were: scope and purpose 85.1% (53%–100%; SD 18.3); stakeholder involvement 67.9% (14%–100%; SD 25.2); rigour of development 64.0% (9%–96%; SD 26); clarity of presentation 76.2% (22%–100%; 20.5); applicability 36.6% (0%–100%; SD 35.2) and editorial independence 57.9% (0%–100%; 37.2). The kappa values ranged from fair $\kappa_w = 0.38$ (95% CI 0.11 to 0.64) to very good 0.94 (95% CI 0.88 to 1.0). The overall inter-rater agreement was intraclass correlation=0.95 (95% CI 0.92 to 0.97), indicating very good strength of agreement.

Fifteen (75%) guidelines were assessed as 'recommended' for use,[2 9–11 18 26–37] since their quality scores ranged between 5 and 7, representing good-quality to high-quality guidelines. Four (20%) guidelines were 'recommended for use after modification', since they were given quality scores of 3 and 4.[38–42] One guideline with an overall score of 2 was 'not recommended'.[43] Three of the 20 guidelines were rated as high (>75%) in all domains of AGREE-II.[9 10 26] Guidelines updated more frequently were more often of higher quality (ie, had higher AGREE-II scores).

Synthesis of recommendations

The synthesis of clinical management themes and corresponding categories for each guideline are provided in table 3. Five major clinical management themes were identified within the eligible guidelines. These were: medical management (management of depression, pain, behaviour); organisation of services (composition of therapy teams, rehabilitation processes, discharge planning); rehabilitation therapies; managing complications and community management. The primary recommendations from the highest rated guidelines[9–11 26–28] are synthesised in online supplementary table 1. Comparison of guideline recommendations between the top-rated stroke guideline and the top-rated guideline for traumatic injury[32] (ie, where a recommendation is consistent across both aetiologies) has been made and is displayed in online supplementary table 1.

Medical management

Thirteen[2 9–11 26–28 31 32 36 38–40 42 43] of the 20 guidelines (65%) included recommendations for medical management. Of these thirteen guidelines, the most common category was for spasticity management (85% provided recommendations), followed by depression management (77% provided recommendations), pain management (54% provided recommendations) and aggression

Table 1 Characteristics of the included guidelines (n=20)

Guideline organisation/society/ authors	Guideline name(s)	Year of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included*	NHMRC grade of recommendation†
USA								
Wheeler *et al*[34]	Occupational Therapy Practice Guidelines for Adults with TBI	2016	Occupational therapists, educators, consumers, families, caregivers, third-party payers and policy-makers	Occupational therapists	Guideline development group	Systematic literature review	Level 1–4‡	NS‡
Wolf *et al*[35]	Occupational Therapy Practice Guidelines for Adults with Stroke	2015	Occupational therapists, educators, clients, families, caregivers, third-party payers and policy-makers	Occupational therapists	Guideline development group review	Systematic literature review	Level 1–4‡	A–C, I‡
DVA/DoD AHA[36]	Management of Stroke Rehabilitation	2010	Healthcare professional in stroke management	Multidisciplinary	Guideline development group review	Systematic literature review	Level 1–4‡	A–C, I, GPP‡
Miller *et al*[41]	Comprehensive Overview of Nursing and Interdisciplinary Rehabilitation Care of the Stroke Patient: a scientific statement from the American Heart Association	2010	Nurses and stroke healthcare clinicians	Multidisciplinary	NS	Systematic literature review	Level 1–4‡	A–C‡
Warden *et al*[42]	Guidelines for the Pharmacologic Treatment of Neurobehavioral Sequelae of Traumatic Brain Injury	2006	NS	Physicians	NS	Systematic literature review	Level 1–4‡	NS
Winstein *et al*[43]	Guidelines for Adult Stroke Rehabilitation and Recovery	2016	NS	Multidisciplinary	Internal and external peer review	Systematic literature review	Level 1–4‡	A–C‡
Australia/New Zealand								
Bayley *et al*[31]	INCOG Guidelines for Cognitive Rehabilitation Following Traumatic Brain Injury: methods and overview	2014	Healthcare professionals, rehabilitation support workers, clients and their families	Multidisciplinary	External review by journal publisher	Systematic review of published guidelines	Levels 1–3.3‡	A–C, GPP‡
Stroke Foundation[9]	Clinical Guidelines for Stroke Management	2017	Administrators, funders, policy makers, health professionals	Multidisciplinary	Public consultation, consumer consultation, peer review by international experts	Systematic literature review	Levels 1–4	A-D, GPP
NZGG[32]	Traumatic Brain Injury: diagnosis, acute management and rehabilitation	2006	Health practitioners, private providers, case managers, educationalists and funders	Multidisciplinary	External peer review, expert peer review	Systematic literature review	Levels 1–3‡	A–C, GPP‡
SFNZ and NZGG[26]	Clinical Guidelines for Stroke Management	2010	Health practitioners, administrators, funders and policy-makers	Interdisciplinary	Public consultation, consumer review, stakeholder review	Systematic literature review	Levels 1–4	A–D, GPP

Continued

Table 1 Continued

Guideline organisation/society/ authors	Guideline name(s)	Year of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included*	NHMRC grade of recommendation†
Canada								
ABIKUS[40]	Evidence-Based Recommendations for Rehabilitation of Moderate to Severe Acquired Brain Injury	2007	Healthcare professionals, policy-makers, funding bodies, rehabilitation support workers, clients, families	Multidisciplinary	External individual reviewers	Systematic review of published guidelines	Levels 1–4‡	E‡
CSS[27 28]	Canadian Stroke Best Practice Recommendations: Stroke Rehabilitation Practice Guidelines, Update 2015	2016	Health professionals, policy-makers, planners, funders, senior managers and administrators	Multidisciplinary	National expert consensus meeting, external expert review	Systematic literature review	Levels 1–4‡	A–C, GPP‡
	Canadian Stroke Best Practice Recommendations: Telestroke Best Practice Guidelines Update 2017	2017	Health professionals, policy-makers, planners, funders, senior managers and administrators	Multidisciplinary	National expert consensus meeting, external expert review	Systematic literature review	Levels 1–4‡	A–C, GPP‡
Khadilkar *et al*[37]	Ottawa Panel Evidence-Based Clinical Practice Guidelines for Post-stroke Rehabilitation	2006	Physiotherapists, occupational therapists, physicians and clients	Multidisciplinary	External expert review and practitioner review	Systematic literature review	Levels 1–3.2‡	A–D‡
RNAO[29 30]	(1) Nursing Best Practice Guideline. Stroke Assessment across the Continuum of Care	2005	Nurses, healthcare professionals and administrators	Nursing	External stakeholder review (including clients and families) SCORE Project review	Systematic literature review	Levels 1–4‡	A–B, GPP‡
	(2) Stroke Assessment across the Continuum of Care 2011 supplement	2011	Nurses, healthcare professionals and administrators	Nursing	Peer review	Systematic literature review of published guidelines	Levels 1–4‡	E‡
Europe								
ESO[38 39]	Guidelines for Management of Ischaemic Stroke and Transient Ischaemic Attack	2008	NS	Multidisciplinary	NS	Systematic literature review	Levels 1–4‡	A–C, GPP‡
	Evidence-Based Stroke Rehabilitation: an expanded guidance document from the ESO Guidelines for Management of Ischaemic Stroke and Transient Ischaemic Attack 2008*	2009	NS	Multidisciplinary	Editorial group review	Systematic literature review	Levels 1–4‡	E‡
ISWP[11]	National Clinical Guidelines for Stroke	2012	Funders, clinical staff, managers of stroke services, patients with stroke, their families and friends	Multidisciplinary	Internal and external peer review (national and international)	Systematic literature review	Levels 1–3‡	E‡

Continued

Table 1 Continued

Guideline organisation/society/ authors	Guideline name(s)	Year of publication	Target users	Guideline writers	Guideline review process	Search strategy for evidence	Level of evidence included*	NHMRC grade of recommendation†
NICE[18]	Stroke Rehabilitation: long-term rehabilitation after stroke	2013	Healthcare professionals, educationalists, consumers	Multidisciplinary	Public consultation	Systematic literature review	Levels 1–3.2‡	E‡
SIGN[2]	Brain Injury Rehabilitation in Adults	2013	Managers of a health service, healthcare clinicians, clients, their carers and researchers	Multidisciplinary	National open meeting, independently expert review, SIGN editorial group	Systematic literature review	Levels 1–4	A–D, GPP
SIGN[33]	Management of Patients with Stroke: identification and management of dysphagia (CPG 119)	2010	Healthcare clinicians, healthcare service planners, clients, their families and carers	Multidisciplinary	Consumer review, independent expert review, public consultation, SIGN editorial group.	Systematic literature review	Levels 1–4	A–D, GPP
SIGN[10]	Management of Patients with Stroke: rehabilitation, prevention and management of complications, and discharge planning (CPG 118)	2010	Health practitioners, specialists in public health, healthcare service planners, clients, families and carers	Multidisciplinary	External expert review, public consultation, SIGN editorial group.	Systematic literature review	Levels 1–4	A–D, GPP

*Level of evidence:
Level 1: A systematic review; meta-analyses of RCTs; well-powered RCTs.
Level 2: An RCT.
Level 3–1: A pseudo-RCT, that is, alternate allocation.
Level 3–2: A comparative study with concurrent controls: non-randomised experimental trial, cohort study, case–control study, interrupted time series with a control group.
Level 3–3: A comparative study without concurrent controls: historical control study, two or more single-arm studies, interrupted time series without a parallel control group.
Level 4: Case studies; a cross-sectional study or case series.
†Grade of the recommendation:
Grade A: Body of evidence can be trusted to guide practice (level 1 or 2 studies with low risk of bias).
Grade B: Body of evidence can be trusted to guide practice in most situations (level 1 or 2 studies with low risk of bias, level 1 or 2 studies with moderate risk of bias).
Grade C: Body of evidence provides some support for recommendation(s) but care should be taken in its application (level 3 studies with low risk of bias, level 1 or 2 studies with moderate risk of bias).
Grade D: Body of evidence is weak and recommendation must be applied with caution (level 4 studies or level 1–3 studies with high risk of bias).
Grade I: Insufficient information to formulate a recommendation.
Grade E: Nil grade system used, alternative approach based on evidence strength and consensus of the guideline development group.
‡Level of evidence and/or grading system converted to NHMRC (2008) classification of evidence.
ABIKUS, Acquired Brain Injury Knowledge Uptake Strategy; CPG, clinical practice guideline; CSS, Canadian Stroke Strategy; DVA/DoD AHA, Department of Veterans Affairs/Department of Defence American Heart Association; ESO, European Stroke Organisation; Grade GPP, Good practice points based on clinical experience/consensus of the guideline development group; INCOG, international cognitive; ISWP, Intercollegiate Stroke Working Party; NHMRC, National Health and Medical Research Council; NICE, National Institute for Health and Care Excellence; NS, none stated; NZGG, New Zealand Guideline Group; RCT, randomised controlled trial; RNAO, Registered Nurses' Association of Ontario; SCORE, Stroke Canada Optimisation of Rehabilitation by Evidence; SFNZ and NZGG, Stroke Foundation of New Zealand and New Zealand Guideline Group; SIGN, Scottish Intercollegiate Guidelines Network; TBI, traumatic brain injury.

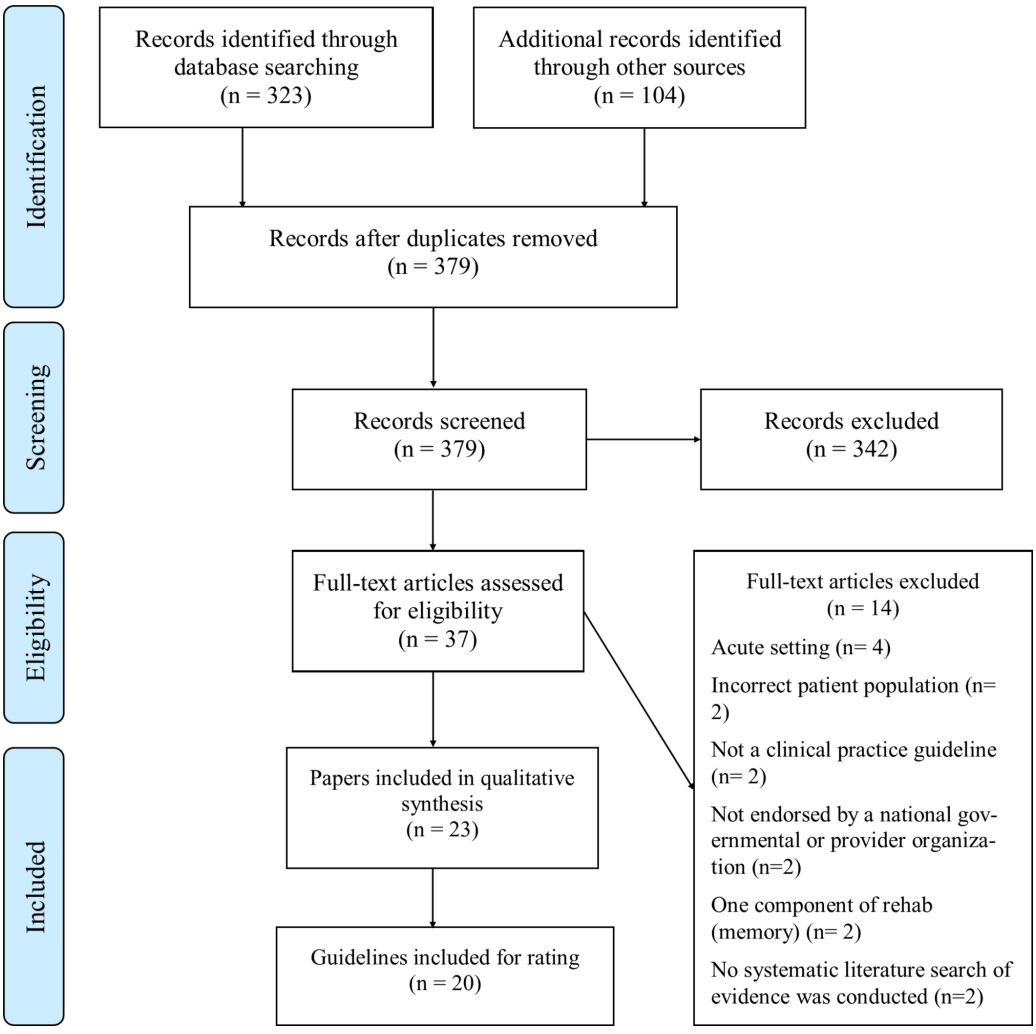

Figure 1 Flow chart of papers through the review.

management (46% provided recommendations). Few guidelines had recommendations for heterotopic ossification (8.3%), psychosis (8.3%), arousal/attention (17%) and memory (17%). Consistency of guideline recommendations were noted for: the use of botulinum toxin type A for the management of spasticity, minimising the use of benzodiazepines and neuroleptic antipsychotic medications in the management of aggression, not routinely prescribing antidepressants poststroke for the prevention of depression and use of selective serotonin reuptake inhibitors (SSRIs) as first line of drug treatment for depression postbrain injury.

Organisation of services

Eighteen of the included guidelines (90%) contained recommendations related to the organisation of rehabilitation services, which were grouped in the following categories: carer support, peer support, multidisciplinary service delivery, specialised rehabilitation unit of care (stroke/neurological ward) and process/delivery of service (table 3). Guideline recommendations within this theme were consistently reported across guidelines; with 5[11 18 26 32 40] of the 18 guidelines reporting at least one recommendation in all 5 categories. The most common categories of service organisation recommendations of these 18 guidelines were use of a multidisciplinary team model (88% provided recommendations), followed by processes/delivery of rehabilitation services (67% provided recommendations) and provision of carer support (56% provided recommendations). It is noted that guidelines that have been updated more recently (ie, Stroke Foundation[9]) are removing recommendations related to organisation of services from the guideline, instead referring readers to a national stroke services framework.

Rehabilitation therapies

Nineteen of the 20 guidelines (95%) had recommendations pertaining to rehabilitation therapies. There were 15 categories identified within this theme (table 3). The most common category of recommendations was for 'motor function' (95% of the 19 guidelines provided recommendations), 'activities of daily living' (89% provided recommendations) 'cognition' (84%), 'upper limb management' and 'patient/family education' (79% each) and 'communication' and 'psychosocial' (74%

Table 2 Guideline assessment according to the AGREE-II instrument (n=20)

Guideline organisation/society/ authors	Domain scores (%)						Mean domain scores (%)	Agreement between appraisers
	Scope and purpose	Stakeholder involvement	Rigour of development	Clarity and presentation	Applicability	Editorial independence		Weighted kappa coefficient (κ, 95% CI)
USA								
Wheeler and Acord-Vira[34]	86.1	61.1	53.1	88.9	10.4	45.8	57.6	0.93 (0.86 to 1.0)
Wolf and Nilsen[35]	94.4	58.3	57.3	66.7	0	29.2	51.0	0.74 (0.61 to 0.87)
DVA/DoD AHA[36]	86.1	63.9	62.5	75	0	0	47.9	0.75 (0.62 to 0.87)
Miller *et al*[41]	69.4	58.3	9.4	22.2	0	50	34.9	0.94 (0.88 to 1.0)
Warden *et al*[42]	80.6	13.9	30.2	50	0	0	29.1	0.67 (0.52 to 0.83)
Weinstein *et al*[43]	27.8	22.2	4.2	38.9	0	79.2	28.7	0.64 (0.41 to 0.87)
Australia/New Zealand								
Bayley *et al*[31]	94.4	66.7	81.3	77.8	68.8	83.3	78.7	0.38 (0.11 to 0.64)
Stroke Foundation[9]	100	100	90.6	100	83.3	100	95.7	0.90 (0.72 to 1.1)
NZGG[32]	91.7	83.3	70.8	83.3	52.1	75	76	0.73 (0.52 to 0.95)
SFNZ and NZGG[26]	100	100	89.6	88.9	75	87.5	90.2	0.70 (0.56 to 0.83)
Canada								
ABIKUS[40]	75	55.6	53.1	77.8	0	0	43.6	0.75 (0.59 to 0.90)
CSS[27 28]	100	91.7	87.5	94.4	66.7	100	90.0	0.91 (0.84 to 0.98)
Khadilkar *et al*[37]	88.9	52.8	70.8	75	0	0	47.9	0.80 (0.68 to 0.91)
RNAO[29 30]	100	80.56	76	86.1	70.8	66.7	80.0	0.38 (0.16 to 0.60)
Europe								
ESO[38 39]	52.8	30.6	45.8	66.7	0.0	100	49.3	0.86 (0.75 to 0.96)
ISWP[11]	100	97	91	97	54	100	89.8	0.77 (0.62 to 0.91)
NICE[18]	91.7	72.2	72.9	66.7	58.3	83.3	74.2	0.64 (0.39 to 0.89)
SIGN[2]	75	75	56.3	75	35.4	50	61.1	0.46 (0.23 to 0.68)
SIGN[33]	91.7	75	89.6	94.4	56.3	25	72	0.62 (0.42 to 0.82)
SIGN[10]	97.2	100	87.5	100	100	83.3	94.7	0.68 (0.36 to 1.0)

ABIKUS, Acquired Brain Injury Knowledge Uptake Strategy; AGREE, Appraisal of Guidelines for Research and Evaluation; CSS, Canadian Stroke Strategy; DVA/DoD AHA, Department of Veterans Affairs/Department of Defence American Heart Association; ESO, European Stroke Organisation; ISWP, Intercollegiate Stroke Working Party; NICE, National Institute for Health and Care Excellence; RNAO, Registered Nurses' Association of Ontario; SFNZ and NZGG, Stroke Foundation of New Zealand and New Zealand Guideline Group; SIGN, Scottish Intercollegiate Guidelines Network.

Table 3 Guideline recommendation themes (five) and associated theme categories in acquired brain injury rehabilitation (n=20)

Theme and guideline recommendation category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Medication management theme																				
Depression/mood management					•	•		•	•	•	•	•			•	•				•
Aggression management			•				•		•		•					•		•		
Psychosis					•															
Memory									•		•									
Executive dysfunction							•				•									
Arousal and attention											•							•		
Hypertension			•																	
DVT/anticoagulation therapy						•		•		•										•
Cholesterol management																				
Pain						•		•		•		•			•	•				•
Incontinence						•		•	•	•										
HO											•									
Spasticity			•			•		•	•	•	•	•			•	•		•		•
Organisation of services theme																				
Carer support		•	•	•					•	•	•					•	•	•		•
Peer support	•								•	•	•					•	•			
Multidisciplinary service coordination	•		•	•		•	•		•	•	•	•		•	•	•	•	•	•	•
Specialised rehabilitation unit			•						•	•	•	•			•	•	•			•
Processes/delivery of rehabilitation services			•			•		•	•	•	•	•		•		•	•	•		•
Rehabilitation therapies theme																				
Amount and intensity	•		•	•		•		•		•		•			•	•	•	•		•
Timing						•		•		•	•	•		•		•	•		•	•
Sensation/sensorimotor			•			•	•	•	•	•	•					•				
Communication			•	•		•		•	•	•	•	•		•	•	•	•	•		•
Visual/perceptual deficits	•	•	•			•		•	•	•	•	•				•	•			•
Cognition	•	•	•	•		•	•	•	•	•	•			•	•	•	•	•		•

Continued

Table 3 Continued

Theme and guideline recommendation category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Psychosocial	•	•	•	•		•			•	•	•			•		•	•	•	•	•
Activities of daily living	•	•	•	•		•	•	•	•	•	•	•		•	•	•	•	•		•
Motor function	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•
Upper limb management	•	•	•	•		•	•	•		•	•	•	•		•	•	•			•
Family participation in therapy		•	•	•		•	•		•	•						•	•			•
Carer/family training			•	•		•	•	•	•	•	•	•			•	•	•		•	
Home programme/self-practice		•	•					•	•	•	•	•				•				
Patient/family education		•	•	•		•	•		•	•	•	•			•	•	•	•	•	•
Goal setting			•	•				•	•	•	•					•	•			•
Managing complications theme																				
Spasticity		•	•	•		•		•	•	•	•	•		•	•	•		•		•
Contracture		•				•		•		•	•	•		•		•	•	•		•
Subluxation		•				•		•		•	•	•		•		•	•			•
Pain						•		•	•	•	•	•		•	•	•	•			•
Oedema								•		•		•								
Fatigue								•		•						•				
Behaviour/mood	•					•	•	•	•		•							•		
Pressure care				•		•				•				•						•
Falls						•		•		•		•		•	•	•				
Nutrition			•	•		•		•		•	•	•		•	•	•	•		•	•
Incontinence				•		•	•	•	•	•				•	•	•	•	•		•
DVT				•		•		•		•	•			•						•
Swallowing (dysphagia)			•	•		•	•	•	•	•	•	•		•		•	•	•	•	•
HO											•									
Seizure management						•					•									
Nursing neurological assessments														•						
Community management theme																				
Driving		•	•			•		•	•	•	•	•				•	•			•

Continued

Table 3 Continued

Theme and guideline recommendation category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Return to work/volunteer			•			•		•	•	•	•	•				•	•	•		•
Leisure		•	•	•		•		•	•	•	•	•				•				
Sexuality		•	•	•		•		•	•	•		•		•		•				•
Psychosocial rehabilitation	•	•	•					•	•	•		•				•	•	•		
Outpatient cognitive rehabilitation	•	•						•		•		•			•	•	•			•
Outpatient motor rehabilitation	•	•				•		•		•		•			•	•	•			•

1=Wheeler,[34] 2=Wolf,[35] 3=DVA/DoD AHA,[36] 4=Miller,[41] 5=Warden,[42] 6=Weinstein,[43] 7=Bayley,[31] 8=Stroke Foundation (Australia),[9] 9=NZGG,[32] 10=SFNZ and NZGG,[26] 11=ABIKUS,[40] 12=CSS,[27 28] 13=Khadilkar *et al*,[37] 14=RNAO,[29 30] 15=ESO,[38 39] 16=ISWP,[11] 17=NICE,[18] 18=SIGN,[2] 19=SIGN,[33] 20=SIGN.[10]

ABIKUS, Acquired Brain Injury Knowledge Uptake Strategy; CSS, Canadian Stroke Strategy; DVA/DoD AHA, Department of Veterans Affairs/Department of Defence American Heart Association; DVT, deep vein thrombosis; ESO, European Stroke Organisation; HO, heterotopic ossification; ISWP, Intercollegiate Stroke Working Party; NICE, National Institute for Health and Care Excellence; RNAO, Registered Nurses' Association of Ontario; SCORE, Stroke Canada Optimisation of Rehabilitation by Evidence; SFNZ and NZGG, Stroke Foundation of New Zealand and New Zealand Guideline Group; SIGN, Scottish Intercollegiate Guidelines Network.

each). Few guidelines made recommendations for the categories of 'sensation/sensorimotor' rehabilitation (42%) and 'home programme/self-practice' (42%).

The guidelines with the broadest scope (ie, had at least one recommendation in most of the 15 categories) were the Stroke Foundation of New Zealand and New Zealand Guideline Group (SFNZ and NZGG),[26] Stroke Foundation (Australia) guidelines[9] and Intercollegiate Stroke Working Party of UK (ISWP)[11] with recommendations in all categories (100%). Guidelines narrowest in scope (ie, recommendations in the fewest number of categories) were Khadilkar *et al*,[37] SIGN[2] and Registered Nurses' Association of Ontario, Canada (RNAO)[29 30] with recommendations in 13%, 33% and 33% of categories, respectively. Guideline recommendations were less consistent across categories in rehabilitation therapies, as shown in table 3.

Managing complications

Most (n=18, 90%) guidelines had recommendations for managing complications, which were grouped into: spasticity, contracture, subluxation, pain, oedema, fatigue, behaviour, pressure care, falls, nutrition, incontinence, deep vein thrombosis, swallowing (dysphagia), heterotopic ossification, seizure management and neurological nursing. The Stroke Foundation (Australia) guidelines[9] was broadest in scope within this category, with complication recommendations in 12 of the 16 categories (75%), followed by SFNZ and NZGG[26] and Weinstein,[43] both with recommendations in 11 of the 16 categories (69%). It is important to note that while Weinstein[43] had broad scope in this category, this guideline was not recommended for use according to the AGREE-II rating.

Community management

Sixteen guidelines (80%) included community management recommendations with the most common categories of recommendations being 'driving', 'return to work/volunteer' and 'sexuality' (11 of the 16 guidelines; 69% made recommendations in these categories). Recommendations in this category varied in terms of specificity; that is, some guidelines stated more general recommendations (ie, therapy should be provided), whereas other guidelines made specific recommendations about therapeutic interventions (ie, task-specific practice).

Overall, we found that the guidelines with the highest AGREE-II ratings of mean domain score percentage (ie, >75% in all six domains) were Stroke Foundation (Australia),[9] SIGN[10] and SFNZ and NZGG.[26] The top four guidelines for breadth of scope and recommendation specificity are NZGG,[32] Canadian Stroke Strategy[27 28] and ISWP[11] and for medical management, Acquired Brain Injury Knowledge Uptake Strategy.[40]

DISCUSSION

This systematic review explores the quality and the scope of published CPGs for both vascular and traumatic acquired brain injury rehabilitation in a single, comprehensive

review. The quality of the reviewed guidelines, as well as the scope and breadth of recommendations contained in these guidelines varied greatly, which has implications for the clinical use of each CPG. Research has demonstrated an association between stroke outcome and CPG compliance,[44] thus, providing clinicians with this synthesised set of recommendations (from highly rated guidelines) is the first step in ensuring quality of care universally in rehabilitation, irrespective of type of acquired brain injury or of country of injury.

This review of 20 CPGs, containing more than 2088 recommendations, demonstrated differences between guidelines which could be expected to substantially influence clinical rehabilitation. The methodological quality of the reviewed guidelines varied, with only three guidelines achieving high ratings in all six AGREE-II domains. Across all the guidelines, the highest AGREE-II domain score was for 'scope and purpose' and the lowest was for 'applicability', suggesting that few guidelines provide information to clinicians for how to implement CPG recommendations into rehabilitation.

While the majority of CPGs were of sufficient quality according to AGREE-II ratings to be recommended, the scope of recommendations along with the depth of recommendations varied. For example, while Miller[41] and RNAO[29 30] made only one recommendation for incontinence management, NZGG[32] provided 11 separate recommendations in the same category. Despite its recent publication (2016), one guideline was not recommended for use[43] and contained multiple recommendation statements that were contradictory to the majority of the other guidelines. For example, in this guideline it was stated that 'routine use of prophylactic antidepressant medications is unclear' which contradicts recommendations in all five top-rated guidelines, whereby 'routine use of antidepressants to prevent poststroke depression is not recommended'.[9–11 26 27] Similarly, this guideline stated 'acupuncture may be considered as an adjunct treatment for dysphagia', which directly contradicts the Australian Stroke Foundation's[9] updated recommendation, whereby 'acupuncture should not be used for treatment of dysphagia in routine practice'. Aside from this, there were recommendations which appeared to be universally agreed to by all guideline development groups. These were those specifically pertaining to 'using a multidisciplinary approach for rehabilitation', 'the prescription of SSRIs for the management of poststroke depression' and the use of 'task-specific motor retraining' for impaired movement. Recommendations in these categories were consistent in their clinical recommendations, the research evidence cited in support of the recommendations and the breadth of content summarised. Having such consistency suggests to clinicians that these areas of practice are universally held as representing 'quality' rehabilitation.

The differing methods used by each guideline development group may explain some of the observed variation between recommendations. Other explanations may include the year of guideline development (ie, availability of evidence for inclusion may have varied), date of search by guideline development group or the eligibility criteria and prioritisation process used when writing the guideline recommendations. Our findings support the importance of moving towards a universal, international guideline with pooled resources for funding adequate searching and appraisal (such as achieved by the international guidelines for the selection of lung transplant candidates).[45]

Separating out clinical conditions (ie, vascular from trauma) is likely inefficient in clinical practice, given that both conditions are treated consistently with common research evidence findings. Our synthesis found common recommendations across both vascular and trauma CPGs in the areas of organisation of services, rehabilitation therapies, managing complications and community management. We do acknowledge unique guidelines for each condition in the areas of 'medication' and 'behaviour' management; however, rehabilitation practice recommendations do not appear to differ outside these areas which suggests that a synthesised set of recommendations could substantially improve the quality of rehabilitation. Kirsner and Marston[46] highlight that variability in guidelines and issues around applicability of recommendations to 'real-life' contexts can make the selection and use of guidelines challenging. The usefulness of CPGs rests on the reasonable assumption that following the recommendations will improve care, but having multiple guidelines to apply within a single neurorehabilitation setting is unlikely to achieve this. Factor such as 20 available guidelines, published across 23 separate documents, with updates occurring in a modular format and varying modes of access (online, freely available, paid access) hinder clinicians' behaviours regarding guideline selection and implementation.

Pragmatically, rehabilitation clinicians are likely to work with mixed acquired brain injury patient populations. Synthesising recommendations of the guidelines with higher methodological quality, as in the present review may improve the future consistency of clinical rehabilitation guidelines and in turn influence the quality of care in this field. Further to this, having direct comparison within a single document between stroke and trauma brain injury recommendations may highlight where rehabilitation practices should differ. Our study has rated all rehabilitation CPGs across both clinical conditions and suggests that clinicians become familiar with those of both high quality and broad scope. While clinicians may be more familiar with their own national/local clinical practice guidelines, findings from our systematic review suggest that these may not always be of the most methodologically rigorous.

The main limitation of the present study is, perhaps also one of its strengths. That is, the use of a standardised method and rating tool. As previously discussed, the AGREE-II instrument assesses how well a CPG development process is reported but not the specific clinical content of the CPG recommendations. As we synthesised only the highest quality guidelines for this review, it must be acknowledged that a guideline could receive a high AGREE-II rating, yet contain low-quality recommendations

based on the level of evidence accepted by the guideline development group. Our chosen review method may mean that additional and important aspects of a CPG and its ease of implementation were not rated. For example, since the rating tool selected (AGREE-II) does not rate the level of intervention detail provided in the recommendation statements, these aspects fell outside of the current systematic review findings. We have sought to capture this detail in our qualitative synthesis; however, we recommend that future discussions of CPG rating tools and systematic reviews of CPGs continue to explore this issue.

SUMMARY

Multiple CPGs exist to guide rehabilitation for adults after acquiring a brain injury, reporting on either vascular (stroke) or traumatic literature, which makes selecting a high-quality guideline to implement overwhelming and difficult. Variability exists in guideline quality, breadth and detail of recommendations and availability of information on applicability of these guidelines. This is likely underpinned by the evidence included and method of evidence synthesis employed by each guideline development group. Clinicians need to be aware of quality differences between these guidelines and be prepared to look beyond their local guidelines to use the highest quality guidelines in the rehabilitation of adults with an acquired brain injury from stroke or traumatic causes.

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Contributors All authors made substantial contribution to the design of the work. LJ, NAL and TH completed PROSPERO trial registration. NAL and LJ completed the search as per search strategy. LJ completed screening and full-text review. LJ and NAL completed AGREE-II ratings for included guidelines. All authors made significant contribution to the interpretation of data and drafting the work or revising it critically for important intellectual content. They provided final approval of the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Competing interests NAL, TH and DAC have been involved in the development of clinical practice guidelines referenced in this paper. They have also authored papers (randomised controlled trials) cited within the body of the guidelines that this systematic review appraised.

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Study Three

Due to copyright, this publication cannot be provided as an appendix. The publication can be found at:

Jolliffe, L., Hoffmann, T. & Lannin, N.A. (2019). Increasing the uptake of stroke upper limb guideline recommendations with occupational therapists and physiotherapists. A qualitative study using the Theoretical Domains Framework. *Australian Occupational Therapy Journal.* Doi:10.1111/1440-1630.12599.

PLOS ONE

RESEARCH ARTICLE

Using audit and feedback to increase clinician adherence to clinical practice guidelines in brain injury rehabilitation: A before and after study

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Abstract

Objective

This study evaluated whether frequent (fortnightly) audit and feedback cycles over a sustained period of time (>12 months) increased clinician adherence to recommended guidelines in acquired brain injury rehabilitation.

Design

A before and after study design.

Setting

A metropolitan inpatient brain injury rehabilitation unit.

Participants

Clinicians; medical, nursing and allied health staff.

Interventions

Fortnightly cycles of audit and feedback for 14 months. Each fortnight, medical file and observational audits were completed against 114 clinical indicators.

Main outcome measure

Adherence to guideline indicators before and after intervention, calculated by proportions, Mann-Whitney U and Chi square analysis.

IDC (GNT1110493), and Heart Foundation (Australia): NAL (GNT102055). There are no conflicts of interest to declare. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests: The authors have declared that no competing interests exist.

Results

Clinical and statistical significant improvements in median clinical indicator adherence were found immediately following the audit and feedback program from 38.8% (95% CI 34.3 to 44.4) to 83.6% (95% CI 81.8 to 88.5). Three months after cessation of the intervention, median adherence had decreased from 82.3% to 76.6% (95% CI 72.7 to 83.3, $p<0.01$). Findings suggest that there are individual indicators which are more amenable to change using an audit and feedback program.

Conclusion

A fortnightly audit and feedback program increased clinicians' adherence to guideline recommendations in an inpatient acquired brain injury rehabilitation setting. We propose future studies build on the evidence-based method used in the present study to determine effectiveness and develop an implementation toolkit for scale-up.

Introduction

Acquired brain injury is a leading cause of disability in adults [1] with a large proportion of patients requiring rehabilitation [2]. Consistent with other areas of health care, neurological rehabilitation has been observed to vary in quality between services [3, 4]. Clinical practice guidelines provide recommendations to assist clinicians make evidence-informed decisions about the interventions they provide [5–7]. Despite the availability of such guidelines, auditing suggests that rehabilitation clinicians do not routinely provide care consistent with guideline recommendations [8]. Audit and feedback has been recommended as an intervention capable of increasing the uptake of evidenced-based recommendations by clinicians [9–11].

A growing number of researchers are trialing audit and feedback interventions to promote the use of evidence in rehabilitation, however outcomes for improving clinician adherence has been mixed. The use of implementation interventions in rehabilitation is undoubtedly a positive step forward, nevertheless, critical reflection on the effectiveness of different interventions is key. Specific to audit and feedback interventions, two systematic reviews have synthesised the evidence on effectiveness; these reviews suggest limited to modest improvements occur at best [12,13]. The latest Cochrane systematic review concluded that audit and feedback generally produces small, but potentially important improvements [12]. This is consistent with a second meta-analysis, which found modest improvements on quality outcomes [13]. These reviews [12, 13] suggest the need for clear definitions of goal-behaviors, and triangulation of data collection to improve the effect of audit and feedback interventions. They also suggested that the characteristics of the feedback component of future studies should be identified so as to build an understanding of the causal mechanisms underpinning audit and feedback as an intervention [12–14].

Prior audit and feedback interventions to increase adherence to guidelines in rehabilitation have been provided infrequently or at low 'dose'. For example, to improve the implementation of transport training after stroke, McCluskey and colleagues [15] delivered a single audit and feedback cycle in their knowledge translation program, while Kristensen & Hounsgaard [16] provided four cycles over 15 months, and Vratsistas-Curto et al [17] provided four cycles over 4 years. What remains unknown is the effect of audit and feedback when it is provided at a higher dose (such as weekly or fortnightly). A further limitation of the rehabilitation studies to

date is that none triangulated their audit information; triangulation occurs by gathering information from multiple sources and while missing from the rehabilitation.

Studies outside of rehabilitation also suggest that it is important to strategically plan the method of feedback delivery; for example, nurses reported feeling 'exasperated' and 'angry' when they received feedback they perceived as critical [18]. Few studies have reported the use of a theoretical underpinning to their feedback delivery [12, 13, 19]. In contrast, LaVigna and colleagues [20] deliberately adopted a 'non-aversive approach' when working with staff in quality improvement cycles, and developed a form of audit and feedback known as periodic service review [20, 21]. Periodic service review has its base in both total quality management [22] and organizational behavior management [23, 24], and differs from other auditing approaches used in prior rehabilitation studies, since it is undertaken at a high dose, uses positive support strategies during feedback, and actively involves staff in the process [21]. It remains unknown if this approach to audit and feedback would increase adherence to guidelines in rehabilitation, where prior audit and feedback studies have not.

Therefore, the aim of this study was to evaluate the impact of a prospective audit and feedback program on adherence to acquired brain injury rehabilitation guidelines. We sought to understand whether:

1. frequent audit and feedback cycles (with positive behavioral support) increased clinician adherence to clinical practice guidelines in acquired brain injury
2. increases in adherence are maintained after the cessation of audit and feedback program
3. changes in adherence differ according to individual guideline indicators

Method

Design

A before and after design with a 3-month follow-up was used to test the effect of a 14-month audit-feedback program in an inpatient rehabilitation setting. There were 8 assessments at baseline, 8 assessments at end of intervention and 20 assessments at follow-up. The study design and flow is depicted in (Fig 1). The administrative organization's Human Research Ethics Committee approved this study prior to its commencement (Alfred Health Human Research Ethics Committee 355/14); a waiver of consent for participation was approved, meaning that all inpatients and all staff were involved for the duration of the study period.

Settings and participants

This study was conducted between September 2014 and March 2016 in a newly established 42-bed acquired brain injury rehabilitation unit in metropolitan Melbourne, Australia. All clinicians (inclusive of nursing, medical, and allied health staff) working on the unit were included in this study and expected to attend each fortnightly feedback session as part of their usual workplace meeting commitments with support of management. Staffing ratios within the unit are presented in Table 1. At the time of this study, other passive knowledge translation interventions (including the availability of guidelines on each ward, and posters of best practice summaries) were also provided to clinicians.

Intervention

A 14-month audit and feedback program was developed. Audit criteria were developed by two authors (NL, LJ) *a priori* from recommendations with high-quality (Grading of Recommendations

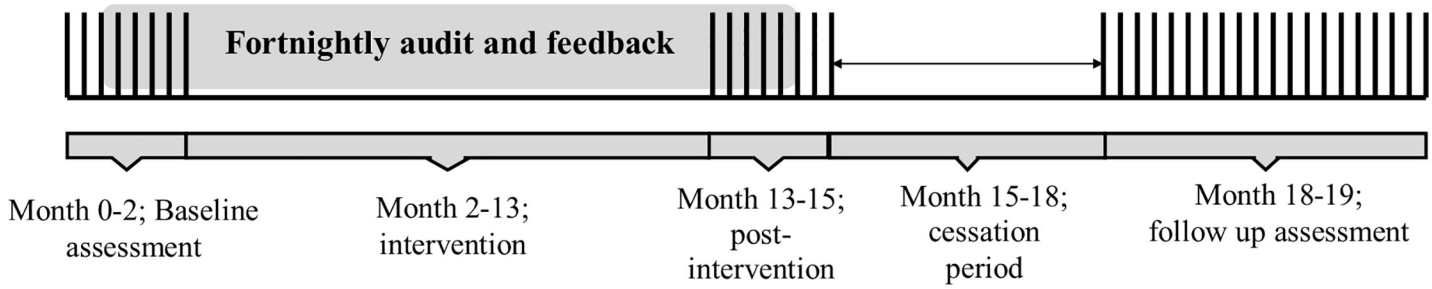

Fig 1. Design and flow of the study.

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Assessment, Development and Evaluation (GRADE) level one) evidence cited in stroke and traumatic brain injury clinical practice guidelines [25, 26] as well as the organization's model of care and practice standards [27]. The resultant 114 observable criteria were mapped to 16 overarching guideline indicator areas for ease of communication with staff regarding performance. These guideline indicator areas included: behavioral support plans, care plans, continuity of care, discharge planning, equipment use, family education, goal setting, medical issues management, medical records, minimally conscious care, patient safety, personal care regimes, post traumatic amnesia management, roles and responsibilities, therapy interventions, and ward rounds. The organization set the target for staff to adhere to a minimum of 75% of applicable guideline indicators per patient prior to commencing the study.

Our audit and feedback program was based on the periodic service review method developed by LeVigna et al[20]. By acknowledging that the clinical team are key to delivery of evidence-based rehabilitation, we aimed to improve and then maintain the quality of the service using positive behavioral approaches to staff management [21]. We adopted a non-aversive approach to working with the staff during the feedback session, making the clinicians the leaders of the change solutions [21, 23, 24]. The audit-feedback cycles were regular and frequent throughout the study period. Each fortnight, a research assistant randomly selected two patients on the rehabilitation unit (one from each of the two medical teams) and completed a) medical file audit; b) on ward observations; c) clinical staff interviews of three disciplines

Table 1. Staffing profile during intervention period.

Discipline	Average staffing ratio per 10 beds	Mean occasions of service per month per 10 beds
Allied Health Assistants	1.31	380
Clinical Psychology	0.33	61
Neuropsychology	0.53	70
Occupational Therapy	1.38	259
Nutrition	0.43	42
Prosthetics and Orthotics	0.14	34
Podiatry	0.05	5
Physiotherapy	1.46	237
Speech Pathology	0.86	175
Social work	1.01	131
Nursing	9.5	-
Specialist Rehabilitation Physician	0.625	-
Junior Medical Staff	1	-

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Table 2. Intervention summary based on TIDieR, delivered by researchers.

Intervention components	Rationale	Mode of Delivery	Delivered to	When/how often
Evidence introductory education session, including target setting of 75% adherence	To familiarise staff with the audit/ feedback intervention and increase awareness of guideline indicators	Face-to-face (group)	Doctors, nurses, allied health staff, patient support staff, reception staff	Each staff member attended one session, and once at each new staff induction to the ward
Point of care access to clinical practice guideline evidence	To educate staff about the guidelines and ensure access to the evidence underpinning guideline indicators	Documents loaded onto an e-reader device	Doctors, nurses, allied health staff, patient support staff	Ongoing
Educational summary of guideline indicators	To provide education about single guideline indicators and promote self-monitoring	Small summarised poster mailed participants, and poster documents placed on wall	Doctors, nurses, allied health staff, patient support staff, reception staff	Small summarised poster mailed fortnightly to all staff; A3 summarised poster placed on wall ongoing
Audit and group feedback	To focus staff on targets and progress, group discussion aided in process of care changes to increase adherence rates	Feedback presentation displayed rates graphically, feedback delivered face-to-face (group)	All available staff on shift at time of feedback presentation	Fortnightly auditing of cases, feedback delivered bi-weekly
Feedback to staff outside of scheduled feedback sessions	To update staff on progress and targets	Feedback provided one-on-one or email copy of feedback presentation. Fortnightly feedback was made available on the organisation's share drive.	Staff who missed all the biweekly feedback sessions and requested an update	Adhoc, ~1 staff per fortnight

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(allied health, nursing and medical); d) patient interview; and e) family / friend interviews. At the completion of both audits, descriptive statistics (proportion of criteria adherence) were calculated and prepared for the clinician feedback meeting. Feedback sessions were offered twice within each fortnight period to enable shift-working staff to attend. These 15-minute sessions provided the audit results to clinicians, and were delivered by the senior author (NL) an accepted member of staff. Following the feedback sessions, data were made available to all staff via a shared drive on the organization's computer network. These audit-feedback cycles were repeated every two weeks for 14 months. The intervention is summarized in Table 2; please refer to (Fig 2) for the flow of the fortnightly intervention and (S1 Table) for the Standards for Reporting Implementation Studies.

Audit data were triangulated, involving a medical file audit, interviews with clinical staff, and interviews with the patient and/or family. An example of an interview question with a clinical staff member is *"Can you identify the patient's primary rehabilitation goals consistent with the documented goals from the interdisciplinary family meeting"*. If the clinician responded correctly, this item was deemed met and scored "yes" on the audit form. An example of a medical file audit indicator was *Does the patient receive 4.5–5 hours of therapy daily*? To score 'yes' for this item, on ward observations as well as review of the patient's therapy timetable was completed. An example of an interview question with the patient and or family member is *"Did someone provide you with a tour of the unit when you first arrived on the ward"* The responses to these interviews (yes or no) were recorded on the audit form. (The data dictionary of audit criteria is available from author on request).

A cessation period of three months then ensued, in which no auditing or feedback occurred. In March 2016, n = 20 randomly selected inpatient cases were audited (consistent with the main audit method) to investigate guideline adherence following intervention cessation.

Organizational context

The intervention was tailored to the organization, and designed to be multifaceted (to increase the likelihood of uptake) and frequent (to lower the fidelity gap). The core of the intervention

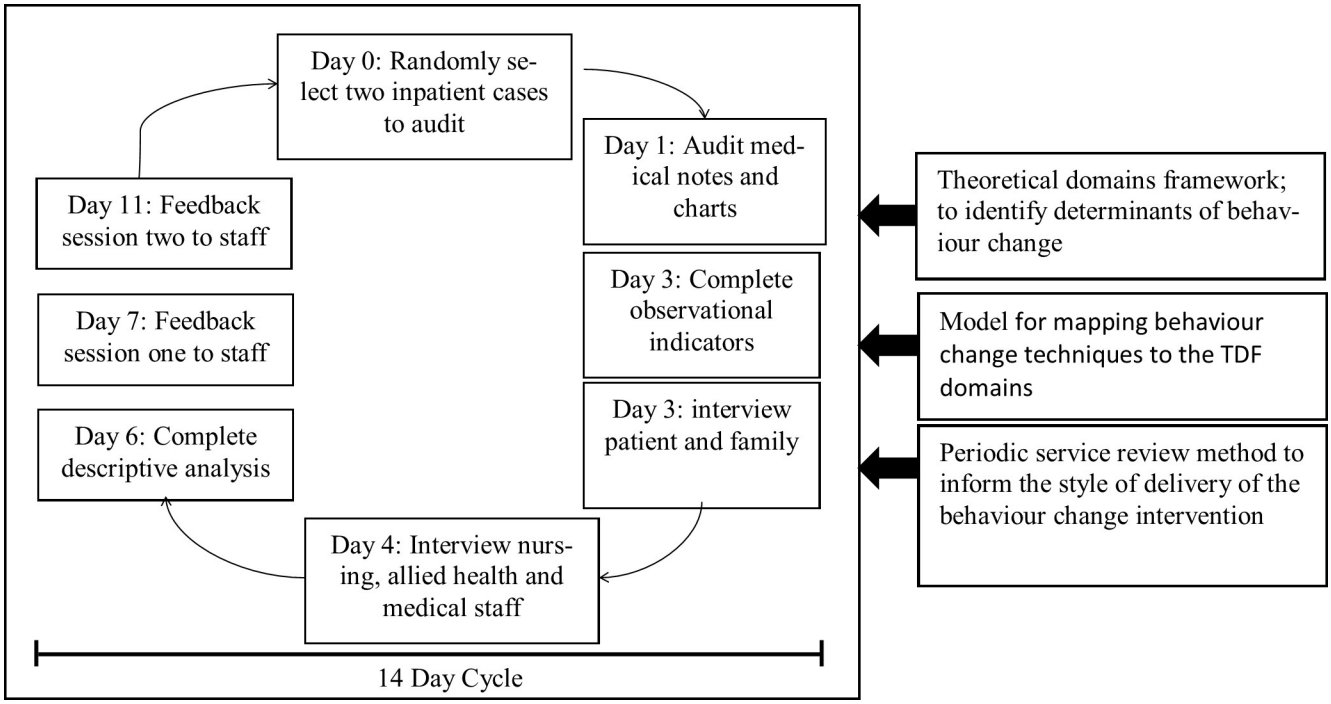

Fig 2. Flow of fortnightly intervention.

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(i.e. audit and feedback) was held consistent throughout the study (no adaptations); instead, the passive knowledge translation interventions (in particular, the education components) were tailored to address highlighted fidelity gaps each fortnight. For example, if auditing revealed low adherence to a guideline indicator, an evidence summary was created to increase staff awareness of the expected behavior. To understand the intervention *dose delivered* and *dose received*, we collected data on both number of staff employed (who would have received all passive knowledge translation components) and number of staff who attended the feedback sessions (referring to exposure to and uptake of the core intervention).

Our implementation intervention targeted behavior changes within both the individual (i.e., staff) and the organization. While the feedback was provided to staff, behavior change discussions held within feedback sessions took into consideration the context of the organization, the patient / family dyads and the national healthcare system). With staff leading the behavior changes, they held in-depth knowledge of the processes that controlled adoption of the guidelines within their organization, maximizing effect[28]. Our implementation targets were individual clinicians who worked within the rehabilitation unit, however, buy-in and support from management was an obvious factor impacting on implementation effectiveness. The Director of Rehabilitation, Director of Nursing Services and the Service Manager were asked to communicate support for guideline implementation to staff during orientation, at staff meetings, and via email throughout the intervention period.

Outcome measures

The primary outcome was adherence to guideline indicators as measured by the audits. Consistent with the auditing which formed part of the intervention, this included triangulation of data from the medical file audits, unit based observations, and patient, staff, family interviews.

Data analysis

Each fortnight, dichotomous data were recorded in an excel spreadsheet, and later imported into SPSS V24 for analysis. The mean adherence from audit data of month 0–2 was calculated to represent 'baseline' adherence. Mean adherence audit data from month 13–15 was calculated to represent 'end of intervention' adherence comparisons. Following intervention cessation (months 15–18), 20 randomly selected cases were audited (month 18–19) to calculate average (mean) adherence to assess if adherence was maintained or reduced. Where an audit item was not applicable to the selected case (i.e., if the selected case was not minimally conscious and therefore the minimally conscious care item(s) were not applicable), this item(s) was removed from the analysis for that period.

Median (95% confidence intervals) and Mann-Whitney U analyses were used to describe comparisons across all data due to the small sample size at each timepoint (n = 8, n = 8, n = 20 respectively) producing non-normally distributed data. Confidence intervals were calculated to highlight statistical significance where it existed, along with measures of variance around median differences (IQR). Chi square analysis for individual guideline indicator items were conducted to compare adherence across comparison points (given data was binary) with Fischer exact test statistic additionally reported due to small sample size[29]. To describe the data, mean (95% confidence intervals) and difference between means (95% confidence intervals) were also calculated and are presented in (S2 Table). The Bonferroni correction was applied to adjust the alpha level for all tests since multiple comparisons were made (with tests run for 230 comparisons, the alpha level was lowered to 0.0002). Refer to (Fig 2) for diagrammatic representation of analysis points.

Following quantitative analysis, narrative synthesis was undertaken to synthesise findings from our study with recommendations relating to conducting audit and feedback projects drawn from previously conducted systematic reviews [12,13]. Two authors [NL, LJ] extracted contributing factors which led to the success of the audit and feedback program into categories highlighted by these previous systematic reviews. All authors then reviewed and refined the list of factors.

Results

During the study period, 58 clinical staff were employed with strong representation at fortnightly feedback sessions, mean of 67% (SD 8) attendance. Clinical profiles of patients audited at time point is presented in Table 3.

The sustained audit and feedback program significantly increased clinician's adherence to guideline recommendation from median 38.8% (95% CI 34.3 to 44.4) at baseline to 83.6% (95% CI 81.8 to 88.5) at the end of the intervention. Table 4 shows median total adherence at each time point. Following cessation of the audit and feedback program, clinician adherence levels decreased by 7% (95% CI .51 to 14.0) from the end of the intervention to follow up, however adherence to guideline indicators was maintained above the organization's goal of 75% adherence.

Adherence differed across guideline indicators, with some indicators more susceptible to change with the audit and feedback program, and others that were not. For example, indicators related to 'goal setting', 'therapy' and 'roles and responsibilities' increased significantly during the intervention period, but this increase was not sustained at follow up. Conversely, adherence to most of the 'ward round' indicators did not improve during the intervention period. Refer to Table 5 (and S2 Table) for full indicator change results.

Table 3. Patient demographic characteristics of randomly selected patients included at each audit time point.

Characteristic	Time points		
	0–2 months *(n = 8)*	13–15 months; post intervention *(n = 8)*	18–19 months; follow-up *(n = 20)*
Diagnosis			
TBI, n (%)	3 (38)	4 (50)	7 (35)
Stroke, n (%)	4 (50)	3 (28)	7 (35)
Other*, n (%)	1 (12)	1 (12)	6 (30)
Gender			
Male, n (%)	6 (75)	6 (75)	16 (80)
Age, *mean years (sd)*	42 (16)	38 (17)	47 (15)
Length of stay *mean days, (min—max)*	193 (23–423)	106 (13–452)	147 (37–362)
Total FIM score at Admission (possible scores18-126), *median (IQR)*	27 (18.5, 42.5)	28 (20, 50.5)	33 (19,70.5)
FIM Cognitive Score at Admission (possible scores 5–35), *median (IQR)*	7.5 (5.5, 16.5)	8.5 (5, 16)	10 (5, 16)
FIM Motor Score at Admission (possible scores 13–91), *median (IQR)*	17.5 (13, 25)	18 (13.5, 37.5)	16 (61,13)

TBI = Traumatic Brain Injury

*Tumour and/or hypoxic brain injury.

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Discussion

Our sustained fortnightly audit and feedback program led to a significant increase in adherence to clinical practice guideline recommendations. Following the three-month cessation period during which no audit and feedback was provided, adherence to guideline recommendations decreased (but remained above the organization's benchmark of ≥75% adherence). The positive results of our study contrast to other audit and feedback studies conducted in rehabilitation [15,16,17]. Our program had strong support from senior management and the organization, as well as external funding. This external context supported higher frequency audit and feedback cycles, and our feedback was grounded in social cognitive modelling. The adherence improvements following intervention were likely due to a combination of the following attributes of our program: a) high level of managerial support, b) feedback delivered using a non-aversive and clinician-led approach, c) high frequency of audit and feedback cycles, d) 12-month duration of the program, and e) shared goal of working towards a target of ≥75% adherence. By describing these attributes, future studies can build on our program's success.

We do acknowledge that when the audit and feedback program was ceased, adherence rates decreased, although they did not return to baseline levels. This decrease was not unexpected, and while we did not investigate the reasons why, we anticipate that the loss of accountability

Table 4. Median (IQR) of clinical practice guideline indicator adherence across measurement points, median differences between timepoints (95% Confidence Interval) and significance of the between group difference.

Adherence	Percent (%) of clinical practice adherence obtained at three time points (IQR)			Difference between groups; Mann-Whitney U, p-value*	
	0–2 months (baseline)	13–15 months (post intervention)	18–19 months (follow-up)	13–15 months minus 0–2 months	18–19 months minus 13–15 months
Total adherence (%)	38.8 (32.8, 65.1)	83.6 (78.4, 89.4)	76.6 (60.4, 88.6)	45.2 (95% CI 38.5 to 50.3) .000, $p = 0.0001$*	-7.0 (95% CI -0.5 to -14.0) 125, $p = 0.0102$

CPG = clinical practice guideline, CI = Confidence Interval

* statistically significant at the Bonferroni adjusted p-value 0.000217

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Table 5. Adherence to audited indictors (n = 114) at three audit time points and difference (Chi square) between time points.

Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	Adherence to audit criteria			Differences in adherence measured between time points			
	0–2 months (n = 8)	13–15 months; post intervention (n = 8)	18–19 months; follow-up (n = 20)	13–15 months minus 0–2 months		18–19 months minus 13–15 months	
	n	n	N	*p* value (Fischer exact statistic)	Cramer's V	*p* value (Fischer exact statistic)	Cramer's V
Behavioural support plan							
1: Patient behavioural support plan is known to the family and informal carers [Model of care recommendation]	3	1	5	*	*	1.0	.289
2: An admission screen of behavioural support requirements has taken place [26]	3	8	19	.026	.674‡	1.0	.122
3: Patient behavioural support plan is in place [26]	2	3	12	.196	.600‡	*	*
4: The implementation of strategies documented in the patient behavioural support plan occurs [26]	2	3	12	.429	.548‡	*	*
5: Patient behavioural support plan is known to staff [26]	7	8	18	*	*	*	*
6: Antecedent behaviours are known to staff [26]	2	1	10	1.0	.333†	.154	.452†
Care plan							
1: Family are able to identify primary rehabilitation goals consistent with documented goals from interdisciplinary family meeting [Model of care recommendation]	3	4	8	.444	.478†	.516	.333†
2: Patient centred goals are displayed appropriately in the patient's room [Model of care recommendation]	1	7	12	.010	.732†	.214	.266
3: Patient is able to identify primary rehabilitation goals consistent with documented goals from interdisciplinary family meeting [Model of care recommendation]	4	6	5	1.0	.076	.569	.262
4: Up-to-date treatment plan is in place [26]	5	6	17	1.0	.135	.606	.118
5: Documented goals guide and inform therapy and treatment [43]	2	8	14	.007	.775‡	.141	.330†
6: Staff are able to identify primary rehabilitation goals consistent with documented goals from interdisciplinary family meeting [Model of care recommendation]	7	8	13	1.0	.258	.142	.365†
Continuity of care							
1: Engagement with visitors is evident throughout a clear welcoming process [Model of care recommendation]	1	6	13	*	*	*	*
2: A patient centred care approach is used on the unit throughout the entire patient journey [10,25,27,40,42,43,44]	2	8	18	.015	.730‡	.577	.175
3: Continuity of care is in place for nursing [Model of care recommendation]	0	8	14	.0001§	1.0‡	.141	.330†
4: Continuity of care is in place for allied health [Model of care recommendation]	1	8	16	*	*	.295	.258
5: Continuity of care is in place for medicine [Model of care recommendation]	1	8	20	*	*	*	*
6: Patient/ family/informal caregivers are involved in the care planning meeting on the unit. [10,27,42,43]	1	7	18	.005	.854‡	1.0	.121
7: Escalation of patient issues or concerns has been documented appropriately [Model of care recommendation]	1	6	13	*	*	*	*
8: Engagement with family/informal caregiver is evident throughout every stage of recovery. [medical notes] [11,27]	5	8	20	.200	.480†	*	*

(*Continued*)

Table 5. (Continued)

Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	Adherence to audit criteria			Differences in adherence measured between time points			
	0–2 months (n = 8)	13–15 months; post intervention (n = 8)	18–19 months; follow-up (n = 20)	13–15 months minus 0–2 months		18–19 months minus 13–15 months	
	n	n	N	*p* value (Fischer exact statistic)	Cramer's V	*p* value (Fischer exact statistic)	Cramer's V
9: Engagement with family/informal caregiver is evident throughout every stage of recovery. [family report] [11, 27]	2	5	10	.021	.732‡	.559	.236
Discharge planning							
1: Interdisciplinary and patient (and family) directed discharge plan development is in place [25,40,43,44]	5	6	7	1.0	.174	.165	.370†
2: Training of family/ informal caregivers occurs prior to discharge: including safe use of equipment and management of the patient to ensure patient & caregiver safety in the home environment [medical notes] [25, 43] (a minimum of 4 weeks)	1	2	0	*	*	*	*
3: Assessment of discharge destination environment and available support occurs prior to discharge [25, 43] (a minimum of 4 weeks)	0	5	4	.167	1.0‡	.455	.430†
4: All required equipment and adaptations are provided prior to discharge [25]	*	1	0	*	*	1.0	1.0‡
5: Training of family/ informal caregivers occurs prior to discharge: including safe use of equipment and management of the patient to ensure patient & caregiver safety in the home environment [family report] [25, 43] (a minimum of 4 weeks prior)	1	1	1	*	*	*	*
6: Educating patients and family/informal caregivers about relevant formal and informal resources and how to access these resources including voluntary services and groups occurs prior to discharge [26, 43]	0	1	1	1.0	.333†	1.0	.577‡
7: Minimum of two weeks (before discharge) are spent in the transitional living space [26]	3	3	1	*	*	1.0	.250
Equipment use							
1: Instructions for the patient's individualised equipment use is in place [43]	7	8	14	1.0	.258	1.0	.156
2: If prescribed, ceiling track hoist is used for every transfer within the past week [Model of care recommendation]	1	4	3	.333	.632‡	1.0	.378†
3: All staff are aware of the patient's individualised equipment needs [medical notes] [Model of care recommendation]	7	6	20	1.0	.277	.259	.331†
4: All staff are aware of the patient's individualised equipment needs [ask staff] [Model of care recommendation]	7	8	20	*	*	*	*
Patient/family education [11]							
1: Ward orientation	3	7	16	.119	.516‡	1.0	.020
2: Diet/nutrition	2	0	1	.487	.337†	1.0	.141
3: Psychosocial changes after ABI	1	7	15	.010	.750‡	1.0	.101
4: Wounds/lines/drains/airways	0	2	2	1.0	.316†	.547	.234
5: Tracheostomy care	*	1	1	*	*	*	*
6: Goal setting and rehabilitation importance	3	8	16	.026	.674‡	.532	.229
7: Discharge planning	1	7	11	.010	.750‡	.201	.287

(*Continued*)

Table 5. (Continued)

Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	Adherence to audit criteria			Differences in adherence measured between time points			
	0–2 months (n = 8)	13–15 months; post intervention (n = 8)	18–19 months; follow-up (n = 20)	13–15 months minus 0–2 months		18–19 months minus 13–15 months	
	n	n	N	*p* value (Fischer exact statistic)	Cramer's V	*p* value (Fischer exact statistic)	Cramer's V
8: Patient/family centred care	2	8	17	.007	.775‡	.567	.184
9: Diagnosis/illness/injury	1	6	16	.041	.630‡	.616	.108
10: Medical procedures/treatments	1	1	7	1.0	1.0‡	.364	.243
11: Safety	1	8	10	.001	.882‡	.026	.459†
12: Activity/mobility	0	7	8	.001	.882‡	.043	.417†
13: Self-care ADLs within the ward	1	7	6	.010	.750‡	.030	.500‡
14: Pain management	0	3	1	.200	.480†	.091	.395†
15: Medication management	0	0	5	*	*	.280	.309†
16: Equipment use	1	8	9	.001	.882‡	.115	.410†
Goal setting							
1: Patient has commenced goals setting within 48 hours of admission [11]	8	8	14	*	*	.277	.287
2: Goal-based planning meeting has taken place [11, 26] (within 2 weeks of admission)	0	8	13	.0001§	1.0‡	.142	.365†
Medical management							
1: Family / caregivers trained in the medical management plans for paretic upper limbs during transfers, hypersensitivity, and neurogenic pain are in place [26]	1	4	2	.143	.730‡	*	*
2: Benzodiazepines and Neuroleptic antipsychotics use minimised [10]	4	6	14	.608	.189	1.0	.030
3: Medication for Executive Dysfunction follows recommended guidelines [26]	*	*	0	*	*	*	*
4: Medication for management of memory is in place [26]	*	*	0	*	*	*	*
5: Stimulants are prescribed for management of memory as appropriate [26]	*	*	0	*	*	*	*
6: Medication for Arousal and Attention is prescribed appropriately [26,40]	2	2	0	*	*	*	*
7: Pain management plans are regularly reviewed [26]	7	8	19	*	*	*	*
8: Medical management plans for paretic upper limbs during transfers, hypersensitivity, and neurogenic pain are in place [26]	2	4	6	.429	.471†	1.0	.239
9: Appropriate medication management of agitation/ aggression is in place [26,40]	3	3	4	*	*	.500	.378†
10: Appropriate medication management of spasticity is in place [10,40,43]	0	3	5	.100	1.0‡	*	*
11: Appropriate medication management of mood and seizures is in place [26]	1	3	18	.400	.612‡	*	*
Medical records							
1: All invasive procedures are documented in accordance with hospital policies [Hospital policy]	1	8	20	.001	.882‡	*	*
2: Records only contain accurate statements of fact or clinical judgement [41]	7	8	20	1.0	.258	*	*
3: Records only contain abbreviations which are accepted and commonly known [Hospital policy]	4	8	20	.077	.577‡	*	*

(*Continued*)

Table 5. (Continued)

Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	Adherence to audit criteria			Differences in adherence measured between time points			
	0–2 months (n = 8)	13–15 months; post intervention (n = 8)	18–19 months; follow-up (n = 20)	13–15 months minus 0–2 months		18–19 months minus 13–15 months	
	n	n	N	*p* value (Fischer exact statistic)	Cramer's V	*p* value (Fischer exact statistic)	Cramer's V
Minimally conscious care							
1: Patients in a Coma, Vegetative and Minimal Conscious State are screened using a consistent assessment of recovery [40]	*	1	1	*	*	*	*
2: The Coma Recovery Scale -Revised has been administered consistently [40]	*	1	1	*	*[0]	*	*
3: Multisensory stimulation for patient in a coma or vegetative state is not carried out as an intervention [40]	*	1	1	*	*	*	*
Safety							
1: During the past week, the patient was sitting out of bed on morning of observation before 8am [Model of care recommendation]	0	4	13	.467	.408[†]	.359	.265
2: Safe diet strategies are in place [Model of care recommendation]	7	8	19	1.0	.258	*	*
3: Safe diet strategies are followed [Model of care recommendation]	7	8	19	1.0	.258	*	*
4: During the past week, the patient was sitting out of bed for all meals [Model of care recommendation]	2	4	14	1.0	.333[†]	.576	.167
5: All patients are screened for their fall risk as soon as practicable after admission [hospital policy]	*	8	20	*	*	*	*
6: All patients are screened for their pressure injury/sore risk as soon as practicable after admission [hospital policy]	*	8	20	*	*	*	*
7: All staff working with patients can identify safe transferring strategies [43]	8	8	20	*	*	*	*
Personal care regime							
1: Maximum privacy during use of the toilet at all times [Model of care recommendation]	*	4	10	*	*	*	*
2: All patients will have showers at a regular time each day consistent with their pre-injury showering time [Model of care recommendation] [medical notes]	0	4	10	.200	1.0[‡]	*	*
3: Patient personal care regimes are documented to ensure consistency between staff & with the aim of maximising independence [Model of care recommendation]	6	6	15	*	*	1.0	.000
4: All patients have a personalised toileting regime in place, at a regular time each day [Model of care recommendation]	1	0	2	1.0	.189	1.0	.222
5: All patients will have showers at a regular time each day consistent with their pre-injury showering time [Model of care recommendation] [ask patient]	1	5	14	.103	.577[‡]	.557	.195
Post traumatic amnesia management							
1: The Westmead PTA Scale (WPTAS) is commenced within 24 hours of emerging from coma and used to assess all patients following closed TBI [45]	2	2	1	*	*	*	*
2: The Orientation Log (O-Log) is commenced within 24 hours of emerging from coma for all other neurological patients (open TBI, stroke, hypoxic brain injury) [45]	*	*	1	*	*	1.0	1.0[‡]

(*Continued*)

Table 5. (Continued)

Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	Adherence to audit criteria			Differences in adherence measured between time points			
	0–2 months (n = 8)	13–15 months; post intervention (n = 8)	18–19 months; follow-up (n = 20)	13–15 months minus 0–2 months		18–19 months minus 13–15 months	
	n	n	N	*p* value (Fischer exact statistic)	Cramer's V	*p* value (Fischer exact statistic)	Cramer's V
3: The WPTAS /O-Log is administered by a consistent member of appropriately trained staff. (Clinical guidelines) [45]	1	4	8	.333	.632‡	.516	.333†
4: The WPTAS/O-Log is administered at a consistent time each day [Model of care recommendation]	0	4	10	.067	1.0‡	1.0	.218
5: Patients in PTA receive goal-oriented and procedural therapy (no new learning) [45]	4	5	4	*	*	1.0	.333†
Roles and responsibilities							
1: Roles and responsibilities for the implementation of the patient's care are in place for family/caregivers and have been discussed with family [Model of care recommendation]	0	5	8	.008	1.0‡	.261	.358†
2: Roles and responsibilities for the implementation of the patient's care are followed by the family/informal caregivers [Model of care recommendation]	4	5	9	*	*	.542	.255
3: Patient and/or their families/ informal caregivers are involved in the provision of patient care [Model of care recommendation]	5	6	11	*	*	1.0	.171
4: Roles and responsibilities for the implementation of the patient's care are in place for family/informal caregivers [Model of care recommendation]	0	7	12	.001	.882‡	.214	.266
5: Roles and responsibilities for the implementation of the patient's care are followed by the family/informal caregivers [Model of care recommendation]	0	7	12	.0001§	1.0‡	.273	.303†
6: Patient and/or their families/ informal caregivers are involved in the provision of patient care as much as they wish [26]	5	8	19	.200	.480†	1.0	.122
Therapy							
1: All appropriate patients are screened by a speech and language therapist within 48 hours of admission [26]	7	8	18	*	*	.577	.175
2: Seating plans are communicated with the family/ informal caregivers [Model of care recommendation]	1	4	5	*	*	*	*
3: A therapy timetable is in place for each patient [Model of care recommendation]	7	8	18	1.0	.258	1.0	.127
4: Therapy is provided in the appropriate context for the individual [Model of care recommendation]	1	8	20	.200	.667‡	*	*
5: Learning and memory aids are in place in patient's room [Model of care recommendation]	5	8	19	.200	.419†	1.0	.122
6: Management of motor function and control is in place and follows evidenced based guidelines [10,11,25,26]	0	7	14	.001	.882‡	1.0	.000
7: Therapy is provided in the appropriate context for the individual [26, 42]	1	8	20	.003	.861‡	*	*
8: Leisure and recreation activities are included in the patient's weekly program [26, 42]	4	2	10	.608	.258	.236	.254
9: Seating needs are assessed within the required timeframe [Model of care recommendation]	4	8	20	.077	.535‡	*	*
10: Seating plans are followed by all staff. [Model of care recommendation]	1	7	12	.010	.837‡	*	*

(*Continued*)

Table 5. (Continued)

Explicit audit indicators linked to model of care and/or clinical practice guideline recommendations	Adherence to audit criteria			Differences in adherence measured between time points			
	0–2 months (n = 8)	13–15 months; post intervention (n = 8)	18–19 months; follow-up (n = 20)	13–15 months minus 0–2 months		18–19 months minus 13–15 months	
	n	n	N	*p* value (Fischer exact statistic)	Cramer's V	*p* value (Fischer exact statistic)	Cramer's V
11: Patients with a visual impairment have been assessed as per guidelines [10,11,25,26,40,43,44]	0	4	6	.167	.632‡	1.0	.000
12: Patients received a minimum of 4 hours of therapy per day at least 5 days a week in the past week [Model of care recommendation]	0	2	3	.467	.378†	1.0	.098
13: There is documented evidence that patients have received therapy from at least 3 different professions during the past week [Model of care recommendation]	6	8	19	.467	.378†	1.0	.122
14: Effective treatment approaches for rehabilitation are in place and embedded in daily life activities [10]	4	7	10	.282	.405†	.190	.330†
15: Learning and memory aids are in place and documented [42, 45]	3	7	20	.070	.632‡	*	*
16: If '15' Is Yes: Patient is trained in the use of one, single external aid to compensate for memory impairments [Model of care recommendation]	2	6	18	.103	.537‡	1.0	.150
17: Errorless learning approach / scripts are documented [Model of care recommendation]	0	2	8	.091	.632‡	1.0	.060
18: Interventions addressing poor executive functioning are in place [45]	1	1	0	.250	.655‡	.167	1.0‡
19: Repetition of computer based tasks are not carried out unless additional cognitive rehabilitation strategies are used [45]	3	2	7	*	*	*	*
20: Staff are aware of seating plan [Model of care recommendation]	4	7	19	.192	.461†	*	*
Ward round							
1: Documented evidence of that the weekly ward round includes ANUM and the patient nurse in addition to RMO/Resident and rehabilitation physician [41]	2	0	0	.467	.378†	*	*
2: Documented evidence of the weekly ward round records nursing dependency data [Model of care recommendation]	*	*	1	*	*	1.0	.122
3: Documented evidence that ward rounds are taken to each patient (inclusive of therapy spaces) [Model of care recommendation]	0	8	20	.0001§	1.0‡	*	*
4: Documented evidence that weekly ward rounds include discussion of: basic care needs, specialised nursing needs, dependency on nursing time for common tasks, and influences on dependency [41]	*	*	1	*	*	1.0	.122

* = Unable to compute as some items responses are 'not applicable'

† = medium effect size[41]

‡ = large effect size[41]

§ statistically significant at the Bonferroni adjusted p-value 0.000217

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(knowledge that auditing was not occurring) as well as no longer having formal opportunities to reflect on practice gaps contributed to the lower rates of adherence. Interestingly, there were some audit indicators that increased in adherence after the program was ceased which suggests

that comprehensive processes developed and established during the study period carried over beyond the period of audit and feedback.

Our results support many findings from audit and feedback studies conducted outside of rehabilitation. Indicators that had high adherence at baseline in our study were also less likely to improve with regular audit and feedback [12, 13, 30, 31]- the benefits of audit and feedback programs are likely greatest when baseline performance is low. The use of positive support while delivering feedback (i.e. employing a 'no blame' ethos and highlighting discipline 'achievements') is also consistent with other studies [18, 32, 33] which suggest that when feedback which is perceived as supportive rather than punitive, it is more likely to positively influence clinician behavior. Finally, our study provided feedback in both written and verbal formats by a respected internal senior member of staff. These characteristics are described in systematic reviews as effective strategies to increase audit and feedback effectiveness [12, 13]. Future studies testing audit and feedback interventions should continue to investigate models of providing feedback.

Setting targets (or goals) has been proposed as increasing the effectiveness of feedback, however, this remains uncertain [34, 35]. In contrast to Garner and colleagues[36], our results suggest that setting goals and developing action plans during feedback sessions was an effective strategy. With positive support, the facilitator guided clinician discussions towards solutions and encouraged the clinicians to create changes that may lead to increased guideline adherence for the following fortnight. The use of a cognitive model, in combination with high frequency (i.e., fortnightly) and solution-focused feedback is a novel addition to the evaluative studies in this field and supported in theory by the work of Hysong [13] and Ivers [12, 31]. Fig 3 outlines these potential factors which may have contributed to the success of the audit and feedback program.

Organizational expectation of clinician participation was likely to contribute to the high level of staff engagement achieved in the present study. Current behavior change models focus predominantly on individual level or local change characteristics (i.e. the Behaviour Change Wheel [37] and Theoretical Domains Framework [38]). Research around behavior change interventions have explored staff motivation for and perceptions of audit and feedback on an individual level [18]. Less discussed is how organizational expectations drive behavior change in clinicians. The revisited Promoting Action on Research Implementation (PARiHS) framework aptly encompasses the construct of environment and context; separating out micro (local) and meso (organizational) from macro (political, policy) levels [39]. In this framework, organizational systems and culture are a key consideration for behavior change. Given the organizational expectation of staff involvement in our current study, as well as the intervention frequency (i.e. fortnightly) and paid staff time release for feedback, the strong contribution of organization and culture to our positive findings cannot be overlooked.

Study limitations

Like all pragmatic studies in the clinical setting, our study is not without limitations. Not all staff attended each fortnight's feedback session. While this reflects the practical reality of a ward environment and the shiftwork nature of hospital staffing, it did mean that not all clinicians received regular feedback. This study sought to investigate the effectiveness of a sustained program, and so this was an accepted limitation within the design of the study. We also acknowledge that the use of only one site may limit the generalizability of the results. The use of only one site also limits our ability to predict whether scaling up will achieve similar rates of adoption and delivery across multiple organizations. Furthermore, contextual factors may have positively affected the uptake at our study site (since it was newly established with newly

- Strong management and organizational support for the audit and feedback program.
- Complete auditing with clear pre-determined indicators and specific criteria for measurement (i.e., what is considered 'indicator met' vs 'indicator unmet')
- Audit against latest clinical practice guideline recommendations
- Complete audit and feedback cycles frequently (fortnightly – monthly)
- Complete audit and feedback cycles over a sustained period of time (>12 months)
- Deliver verbal feedback in the form of face to face meetings from a respected internal senior staff member
- Use positive behavioural support (from social cognitive modelling) during feedback meetings and facilitate the group to come to the correct solution
- Encourage and empower clinical staff to be responsible for modifying processes that might increase adherence for the following audit and feedback cycle.
- Provide strong emphasis on a no blame ethos, and acknowledge department/s (i.e., occupational therapy, nursing, physiotherapy) who demonstrate excellent achievement (for that cycle).
- Provide access to each cycle's feedback on a shared system (e.g. shared network computer drive) to all relevant clinical staff.

Fig 3. Factors that contribute to the success of the audit and feedback program as indicated by the present study.

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employed staff) which may not directly translate to other sites. Our program also sought to improve adherence to n = 114 indicators of best-practice rehabilitation. While effective at the single site, scaling up our complex audit and feedback intervention may not be straightforward and future programs may choose a smaller number of indicators to implement. Finally, this was a funded study, so sustainable infrastructure needs to be established to enable scaling up. We recommend that future studies include a controlled comparison, consider using both publically and privately funded rehabilitation hospitals, and include a cost/benefit analysis alongside any evaluation of efficacy.

Conclusion

Our study demonstrated that a frequent and sustained audit and feedback program is an effective knowledge translation intervention to increase adherence to brain injury rehabilitation guidelines. Findings also highlighted that some guideline recommendation indicators that are less likely to change with audit and feedback, suggesting that alternative knowledge translation strategies may be more appropriate to achieve behavior change for these items. Our program

has the potential to inform both local and larger initiatives to improve the quality of rehabilitation received, and more significantly beyond rehabilitation, in the field of implementation science and the knowledge base underpinning audit and feedback.

Supporting information

S1 Table. Standards for Reporting Implementation Studies: the StaRI checklist for completion.
(DOCX)

S2 Table. Proportion (%) (95% CI) of clinical practice guideline indicator adherence (n = 114) across measurement points.
(DOCX)

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