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Effectiveness of research implementation strategies for evidence informed healthcare policy and practice

Mitchell Nicholas Sarkies

Bachelor of Applied Science (Physiotherapy)

A thesis submitted for the degree of Doctor of Philosophy at Monash University in 2018

Department of Physiotherapy

Faculty of Medicine, Nursing and Health Sciences


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Abstract

Background: Globally, health systems fail to use scientific evidence optimally. This is demonstrated by time lags between study conduct and uptake into healthcare policy and practice. The delay in research implementation leads to healthcare inefficiency, and failure to benefit from potential improvements in mortality, quality of life and other health outcomes. Research implementation strategies such as education, knowledge brokering, and audit and feedback are increasingly seen as a means to reduce the gap between research evidence and healthcare policy and practice. However, a systematic review conducted as part of this thesis identified only three experimental studies evaluating the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare. Therefore, comparative effectiveness studies using randomised controlled designs are needed in order to justify further investment of public health resources towards research implementation strategies. The aim of this doctoral research is to explore the application of different methodological approaches to determine the effectiveness of research implementation strategies for facilitation of evidence-informed healthcare resource allocation decisions.

Method: This program of doctoral research consisted of five studies. These studies focussed on applying conventional implementation study designs and the novel application of counterbalanced methodology in implementation settings. A conventional implementation study design was applied to implement weekend allied health service recommendations in Australian and New Zealand hospitals. This conventional application commenced with a systematic review and meta-analysis evaluating the effectiveness of additional weekend allied health service provision in specific hospital settings (Chapter 4) to determine readiness for implementation. Chapter 5 then presents a cluster randomised controlled trial protocol to implement evidence based weekend service recommendations into healthcare policy and practice. The novel application of counterbalanced methodology focussed on implementing evidence for falls prevention and deep vein thrombosis management. This commenced with a methodological description of a helix counterbalanced study design and how this can be applied to implementation trials (Chapter 6). A counterbalanced randomised controlled implementation study design was then applied to compare the effectiveness of video and written knowledge translation strategies in Chapter 7, allowing the concurrent evaluation of implementation strategies across multiple contexts.

Results: Applying a conventional study design to implement weekend allied health service recommendations in Chapter 4 and 5 begun with a systematic review and meta-analysis finding additional weekend allied health service provision reduced hospital length of stay in subacute rehabilitation wards but had no identified benefit for acute general medical and surgical wards (Chapter 4). The subsequent cluster randomised controlled trial protocol to implement evidence based weekend service recommendations for allied health managers (Chapter 5) will be completed postdoctoral conferral. A novel application of helix counterbalanced methodology to implement evidence for falls prevention and management of deep vein thrombosis using video and written knowledge translation strategies in Chapter 6 and 7 resulted in the recruitment of 119 nursing and allied health participants. Exposure to the video modality increased the likelihood of a knowledge test response that was aligned with the research evidence compared to the no information control, but this was not the case for exposure to written modality.

Conclusions: A number of different methodological approaches can facilitate the use of high-level randomised controlled experiments to evaluate research implementation strategies. Novel application of counterbalanced methodology identified that the provision of video knowledge translation strategies to nursing and allied health professionals increases the likelihood they will understand the main findings from research articles. It is hoped that applying a conventional cluster randomised controlled trial to implement evidence based weekend service recommendations leads to socially meaningful improvements in patient and organisational outcomes.

Keywords: Implementation, nursing, allied health, weekend, falls, deep vein thrombosis, counterbalanced, helix, efficacy standardised effect, health policy.

General Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signature:

Print name: Mitchell Nicholas Sarkies

Date:

Thesis including published works declaration

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes three original papers published in peer-reviewed journals and three unpublished papers. The core theme of the thesis is implementing evidence into healthcare policy and practice. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the student, working within the Faculty Medicine, Nursing and Health Sciences under the supervision of Professor Terry P Haines, Dr Kelly-Ann Bowles, Dr Elizabeth H Skinner, and Dr Jennifer White.

The inclusion of co-authors reflects the fact that the work came from active collaboration between researchers and acknowledges input into team-based research. In the case of Chapters 2, 4, 5, 6, and 7, my contribution to the work involved the following:

Table of publications in thesis

Thesis Chapter	Publication title	Publication status	Nature and % of student contribution	Co-author name(s) and % of co-author's contribution	Co-author(s) Monash student Y/N
Chapter 2	The effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare: a systematic review	Published *Implementation Science*	Led the conception, design, search strategy development, registration, screening, data extraction, analysis and synthesis, drafting and manuscript preparation: 75%	Bowles, K-A. contributed to the conception, design, search strategy development, and drafting and preparing the manuscript: 5% Skinner, E. H. contributed to the conception, design, search strategy development, drafting and manuscript preparation: 5% Haas, R. contributed screening, data extraction, and drafting and manuscript preparation: 5% Lane, H. contributed screening, data extraction, and drafting and manuscript preparation: 5% Haines, T. P. contributed to the conception, design, search strategy, analysis and synthesis and drafting and manuscript preparation: 5%	No No Yes Yes No

				Bowles, K-A. contributed to the conception, drafting and manuscript preparation: 5%	No
				Haines, T, P. contributed to the conception, drafting and manuscript preparation: 10%	No
Chapter 4	Additional weekend allied health services reduce length of stay in subacute rehabilitation wards but their effectiveness and cost-effectiveness are unclear in acute general medical and surgical hospital wards: a systematic review	Published *Journal of Physiotherapy*	Led the conception, design, search strategy development, registration, screening, data extraction, analysis and synthesis, drafting and manuscript preparation: 65%	White, J. contributed to the conception, screening, data extraction, drafting and manuscript preparation: 5%	No
				Henderson, K. contributed to the, screening, data extraction, analysis and synthesis, drafting and manuscript preparation: 5%	No
				Haas, R. contributed to the conception, design, search strategy development, screening, data extraction, analysis and synthesis, drafting and manuscript preparation: 10%	Yes
				Bowles, J. contributed to the screening, data extraction, drafting and manuscript preparation: 5%	No
				Evidence Translation in Allied Health (EviTAH) Group. contributed to the conception, design, search strategy development, drafting and manuscript preparation: 10%	No
Chapter 5	Implementation of evidence based weekend service recommendations for allied health managers: a cluster randomised controlled trial protocol.	Published *Implementation Science*	Led the conception, design, intervention development, ethics submission, registration, drafting and manuscript preparation: 58%	White, J. contributed to the ethics submission, drafting and manuscript preparation: 2%	No
				Morris, M. contributed to the conception, intervention development, drafting and manuscript preparation: 2%	No
				Taylor, N. F. contributed to the conception, intervention development, ethics submission, drafting and manuscript preparation: 2%	No
				Williams, C. contributed to the conception, intervention development, ethics submission, drafting and manuscript preparation: 2%	No
				O'Brien, L. contributed to the conception, intervention development, drafting and manuscript preparation: 2%	No
				Martin, J. contributed to the conception, intervention development, drafting and manuscript preparation: 2%	No
				Bardoel, A. contributed to the conception, intervention development, drafting and manuscript preparation: 2%	No

				Holland, A. E. contributed to the conception, intervention development, ethics submission, drafting and manuscript preparation: 2%	No
				Carey, L. contributed to the conception, intervention development, drafting and manuscript preparation: 2%	No
				Skinner, E. contributed to the conception, intervention development, ethics submission, drafting and manuscript preparation: 5%	No
				Bowles, K. contributed to the conception, intervention development, drafting and manuscript preparation: 5%	No
				Grant, K. contributed to the intervention development, drafting and manuscript preparation: 2%	No
				Philip, K. contributed to the conception, drafting and manuscript preparation: 2%	No
				Haines, T. P. contributed to the conception, design, intervention development, ethics submission, registration, drafting and manuscript preparation: 10%	No
Chapter 6	A novel counterbalanced implementation study design: methodological description and application to implementation research	Published *Implementation Science*	Led the conception, design, drafting and manuscript preparation: 64%	Skinner, E. H. contributed to the drafting and manuscript preparation: 5%	No
				Bowles, K-A. contributed to the drafting and manuscript preparation: 5%	No
				Morris, M. contributed to the drafting and manuscript preparation: 2%	No
				Williams, C. contributed to the drafting and manuscript preparation: 2%	No
				O'Brien, L. contributed to the drafting and manuscript preparation: 2%	No
				Bardoel, A. contributed to the drafting and manuscript preparation: 2%	No
				Martin, J. contributed to the drafting and manuscript preparation: 2%	No
				Holland, A. E. contributed to the drafting and manuscript preparation: 2%	No
				Carey, L. contributed to the drafting and manuscript preparation: 2%	No
				White, J. contributed to the drafting and manuscript preparation: 2%	No
				Haines, T. P. contributed to the conception, design, drafting and manuscript preparation: 10%	No

Chapter 7	Video strategies improved health professional knowledge across different contexts: a helix counterbalanced randomised controlled study	Published *Journal of Clinical Epidemiology*	Led the conception, design, intervention development, ethics submission, registration, recruitment, data collection, analysis and synthesis, drafting and manuscript preparation: 80%	Maloney, S. contributed to the conception, drafting and manuscript preparation: 5% Symmons, M. contributed to the conception, ethics submission, drafting and manuscript preparation: 5% Haines, T. P. contributed to the conception, design, intervention development, ethics submission, registration, recruitment, data collection, analysis and synthesis, drafting and manuscript preparation: 10%	No No No

I have renumbered sections and reformatted referencing style of submitted or published papers to generate a consistent presentation as well as a consolidated reference list within the thesis.

Student signature: Date:

The undersigned hereby certifies that the above declaration correctly reflects the nature and extent of the student's and co-authors' contributions to this work. In instances where I am not the responsible author I have consulted with the responsible author to agree on the respective contributions of the authors.

Main supervisor signature: Date:

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Oral and poster presentations by candidate

Oral presentations

Sarkies, M. The success of video and written implementation strategies for knowledge translation in nursing and allied health: a novel helix randomised study. Victorian Allied Health Conference – Driving Change, Melbourne, Australia, March 2019. Oral presentation.

Sarkies, M. A novel 'helix' crossover randomised study design: methodological description and potential application to implementation research. Global Evidence and Implementation Summit 2018, Melbourne, Australia, October 2018.

Sarkies M. Additional weekend allied health services reduce hospital length of stay in subacute rehabilitation wards but their effectiveness and cost effectiveness are unclear in acute general medical and surgical wards: a systematic review and meta-analysis. Monash Health Physiotherapy and Exercise Physiology Conference, Melbourne, Australia, September 2018.

Sarkies, M., Skinner, E., Bowles, K-A., Morris, M., Williams, C., O'Brien, L., Bardoel, A., Martin, J., Holland, A., Carey, L., White, J., Haines, T. A novel 'helix' crossover randomised study design: methodological description and potential application to implementation research. School of Primary and Allied Health Care and Monash Biomedical Imaging 2018 Research Symposium, Monash University, Melbourne, Australia, June 2018.

Sarkies, M., Bowles, K-A., Skinner, E., Haas, R., Lane, H., Haines, T. The effectiveness of research implementation strategies for promoting evidence based policy and management decisions in healthcare: a systematic review. Evidence Translation in Allied Health (EviTAH), Monash University, Melbourne, Australia, November 2017.

Sarkies, M., Skinner, E., Bowles, K-A., Haines T. Conceptualising and evaluating implementation success: the efficacy standardised effect. School of Primary and Allied Health Care Research Showcase, Monash University, Melbourne, Australia, September 2017.

Sarkies, M., Skinner, E., Bowles, K-A., Haines, T. Conceptualising and evaluating implementation success: the efficacy standardised effect. Global Implementation Conference 2017 – Expanding Implementation Perspectives: Engaging Systems, Toronto, Canada, June 2017.

O'Brien, L., Sarkies, M., Bowles, K-A., Haas, R., Haines, T. Are patients' perceptions of overall service quality influenced by the presence of a weekend allied health service on acute hospital wards? Victorian Allied Health Conference: Allied Health Future Directions, Melbourne, Australia, August 2017.

Poster presentations

Sarkies, M., Maloney, S., Symmons, M., Haines, T. The success of video and written implementation strategies for knowledge translation in nursing and allied health: a novel helix randomised study. Monash Health Translation Precinct (MHTP) 2018 Research Symposium, Melbourne, Australia, November 2018.

Sarkies, M., Skinner, E., Bowles, K-A., Haines T. The effectiveness of research implementation strategies on evidence informed decision-making by allied health managers: a randomised controlled trial protocol. Monash Health Physiotherapy and Exercise Physiology Conference, Melbourne, Australia, September 2017.

Sarkies, M., White, J., Morris, M., Taylor, N., Williams, C., O'Brien, L., Martin, M., Bardoel, A., Holland, A., Carey, L., Skinner, E., Bowles, K-A., Grant, K., Philip, K., Haines, T. The Effectiveness of research implementation strategies on evidence informed decision-making by allied health managers: a randomised controlled trial protocol. Global Implementation Conference 2017 – Expanding Implementation Perspectives: Engaging Systems, Toronto, Canada, June 2017.

Sarkies, M., Bowles, K-A., Skinner, E., Haas, R., Lane, H., Haines, T. The effectiveness of research implementation strategies for promoting evidence based policy and management decisions in healthcare: a systematic review. Global Implementation Conference 2017 – Expanding Implementation Perspectives: Engaging Systems, Toronto, Canada, June 2017.

Sarkies, M., White, J., Morris, M., Taylor, N., Williams, C., O'Brien, L., Martin, J., Bardoel, A., Holland, A., Carey, L., Skinner, E., Bowles, K-A., Grant, K., Philip, K., Haines, T. The effectiveness of research implementation strategies on evidence informed decision-making by allied health managers: a randomised

controlled trial protocol. School of Primary and Allied Health Care Research Showcase, Monash University, Melbourne, Australia, September 2017.

Sarkies, M., White, J., Morris, M., Taylor, N., Williams, C., O'Brien, L., Martin, M., Bardoel, A., Holland, A., Carey, L., Skinner, E., Bowles, K-A., Grant, K., Philip, K., Haines, T. The effectiveness of research implementation strategies on evidence informed decision-making by allied health managers: a randomised controlled trial protocol. 12th National Allied Health Conference: Stronger Together, Sydney, Australia, August 2017.

Sarkies, M., White, J., Morris, M., Taylor, N., Williams, C., O'Brien, L., Martin, J., Bardoel, A., Holland, A., Carey, L., Skinner, E., Bowles, K-A., Grant, K., Philip, K., Haines, T. The effectiveness of research implementation strategies on evidence informed decision-making by allied health managers: a randomised controlled trial protocol. Victorian Allied Health Conference: Allied Health Future Directions, Melbourne, Australia, March 2017.

Sarkies, M., Bowles, K-A., Skinner, E., Haas, R., Mitchell, D., O'Brien, L., May, K., Ghaly, M., Ho, M., Haines T. Do daily ward interviews improve measurement of hospital quality and safety indicators? A prospective observational study. Monash Health Translation Precinct Research Week, Monash Health, Melbourne, Australia, November 2016.

Sarkies, M., Bowles, K-A., Skinner, E., Mitchell, D., Haas, R., Salter, K., Ho, M., Haines, TP. Disinvestment research in high risk clinical populations: weekend allied health services to acute medical and surgical ward tracheostomy patients – a pilot non-randomised controlled clinical trial. Monash Health Physiotherapy and Exercise Physiology Research and Innovation Conference, Monash Health, Melbourne, Australia, September 2016.

Sarkies, M., Bowles, K-A., Skinner, E., Mitchell, D., Haas, R., Salter, K., Ho, M., Haines, T. Disinvestment research in high risk clinical populations: weekend allied health services to acute medical and surgical ward tracheostomy patients – a pilot non-randomised controlled clinical trial. 11th National Allied Health Conference, Melbourne, Australia, November 2015.

List of publications

Publications by candidate incorporated into thesis:

Published

Sarkies M, Maloney S, Symmons M, Haines T. (2019). Video strategies improved health professional knowledge across different contexts: a helix counterbalanced randomised controlled study. Journal of Clinical Epidemiology. 112:1-11. doi:10.1016/j.jclinepi.2019.04.003.

Sarkies, M. N., Skinner, E. H., Bowles, K.-A., Morris, M. E., Williams, C., O'Brien, L., Bardoel A, Martin J, Holland AE, Carey L, White J, Haines, T. P. (2019). A novel counterbalanced implementation study design: methodological description and application to implementation research. Implementation Science, 14(1), 45. doi:10.1186/s13012-019-0896-0.

Sarkies, M. N., White, J., Henderson, K., Haas, R., & Bowles, J. (2018). Additional weekend allied health services reduce length of stay in subacute rehabilitation wards but their effectiveness and cost effectiveness are unclear in acute general medical and surgical hospital wards: a systematic review. Journal of Physiotherapy, 64(3), 142-158. doi:10.1016/j.jphys.2018.05.004.

Sarkies, M. N., White, J., Morris, M. E., Taylor, N. F., Williams, C., O'Brien, L., Martin, J., Bardoel, A., Holland, A. E., Carey, L., Skinner, E. H., Bowles, K-A., Grant, K., Philip, K., Haines, T. P. (2018). Implementation of evidence based weekend service recommendations for allied health managers: a cluster randomized controlled trial protocol. Implementation Science, 13(1), 60. doi:10.1186/s13012-018-0752-7.

Sarkies, M. N., Bowles, K. A., Skinner, E. H., Haas, R., Lane, H., & Haines, T. P. (2017). The effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare: a systematic review. Implementation Science, 12(1), 132. doi:10.1186/s13012-017-0662-0.

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Chapter 1 – introduction

Background

Significance of the evidence to practice gap

Globally, health systems fail to use scientific evidence optimally (J. M. Grimshaw, M. P. Eccles, J. N. Lavis, S. J. Hill, & J. E. Squires, 2012; Rebecca. LaRocca, Jennifer. Yost, Maureen. Dobbins, Donna. Ciliska, & Michelle. Butt, 2012; Straus, Tetroe, & Graham, 2009). This is demonstrated by time lags between study conduct and eventual implementation into healthcare policy and practice. It takes an estimated average of 17 years for approximately 14% of new scientific discoveries to enter day-to-day clinical practice (Balas & Boren, 2000; Grant, Green, & Mason, 2003; Z. S. Morris, Wooding, & Grant, 2011; J. M. Westfall, Mold, & Fagnan, 2007). In more complex public health settings, it can take up to 54 years between initial research and subsequent translation to improved health outcomes (Hanney et al., 2015). Rates of return in terms of health and economic gains from health research are sensitive to the time lag between the conduct of a study and subsequent translation into practice (Health Economics Research Group Office of Health Economics RAND Europe, 2008). Therefore, reducing the time between initial scientific 'discovery' and the implementation of evidence into policy and practice may be one way to improve health and economic outcomes.

The ongoing delay in research implementation leads to healthcare inefficiency, and failure to benefit from improvements in mortality, quality of life and other health outcomes had research findings been implemented (D. Davis et al., 2003). This can be considered a substantial problem for both individual patients and society as a whole. Failure to contemporaneously implement research findings denies patients access to potentially effective treatments that have not yet been incorporated to practice (D. Davis et al., 2003). Further, delays can perpetuate the delivery of obsolete, low value, and potentially dangerous healthcare interventions (Adam. G. Elshaug, Amber. M. Watt, Linda. Mundy, & Cameron. D. Willis, 2012; T. P. Haines et al., 2017). There is always likely to be variations between research evidence and clinical practice, as evidence informed decision-making relies on more than just research evidence. However, the proportion of people receiving non-evidence based care indicates current variations may be at unacceptable levels. Early proponents of

evidence based medicine estimated that 20-25% of patients received unnecessary or potentially harmful treatments (Smith, 1991). More recent studies from the Netherlands, Australia and the United States suggest at least 30-47% of patients do not receive care according to current scientific evidence (Richard. Grol & Grimshaw, 2003; Runciman et al., 2012). Evidence that optimal care is not being provided is also supported by the increasing ethnic, geographical, and organisational disparity in health resource use and outcomes achieved (Wennberg, 1998). For example, a recent Grattan Institute report demonstrated wide inconsistencies in health outcomes between Australian hospitals when treating the same patient groupings indicating that evidence based care may not be consistently provided across Australia (Duckett, Breadon, Weidmann, & Nicola, 2014).

There are many levels through which strategies to facilitate adoption of evidence into policy and practice can be driven. For the purpose of this thesis, the different levels are simplified and presented in Figure 1.1. There are organisations around the world operating at these different levels of decision making that make specific recommendations on how health resources should be allocated (Murthy et al., 2012). In the United Kingdom, the National Institute for Health and Clinical Excellence (NICE) provides evidence based guidance on quality standards, therapeutic practice, and health technologies to the National Health Service (NHS) (National Institute of Clinical Excellence (NICE)). In the United States of America (USA), the Agency for Healthcare Research and Quality (AHRQ) works within the Department of Health and Human Services to produce and support understanding of evidence to improve healthcare safety, quality, accessibility, equity, and affordability. In Australia, the National Health and Hospital Reform Commission (NHHRC) has recommended specific changes in how health resources should be allocated (National Health Hospitals Reform Commission, 2009).

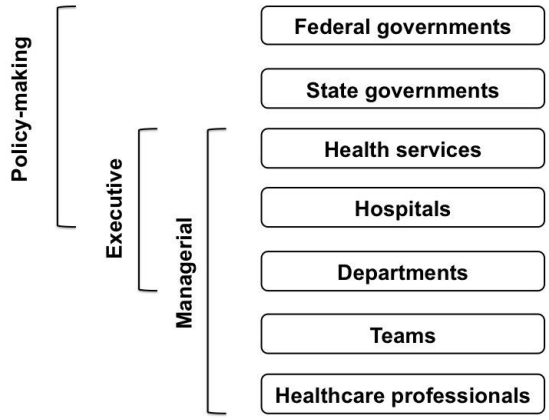


Figure 1.1. Healthcare resource allocation decision levels

Structural changes to health system delivery rely on decision making by individual healthcare practitioners, managers, policy makers, and organisations (Duckett et al., 2014). Individual healthcare practitioners make point of care resource allocation decisions regarding how to prioritise their time, which assessments are needed to inform diagnosis and treatment, and eventual treatment selection (Strech, Synofzik, & Marckmann, 2008). These clinical level decisions can affect individual patient outcomes and aggregate organisation cost (Palese. et al., 2011; Rhodes et al., 2013; Rose et al., 2000). At the organisational level, healthcare policy makers and managers have capacity to lead workforce reforms by mobilising and allocating macro-level resources (Shelley. Bowen & Zwi, 2005; Brijlal, Gilson, Makan, & McIntyre, 1997; Health, 2001). Resources are allocated on a population basis, focusing on outcomes for entire communities rather than individuals (Kemm, 2006; Orton, Lloyd-Williams, Taylor-Robinson, O'Flaherty, & Capewell, 2011). These macro-level decisions play an important role in improving service delivery by reallocating health resources from ineffective interventions to those with demonstrable health gains (T. P. Haines et al., 2014). This is actualised by the allocation of health resources to programs and services that meet health needs, with communities experiencing the impact of policy decisions in their ability to realise optimal health outcomes through service utilisation (Petrou & Wolstenholme, 2000; Wright, Williams, & Wilkinson, 1998). All levels of healthcare resource allocation decision making are more likely to maximise patient outcomes and improve utility of scientific investment when based on the best available research evidence (Redman et al., 2015; Slade, Philip, & Morris, 2018).

Evidence informed decision making

Evidence informed decision-making (EIDM) refers to the complex process of considering the best available evidence when delivering health services (Dobbins, Hanna, et al., 2009; Rebecca. LaRocca et al., 2012; Orton et al., 2011). 'Evidence' can be information derived from a broad range of primary, secondary, and tertiary sources including but not exclusive to scientific research. High quality scientific research, professional experience, expert opinion, patient values, and local contextual factors may all contribute to the evidence informed decision making process (Rycroft-Malone et al., 2004). These information sources have a clear hierarchy in terms of their validity and reliability. Within Australia, the National Health and Medical Research Council (NHMRC) developed designations of 'levels of evidence' to describe this hierarchy, presented in Table 1.1 (National Health and Medical Research Council, 2000, 2008). The most valid and reliable source of information is a systematic review of randomised controlled trials (Level I). This is followed by randomised controlled trials (Level II), progressively moving down the hierarchy to non-randomised studies (Level III) and individual case reports (Level IV).

Table 1.0.1. NHMRC levels of evidence hierarchy

Level	Intervention	Diagnostic accuracy	Prognosis	Aetiology	Screening Intervention
I	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies
II	A randomised controlled trial	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among consecutive persons with a defined clinical presentation	A prospective cohort study	A prospective cohort study	A randomised controlled trial
III-1	A pseudo-randomised controlled trial	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among non-consecutive persons with a defined clinical presentation	All or none of the people with the risk factor experience the outcome	All or none of the people with the risk factor experience the outcome	A pseudo-randomised controlled trial
III-2	A comparative study with concurrent controls: • Non-randomised experimental trial • Cohort study • Case-control study • Interrupted time series with a control group	A comparison with reference standard that does not meet the criteria required for Level II and III-1 evidence	Analysis of prognostic factors amongst persons in a single arm of a randomised controlled trial	A retrospective cohort study	A comparative study with concurrent controls: •Non-randomised, experimental trial •Cohort study •Case-control study
III-3	A comparative study without concurrent controls: • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group	Diagnostic case-control study	A retrospective cohort study	A case-control study	A comparative study without concurrent controls: •Historical control study •Two or more single arm study
IV	Case series with either post-test or pre-test outcomes	Study of diagnostic yield (no reference standard)	Case series, or cohort study of persons at different stages of disease	A cross-sectional study or case series	Case series

Proponents of evidence informed resource allocation decision making for individual health professionals describe this process as the integration of clinical expertise with the best available research when making decisions about the care of individual patients (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). At the policy level, evidence informed decision-making refers to the transparent analysis of policy and management options with expert consultation to arrive at the allocation and governance of resources (Head, 2016; Monroe, 2011; Nutley, Davies, & Smith, 2000). The rationale for engaging in evidence informed decision making is that higher health gains can be achieved with relatively lower cost (Anderson & Shemilt,

2010; Birch, 1997; Birch & Gafni, 2004; Titler, 2008). This can be accomplished by adopting new healthcare interventions that have been shown to be effective and cost effective, or by disinvesting from ineffective or harmful practices (Ciliska, Thomas, & Buffett, 2008; T. P. Haines et al., 2017). It is important to consider all available sources of evidence when making healthcare resource allocation decisions. The evidence hierarchy guides the weight of influence these information sources should have on healthcare decisions. For example, if a health professional is presented with Level I evidence, this must be given appropriate consideration based on the hierarchy of evidence, particularly if comparative evidence sources are based on anecdotal experience.

There are many barriers to evidence informed decision making. At the individual health professional level, frequently reported barriers include: insufficient time, uncertainty of risk, attitudes towards evidence, availability of relevant literature, limited skills in critical appraisal, and lack of generalisabilty of research findings (A.-M. Boström, K. N. Kajermo, G. Nordström, & L. Wallin, 2008; Cheater et al., 2005; Jette et al., 2003). It is worth noting that some of these perceived barriers could be conceptualised differently. For example, the barrier of 'insufficient time' for evidence informed decision-making could also be perceived as a prioritisation barrier; if a health professional that reports not having enough time is provided with additional time resource, they may not necessarily reallocate their time to engage in the implementation of research into practice. Barriers are often consistent across all healthcare settings. However, unique challenges arise for evidence informed decision-making at the policy, management, and organisational levels. Organisational resistance to change can provide an internal barrier to evidence informed decision making (Dobbins, Rosenbaum, Plews, Law, & Fysh, 2007), where external limitations such as lack of financial incentives, community views, and political context create a complex external environment to navigate (Sarah. Bowen, Erickson, Martens, & Crockett, 2009; Lavis, 2006, 2009).

Identifying facilitators of evidence informed decision making is thought to influence the effectiveness of strategies to overcome perceived barriers (Sarkies et al., 2017). Organisational leadership and managerial support for research are frequently reported facilitators of evidence informed decision making (Ellen et al., 2014). It is possible that the provision of leadership and support for research at the organisation level reduces perceived risk and resource limitation barriers. If organisations are providing individuals with

'protected time' away from direct clinical duties to engage in interpreting and applying research findings to their practice, this may address the barriers of insufficient time and unavailability of relevant literature. Interpersonal relationships and trust have been documented as facilitators of evidence informed decision-making by healthcare policy makers. A recent systematic review by Oliver et al. (2014) reported on a number of studies suggesting regular contact, collaboration, developing and maintaining relationships, mutual respect, and trust, as important facilitators (Oliver, Innvar, Lorenc, Woodman, & Thomas, 2014). Researchers have identified these barriers to, and facilitators of evidence informed decision making in order to inform the development and evaluation of strategies for implementing research into practice. This field of study is known as implementation science.

Implementation science

In recent years, there has been increasing attention given to implementation science as a means to reduce the gap between research evidence, and healthcare policy and practice (J. M. Grimshaw et al., 2012). Implementation research is a growing but poorly understood field of science that aims to improve the uptake of evidence in practice (Peters, Adam, Alonge, Agyepong, & Tran, 2013). Research implementation represents a marked phase in the efficacy to effectiveness continuum. This translational pipeline conceptualises healthcare research in a way that begins at 'pre-intervention', and moves through efficacy studies, to effectiveness studies, and finally ending in dissemination and implementation (Figure 1.2) (Landsverk, Brown, Reutz, Palinkas, & Horwitz, 2011; Levy, 1982). Approximately 100 different and competing terms have been used to describe implementation research, including: knowledge translation, translational research, and evidence translation (McKibbon et al., 2010). Interventions developed and evaluated in this field of study have also been described differently in various contexts. For the purpose of this thesis, we will refer to these interventions as 'research implementation strategies'. The journal of Implementation Science defines this form of research as: 'the scientific study of methods to promote the systematic uptake of research findings and other evidence based practice into routine practice, and, hence, to improve the quality and effectiveness of health services' (Martin P. Eccles & Mittman, 2006). Health professionals at point of care, and policy makers when structuring services, can use research implementation strategies to facilitate evidence informed decision-making. At the level of healthcare policy and management decisions, research implementation has the potential to create systematic improvements in

service delivery through structural improvements. It is therefore suggested that the value of research investment can be maximised by the improvement of population health outcomes when healthcare systems, organisations, and professionals adopt findings from clinical and health service research into practice (Martin P. Eccles & Mittman, 2006; Zardo & Collie, 2015).

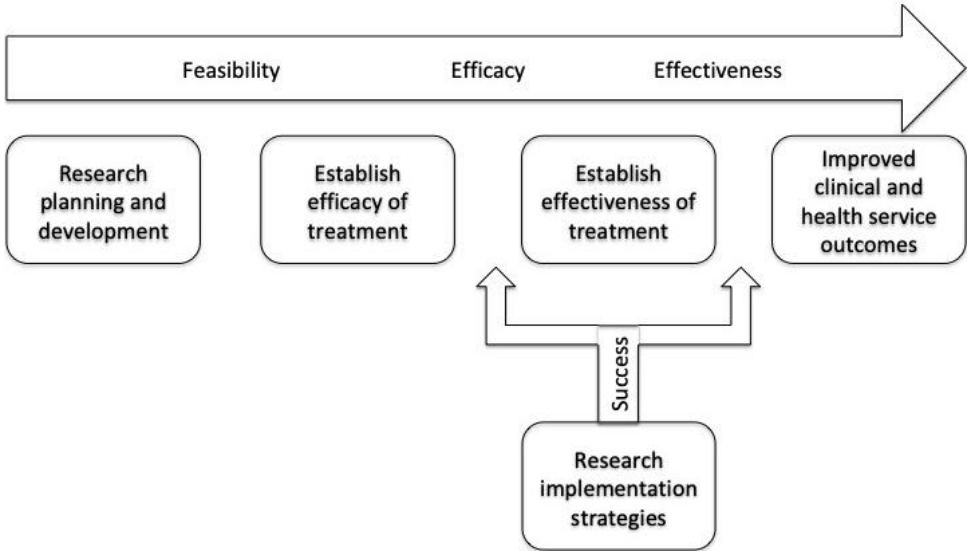


Figure 1.2. Efficacy to effectiveness continuum

It is acknowledged that the implementation stage has been placed differently in relation to the effectiveness stage in our conceptualisation of the efficacy to effectiveness continuum when compared to other descriptions. Some have instead proposed dissemination and implementation stages occur after effectiveness studies (C. Hendricks. Brown et al., 2017). We posit that implementation efforts can be directed at translating the benefits of treatments from efficacy to effectiveness stages, or from the effectiveness stage to broader improvements in clinical and health service outcomes. This depends on the treatment of interest and whether some form of formal or informal implementation must take place to evaluate 'effectiveness'. Placement of 'implementation' in some circumstances prior to 'effectiveness' is justified, as effectiveness is defined in relation to what is expected when treatments are delivered in 'real life' settings (Singal, Higgins, & Waljee, 2014). Therefore, not only does the treatment need to be structured and evaluated in 'real life' but the implementation strategy must also be delivered in a way that is feasible in 'real life'. By that definition, if research evaluates the effectiveness of treatments by themselves and the success of implementation in a controlled environment not reflective of real life settings, then it is more a hybrid

effectiveness implementation study rather than a pure effectiveness study (Curran, Bauer, Mittman, Pyne, & Stetler, 2012). Instead it is argued that for a treatment to be evaluated in a pure effectiveness trial, some form of formal or informal implementation may need to take place.

There are many unanswered questions regarding translation gaps between efficacy and effectiveness studies. This translation gap is similar to that identified between research and practice. If an efficacious treatment is unable to demonstrate effectiveness, then it is unlikely to reach the implementation stage. Patients may be missing out on potentially beneficial treatments that were unable to demonstrate effectiveness due to contextual barriers, which could be addressed by implementation strategies. Therefore it is important to consider the application of implementation methodology throughout the full research translation continuum.

A number of theoretical frameworks and models have been developed in implementation science (Moullin, Sabater-Hernández, Fernandez-Llimos, & Benrimoj, 2015). These theories are thought to improve the development of implementation strategies by mapping the processes and determinants that action change mechanisms. Theories may be defined as a system of variables (and relationships between variables) used to structure observations for the understanding of phenomena (Bluedorn & Evered, 1980; Cairney, 2011; Frankfort-Nachmias & Nachmias, 2007; Wacker, 1998). Concepts have been adapted from different professional disciplines such as psychology, due to the relative novelty of implementation science as a field of science (Per. Nilsen, 2015). Theoretical frameworks and models provide a synthesising architecture to generalise findings across implementation settings (Birken et al., 2017; Foy et al., 2011), and can guide implementation, help identify barriers and facilitators, inform selection of implementation strategies, and frame research design (Proctor, Powell, Baumann, Hamilton, & Santens, 2012). Some authors have stated that generalising findings from studies uninformed by theoretical frameworks is problematic (Martin. P. Eccles, Grimshaw, Walker, Johnston, & Pitts, 2005). It is argued an informed choice regarding adopting or not adopting complex interventions in resource scarce healthcare environments cannot be made without understanding how the targeted behavioural characteristics, professionals, organisations, and healthcare settings influence the success of implementation strategies (Martin. P. Eccles et al., 2005). However, the reliance on formalised theoretical frameworks and models has also been criticised (Bhattacharyya, Reeves, Garfinkel, & Zwarenstein, 2006; Oxman, Fretheim, & Flottorp, 2005). There is little empirical evidence that

theoretically designed behavior change interventions are more effective than those not designed based on theory (Bhattacharyya et al., 2006), and that common sense can guide implementation equally as well (Oxman et al., 2005). Regardless of the subjective decision to guide implementation strategies by theory, it is important to understand the different theories, frameworks and models available in implementation research. A recent narrative literature review by Per. Nilsen (2015) proposed a taxonomy distinguishing between categories of theories, models and frameworks in implementation science. Three overarching aims of theoretical frameworks and models were identified:

1. Describing and/or guiding the process of translating research into practice (process models).
2. Understanding and/or explaining what influences implementation outcomes (determinant frameworks, classic theories, implementation theories).
3. Evaluating implementation (evaluation frameworks).

Overlap between these distinguishing categories is acknowledged, as by achieving their respective main aim (for example, identifying barriers to implementation), they may also achieve secondary aims (for example, guiding implementation practice). In relation to the presented program of doctoral research, this categorisation will be critically explored and provide the basis for theoretically grounding sections of this thesis when deemed appropriate. The presented categorisation and discussion of specific models is by no means exhaustive but simply provides an introductory exploration for the purposes of this thesis.

Describing and/or guiding the process of translating research into practice

Process models

Process models state specific, progressive stages for implementing research into policy and practice (Per. Nilsen, 2015). Action (or planned action) process models such as the Knowledge to Action Framework (Graham et al., 2006) and the Academic Centre for Evidence based Practice (ACE) Star Model of Knowledge Transformation (Stevens, 2013) proceed in a linear pathway to guide change. The benefit of which is to provide a model for ‘how to implement’. Linear models delineating complex systems to complicated processes, where evidence is disseminated from producers to users, have been criticised for being too ‘reductionist’ and not recognising the complexity of ‘wicked problems’ that present when translating research into healthcare policy and practice (Strehlenert, 2017). Subsequently, recent process models have incorporated more emphasis on the implementation context and role that facilitative approaches play in

implementation (Nutley, Walter, & Davies, 2007).

Understanding and explaining what influences implementation outcomes

Determinant frameworks

Differing from process models, determinant frameworks stipulate barriers and facilitators (and the relationship between) that determine implementation success (Per. Nilsen, 2015). These frameworks can identify determinants related to the characteristics of the practice/policy change, individuals or organisations adopting the change, end beneficiaries (e.g. patients), contextual factors, and implementation strategies. Three well known determinant frameworks are the integrated Promoting Action on Research Implementation in Health Services (i-PARIHS) Framework (Harvey & Kitson, 2015; Kitson et al., 2008), the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al., 2009), and a conceptualisation of interrelating factors perceived to be associated with effective research implementation strategies (Sarkies et al., 2017). These determinant frameworks take a systems approach, considering the different levels of decision-making, and the relationships between barriers and facilitators at these different levels. They have been developed through observation of determinants for successful implementation in systematic reviews, synthesis of results from empirical studies, and existing frameworks from different disciplines. However, determinants and relations between determinants have mostly been identified by presumption rather than high-level empirical evidence, and there is no consistent approach to matching implementation strategies to identified determinants.

Classic theories

Theories from other fields of study such as psychology, management, and organisational research are referred to as classic (or classic change) theories when applied to implementation science (Per. Nilsen, 2015). These theories describe change mechanisms rather than providing a pathway for action. Individual level factors are the most widely considered, however, as the field of implementation science increasingly recognises the role of organisational level factors in understanding change, theories are now considering complex multilevel structures such as ‘communities of practice’. Theories like the Theory of Reasoned Action (Everett. M. Rogers, 2010) have been ‘borrowed’ from psychology to explore individual voluntary behaviours in the context of attitudes and social norms, without necessarily providing pathways to intervene. Where the Theory of Diffusion (Everett. M. Rogers, 2010) takes a more organisational and systems approach to explain

how certain elements influence the spread of innovations.

Implementation theories

Several theoretical frameworks and models have now been developed specifically for use in implementation science (Per. Nilsen, 2015). These differ somewhat from 'classic theories' and the other categorisations, in that they posit potential pathways for interventional action, rather than purely explaining phenomena. Some of these have been developed over time as the field has developed, where some were adapted from theories designed in other fields to understand and explain the implementation process. Organisational Readiness for Change (Bryan. J. Weiner, 2009), Capacity, Opportunity, Motivation Behaviour (COM-B) (Susan. Michie, Maartje. M. van Stralen, & Robert. West, 2011), and the Normalisation Process models (May et al., 2007) allow researchers to prioritise critical components for interpreting the 'how and why' of implementation (Per. Nilsen, 2015). Strategies can then be appropriately tailored to the particular contexts of interest.

Evaluating implementation

Evaluation frameworks

Evaluation frameworks provide a structure for evaluating the success of implementation (Per. Nilsen, 2015). Specific implementation outcomes have been developed in a framework designed to evaluate implementation undertakings. These include a series of eight distinct process measures informed by a narrative review of the evidence (E. K. Proctor et al., 2011). Theoretical models and frameworks from the previously mentioned categories (Process, Determinant, Classic, and Implementation) can be applied as an evaluation framework. Therefore, considerable overlap is acknowledged between evaluation frameworks and other categories. The Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) is an evaluation framework well known for its application in public health promotion interventions (Russell E Glasgow, Vogt, & Boles, 1999). This evaluation framework provides a structure for evaluating public health impact of health promotion interventions.

The utility of formal theoretical underpinning to inform development, selection and application of research implementation strategies remains debatable. By critically exploring the categorisation of theory in implementation by Per. Nilsen (2015), a structure for theoretical grounding is available regarding implementation strategy design for the program of research contributing to this thesis. The following section

explores evidence from previous effectiveness studies and how this can be used to further inform implementation strategy design.

Designing implementation strategies

The use of theoretical underpinning to guide implementation strategy development and evaluation has been increasing over time (Birken et al., 2017). Applying theory to implementation practice may provide an opportunity to experiment, describe, and improve theories, eventually developing an evidence base to justify use in informing research implementation strategies. Descriptions of theory application have been presented in a number of case studies (Milat & Li, 2017). As the field develops, further high-level evaluations using randomised controlled study designs and eventual systematic reviews of these studies will provide clearer indications of what works in what context. This is important, as research implementation strategies that are informed by a theoretical framework or model are assumed to be more successful (Martin. P. Eccles et al., 2005; Alison. Kitson, Gill. Harvey, & Brendan. McCormack, 1998; Michie et al., 2005; Sales, Smith, Curran, & Kochevar, 2006), however, high levels of evidence have not yet been presented to support this claim (Bhattacharyya et al., 2006; Milat & Li, 2017).

A number of research implementation strategies (with and without theoretical basis) have been identified and evaluated in various settings to determine their effectiveness (Sarkies et al., 2017). Comparisons between passive single mode, and active multimodal strategies are often cited in studies, suggesting that 'more is better' (Rebecca. LaRocca et al., 2012). A meta-analysis of 31 studies by Mansouri and Lockyer (2007) concluded that continuing medical education might have larger positive effects on knowledge, performance and patient outcomes when they include active and multicomponent strategies. Passive, single mode strategies have been reported as ineffective (Althabe et al., 2008; Bero et al., 1998; Di Noia, Schwinn, Dastur, & Schinke, 2003; Giguère et al., 2012; Grimshaw et al., 2006; Grimshaw et al., 2001; Marinopoulos et al., 2007). But as implementation science has become more nuanced, the idea that 'more is better' is now being challenged. A randomised controlled trial by Dobbins, Hanna, et al. (2009) evaluating the impact of knowledge translation and exchange strategies reported 30% of participants in the most interactive intervention group had little or no engagement with the components of that intervention. Given inadequate time is a frequently reported barrier to evidence informed decision making (Richard Grol & Wensing, 2004; Oliver et al., 2014), interventions that require commitment of dedicated time and resources may be unable to

overcome this barrier. The complexity of implementation strategies may also dilute the key messages, reducing the ability of decision makers to understand and act upon information presented (Rebecca. LaRocca et al., 2012). Successful research implementation strategies may improve exposure to the intervention by tailoring elements to meet participant needs. A relatively successful strategy reported in a study by Di Noia et al. (2003) provided tailored materials including constituency specific content according to participant preference. This finding was consistent with outcomes from the active and tailored intervention group in the study by Dobbins, Hanna, et al. (2009), which reported the most effective strategy was 'tailored targeted messaging'.

Evidence gap in implementation science

One of the central 'doctrines' of implementation science is that the evidence to policy and practice gap is undesirable, and successful efforts to reduce this gap are beneficial. Efforts to reduce the evidence to practice and policy gap are more likely to be successful if based on high-level evidence (Brownson, Fielding, & Maylahn, 2009; Chalmers, 2005; D. Davis et al., 2003; Jernberg et al., 2011; Madon, Hofman, Kupfer, & Glass, 2007). Yet, there is a paucity of clear evidence supporting research implementation strategies (with or without theoretical grounding) for improving evidence informed healthcare resource allocation decision making (Rebecca. LaRocca et al., 2012; Murthy et al., 2012). Implementation strategies are complex interventions (Curran et al., 2012; Hasson, 2010; Simpson et al., 2013). These interventions often involve changing individual behaviours, organisational culture and decision-making, and/or introduction of new technology (Richard. Grol & Grimshaw, 2003; Runciman et al., 2012). It may be difficult to isolate the individual components of these interventions for evaluation, as interaction effects may influence the success of strategies so that effects are more (or less) than the 'sum of parts'. This has led to considerable difficulty in evaluating these interventions (Blackwood, 2006; M. Campbell et al., 2000; N. C. Campbell et al., 2007; May et al., 2007; Oakley, Strange, Bonell, Allen, & Stephenson, 2006). Process evaluations and other low level evidence according to the National Health and Medical Research Council Evidence Hierarchy have become a focus in implementation science to help understand change mechanisms, particularly in healthcare policy and management (Bullock, Morris, & Atwell, 2013; D. Campbell, Donald, Moore, & Frew, 2011; Flanders, Kaufman, Saint, & Parekh, 2009; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013; M. G. Wilson et al., 2015). When presented with only low levels of evidence, it is the responsibility of scientific

communities within a field of research to seek confirmation from high levels of evidence in order to avoid potential risk of bias and errors due to confounding factors. Therefore, a review of high level evidence evaluating the success of research implementation strategies for evidence informed decision making by policy makers and managers is needed to inform strategies, as well as theoretical models and frameworks.

Chapter conclusion

This introductory chapter outlines the problems associated with the delay in implementing evidence into policy and practice, and the challenges surrounding evidence informed decision-making. Implementation science is seen as a potential solution to these problems. However, little evidence has been identified in the literature to support implementation approaches for resource allocation decision making, particularly in management and policy-making settings. Comparative, high quality randomised trials in research implementation are needed to further the evidence base supporting or refuting the success of different implementation strategies in different settings. While accumulating high level evidence is desirable, it is also challenging due to previously identified implementation barriers. An exploration of different methodological approaches is needed in implementation science to move beyond the current reliance on low levels of evidence used to evaluate the effectiveness of complex interventions across different settings. Before exploring these approaches in prospective studies, it is important to review the existing literature to identify previous successes, failures and knowledge gaps, before determining where scientific contributions to the field can be made.

Chapter 2 – Systematic review: the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare

Preamble to Chapter 2 – Systematic review

A systematic review of the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare was performed to identify the previous work in this area, as well as knowledge gaps in the literature to focus a pathway of enquiry. Findings from this systematic review informed the development of research aims and approaches to address these aims. Therefore, the specific research questions, thesis structure, and methodological approach will follow this review.

The following systematic review is adapted from an article published during 2017 in Implementation Science. The article citation is: Sarkies, M. N., Bowles, K-A., Skinner, E. H., Haas, R., Lane, H., & Haines, T. P. (2017). The effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare: a systematic review. *Implementation Science, 12*(1), 132. doi:10.1186/s13012-017-0662-0. (Sarkies et al., 2017)

Abstract

Background

It is widely acknowledged that health policy and management decisions rarely reflect research evidence. Therefore, it is important to determine how to improve evidence informed decision-making. The primary aim of this systematic review was to evaluate the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare. A secondary aim of the review was to describe factors perceived to be associated with effective strategies and the interrelationship

between these factors.

Methods

An electronic search was developed to identify studies published between 01/01/2000 and 02/02/2016. This was supplemented by checking the reference list of included articles, systematic reviews, and hand searching publication lists from prominent authors. Two reviewers independently screened studies for inclusion, assessed methodological quality and extracted data.

Results

After duplicate removal, the search strategy identified 3830 titles. Following title and abstract screening, 96 full text articles were reviewed, of which 19 studies (21 articles) met all inclusion criteria. Three studies were included in the narrative synthesis, finding policy briefs including expert opinion might affect intended actions, and intentions persisting to actions for public health policy in developing nations. Workshops, ongoing technical assistance and distribution of instructional digital materials may improve knowledge and skills around evidence informed decision making in US public health departments. Tailored, targeted messages were more effective in increasing public health policies and programs in Canadian public health departments compared to messages and a knowledge broker. Sixteen studies (18 articles) were included in the thematic synthesis, leading to a conceptualisation of interrelating factors perceived to be associated with effective research implementation strategies. A hierarchal flow was described from: (1) establishing an *imperative* for practice change, (2) building *trust* between implementation stakeholders, (3) developing a *shared vision*, to (4) actioning *change mechanisms*. This was underpinned by the (5) employment of effective *communication strategies* and (6) provision of *resources* to support change.

Conclusions

Evidence is developing to support the use of research implementation strategies for promoting evidence informed policy and management decisions in healthcare. The design of future implementation strategies should be based on the interrelating factors perceived to be associated with effective strategies.

Background

The use of research evidence to inform health policy is strongly promoted (Orton et al., 2011). This drive has developed with increased pressure on healthcare organisations to deliver the most effective health services in an efficient and equitable manner (Ciliska, Dobbins, & Thomas, 2008). Policy and management decisions influence the ability of health services to improve societal outcomes by allocating resources to meet health needs (Mosadeghrad, 2014). These decisions are more likely to improve outcomes in a cost efficient manner when they are based on the best available evidence (Brownson et al., 2009; Chalmers, 2005; D. Davis et al., 2003; Jernberg et al., 2011; Madon et al., 2007).

Evidence informed decision-making refers to the complex process of considering the best available evidence from a broad range of information when delivering health services (Dobbins, Hanna, et al., 2009; Rebecca. LaRocca et al., 2012; Orton et al., 2011). Policy and management decisions can be influenced by economic constraints, community views, organisational priorities, political climate, and ideological factors (Sarah. Bowen et al., 2009; Bucknall & Fossum, 2015; Klein, 2003; Lavis, 2006; Lavis, Ross, & Hurley, 2002; Walt, 1994). While these elements are all important in the decision making process, without the support of research evidence they are an insufficient basis for decisions that affect the lives of others (Chalmers, 2003; Macintyre & Petticrew, 2000).

Recently, increased attention has been given to implementation research to reduce the gap between research evidence and healthcare decision making (J. M. Grimshaw et al., 2012). This growing but poorly understood field of science aims to improve the uptake of research evidence in healthcare decision making (Peters et al., 2013). Research implementation strategies such as knowledge brokerage and education workshops promote the uptake of research findings into health services. These strategies have the potential to create systematic, structural improvements in healthcare delivery (Stone et al., 2002). However, many barriers exist to successful implementation (B. Haynes & Haines, 1998; Paramonczyk, 2005). Individuals and health services face financial disincentives, lack of time or awareness of large evidence resources, limited critical appraisal skills, and difficulties applying evidence in context (Maureen. Dobbins, Rhonda. Cockerill, &

Jan. Barnsley, 2001; Innvær, Vist, Trommald, & Oxman, 2002; Lavis, 2009; Murthy et al., 2012; Ram & Wellington, 2002; Tetroe et al., 2008; P. M. Wilson, Watt, & Hardman, 2001).

It is important to evaluate the effectiveness of implementation strategies and the interrelating factors perceived to be associated with effective strategies. Previous reviews on health policy and management decisions have focussed on implementing evidence from single sources such as systematic reviews (Murthy et al., 2012; Perrier, Mrklas, Lavis, & Straus, 2011). Strategies that involved simple written information on accomplishable change may be successful in health areas where there is already awareness of evidence supporting practice change (Murthy et al., 2012). Re-conceptualisation or improved methodological rigor has been suggested by Mitton, Adair, McKenzie, Patten, and Perry (2007) to produce a richer evidence base for future evaluation, however only one high quality randomised controlled trial has been identified since (Armstrong, 2011; Dobbins, Hanna, et al., 2009). As such, an updated review of emerging research in this topic is needed to inform the selection of research implementation strategies in health policy and management decisions.

The primary aim of this systematic review was to evaluate the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare. A secondary aim of the review was to describe factors perceived to be associated with effective strategies and the interrelationship between these factors.

Methods

Identification and selection of studies

This systematic review was registered with Prospero (record number: 42016032947) and has been reported consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Appendix 2.2). Ovid MEDLINE, Ovid EMBASE, PubMed, CINAHL Plus, Scopus, Web of Science Core Collection, and The Cochrane Library were searched electronically from 01/01/2000 to 02/02/2016 in order to retrieve literature relevant to the current healthcare environment. The search was limited to English language and terms relevant to the field, population, and intervention were combined (Appendix 2.3). Search

terms were selected based on their sensitivity, specificity, validity, and ability to discriminate implementation research articles from non-implementation research articles (Lokker et al., 2010; McKibbon et al., 2010; McKibbon et al., 2012). Electronic database searches were supplemented by cross checking the reference list of included articles and systematic reviews identified during the title and abstract screening. Searches were also supplemented by hand searching publication lists from prominent authors in the field of implementation science.

Study selection

Type of studies

All study designs were included. Experimental and quasi-experimental study designs were included to address the primary aim. No study design limitations were applied to address the secondary aim.

Population

The population included individuals or bodies who made resource allocation decisions at the managerial, executive, or policy level of healthcare organisations or government institutions. Broadly defined as healthcare policy makers or managers, this population focuses on decision making to improve population health outcomes by strengthening health systems, rather than individual therapeutic delivery. Studies investigating clinicians making decisions about individual clients were excluded, unless these studies also included healthcare policy makers or managers.

Interventions

Interventions included research implementation strategies aimed at facilitating evidence informed decision-making by healthcare policy makers and managers. Implementation strategies may be defined as methods to incorporate the systematic uptake of proven evidence into decision making processes to strengthen health systems (Implementation Science, 2018). While these interventions have been described differently in various contexts, for the purpose of this review we will refer to these interventions as ‘research implementation strategies’.

Type of outcomes

This review focused on a variety of possible outcomes that measure the use of research evidence. Outcomes were broadly categorised based on the four levels of Kirkpatrick's Evaluation Model Hierarchy: Level 1 – Reaction (e.g. change in attitude towards evidence); Level 2 – Learning (e.g. improved skills acquiring evidence); Level 3 – Behaviour (e.g. self-reported action taking); Level 4 – Results (e.g. change in patient or organisational outcomes) (Kirkpatrick, 1954).

Screening

The web based application Covidence (Covidence. Melbourne, Victoria, Australia) was used to manage references during the review (Covidence, 2018). Titles and abstracts were imported into Covidence and independently screened by the lead investigator (MS) and one of two other reviewers (RH, HL). Duplicates were removed throughout the review process using Endnote (EndNote™. Philadelphia, Pennsylvania, USA), Covidence, and manually during reference screening. Studies determined to be potentially relevant or whose eligibility was uncertain were retrieved and imported to Covidence for full text review. The lead investigator (MS) and one of two other reviewers (RH, HL) then independently assessed the full text articles for the remaining studies to ascertain eligibility for inclusion. A fourth reviewer (KAB) independently decided on inclusion or exclusion if there was any disagreement in the screening process. Attempts were made to contact authors of studies whose full text articles were unable to be retrieved, and those that remained unavailable were excluded.

Quality assessment

Experimental study designs, including randomised controlled trials and quasi-experimental studies were independently assessed for risk of bias by the lead investigator (MS) and one of two other reviewers (RH, HL) using the Cochrane Collaboration's tool for assessing risk of bias (Higgins et al., 2011). Non-experimental study designs were independently assessed for risk of bias by the lead investigator (MS) and one of two other reviewers (RH, HL) using design specific risk of bias critical appraisal tools: (1) Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies from the National Heart, Lung, and Blood Institute (NHLBI, 2014, February) (National Heart, 2014); and (2) Critical Appraisal Skills Program

(CASP) Qualitative Checklist for qualitative, case study, and evaluation designs (Critical Appraisals Skills Programme (CASP), 2017).

Data extraction

Data was extracted using a standardised, piloted data extraction form developed by reviewers for the purpose of this study (Appendix 2.4). The lead investigator (MS) and one of two other reviewers (RH, HL) independently extracted data relating to the study details, design, setting, population, demographics, intervention, and outcomes for all included studies. Quantitative results were also extracted in the same manner from experimental studies that reported quantitative data relating to the effectiveness of research implementation strategies in promoting evidence informed policy and management decisions in healthcare. Attempts were made to contact authors of studies where data was not reported or clarification was required. Disagreement between investigators was resolved by discussion, and where agreement could not be reached, an independent fourth reviewer (KAB) was consulted.

Data analysis

A formal meta-analysis was not undertaken due to the small number of studies identified and high levels of heterogeneity in study approaches. Instead, a narrative synthesis of experimental studies evaluating the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare, and a thematic synthesis of non-experimental studies was performed to describe factors perceived to be associated with effective strategies and the interrelationship between these factors. Experimental studies were synthesised narratively, defined as studies reporting quantitative results with both an experimental and comparison group. This included specified quasi-experimental designs, which report quantitative before and after results for primary outcomes related to the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare. Non-experimental studies were synthesised thematically, defined as studies reporting quantitative results without both an experimental and control group, or studies reporting qualitative results. This included quasi-experimental studies that do not report quantitative before and after results for primary outcomes related to the effectiveness of research implementation strategies for promoting evidence informed

policy and management decisions in healthcare.

The thematic synthesis was informed by inductive thematic approach for data referring to the factors perceived to be associated with effective strategies and the interrelationship between these factors. The thematic synthesis in this systematic review was based on methods described by Thomas and Harden (2008). Methods involved three stages of analysis: (1) line by line coding of text; (2) inductive, development of descriptive themes similar to those reported in primary studies; (3) analytical themes representing new interpretive constructs undeveloped within studies but apparent between studies once data is synthesised. Data reported in the results section of included studies were reviewed line-by-line and open coded according to meaning and content by the lead investigator (MS). Codes were developed using an inductive approach by the lead investigator (MS) and a second reviewer (TH). Concurrent with data analysis, this entailed constant comparison, ongoing development, and comparison of new codes as each study was coded. Immersing reviewers in the data, reflexive analysis, and peer debriefing techniques were used to ensure methodological rigor throughout the process. Codes and code structure was considered finalised at point of theoretical saturation (when no new concepts emerged from a study). A single researcher (MS) was chosen to conduct the coding in order to embed the interpretation of text within a single immersed individual to act as an instrument of data curation (E. H. Bradley, Curry, & Devers, 2007; Janesick, 2003). Simultaneous axial coding was performed by the lead investigator (MS) and a second reviewer (TH) during the original open coding of data to identify relationships between codes and organise coded data into descriptive themes. Once descriptive themes were developed, the two investigators then organised data across studies into analytical themes using a deductive approach by outlining relationships and interactions between codes across studies. To ensure methodological rigor, a third reviewer (JW) was consulted via group discussion to develop final consensus. The lead author (MS) reviewed any disagreements in descriptive and analytical themes by returning to the original open codes. This cyclical process was repeated until themes were considered to sufficiently describe the factors perceived to be associated with effective strategies and the interrelationship between these factors.

Results

Search results

The search strategy identified a total of 7783 articles, 7716 were identified by the electronic search strategy, 56 from reference checking of identified systematic reviews, 8 from reference checking of included articles, and 3 article from hand searching publication lists of prominent authors. Duplicates (3953) were removed using Endnote (n = 3906) and Covidence (n = 47), leaving 3830 articles for screening (Figure 2.1).

Of the 3830 articles, 96 were determined to be potentially eligible for inclusion after title and abstract screening (see Appendix 2.5 for full list of 96 articles). The full text of these 96 articles was then reviewed, with 19 studies (n = 21 articles) meeting all relevant criteria for inclusion in this review (Beynon, Chapoy, Gaarder, & Masset, 2012; Brownson et al., 2007; Bullock et al., 2013; D. Campbell et al., 2011; Chambers, Grant, Warren, Pearson, & Wilson, 2012; Champagne, Lemieux-Charles, Duranceau, MacKean, & Reay, 2014; Courtney, Joe, Rowan-Szal, & Simpson, 2007; Dagenais, Somé, Boileau-Falardeau, McSween-Cadieux, & Ridde, 2015; Maureen. Dobbins, Rhonda. Cockerill, & Jan. Barnsley, 2001; Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, & Donna. Ciliska, 2001; Dobbins, Hanna, et al., 2009; Döpp, Graff, Rikkert, van der Sanden, & Vernooij-Dassen, 2013; Flanders et al., 2009; Gagliardi, Fraser, Wright, Lemieux-Charles, & Davis, 2008; Kitson et al., 2011; Moat, Lavis, Clancy, El-Jardali, & Pantoja, 2014; Traynor, DeCorby, & Dobbins, 2014; Uneke, Ndukwe, Ezeoha, Uro-Chukwu, & Ezeonu, 2015; Waqa, Mavoa, Snowdon, Moodie, Nadakuitavuki, et al., 2013; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013; M. G. Wilson et al., 2015). The most common reason for exclusion upon full text review was that articles did not examine the effect of a research implementation strategy on decision-making by healthcare policy makers or managers (n = 22).

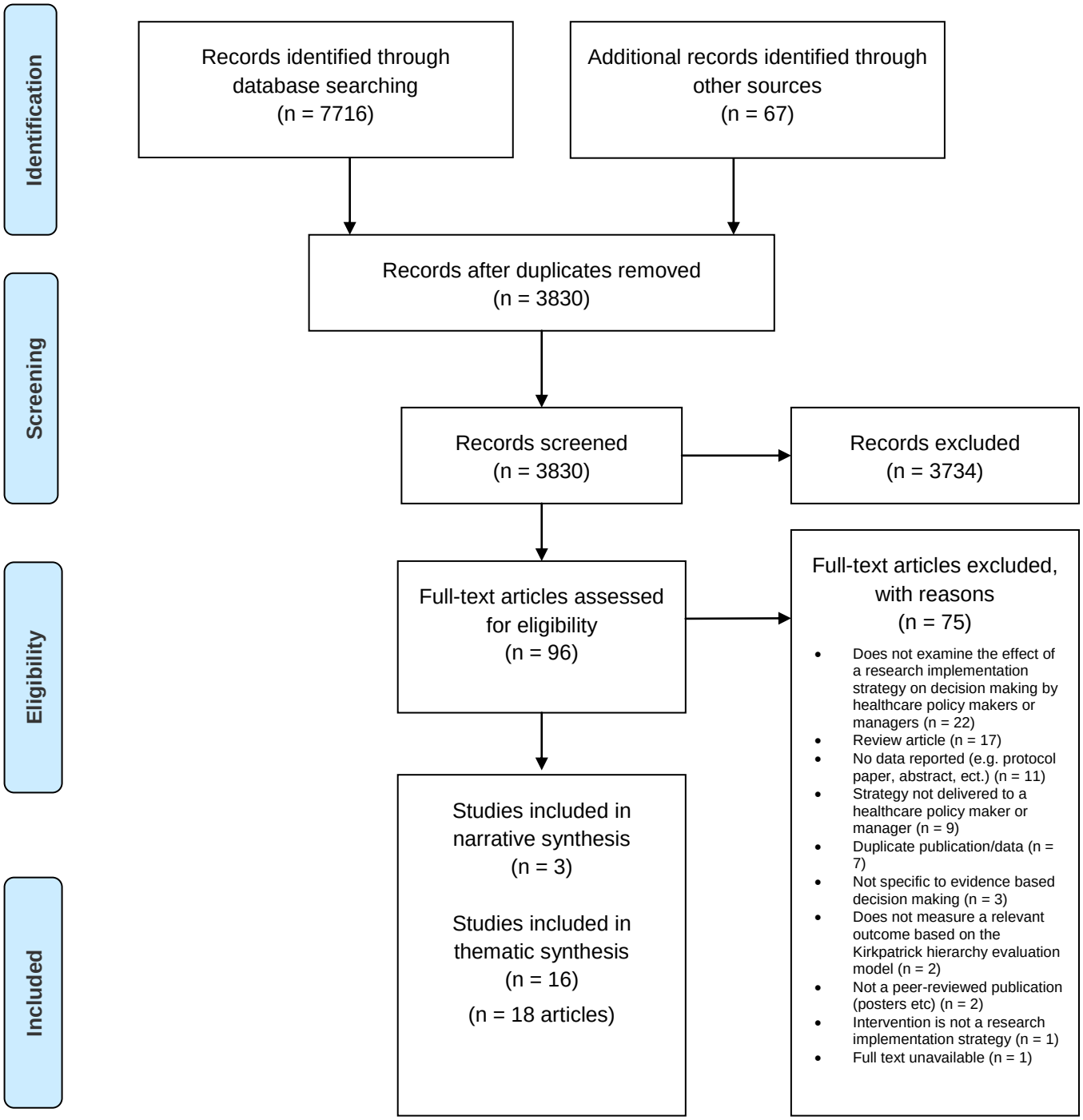


Figure 2.1. PRISMA flow diagram

Characteristics of included studies

The characteristics of included studies are shown in Table 2.1. Three experimental studies evaluated the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare systems. Sixteen non-experimental studies described factors perceived to be associated with effective research implementation strategies.

Study design

Of the 19 included studies, there were two randomised controlled trials (RCT's) (Beynon et al., 2012; Dobbins, Hanna, et al., 2009), one quasi experimental study (Brownson et al., 2007), four program evaluations (Bullock et al., 2013; D. Campbell et al., 2011; Kitson et al., 2011; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013), three implementation evaluations (Dagenais, Somé, et al., 2015; Flanders et al., 2009; Uneke et al., 2015), three mixed methods (Döpp et al., 2013; Gagliardi et al., 2008; Traynor et al., 2014), two case studies (Chambers et al., 2012; Champagne et al., 2014), one survey evaluation (Moat et al., 2014), one process evaluation (M. G. Wilson et al., 2015), one cohort study (Courtney et al., 2007), and one cross sectional follow up survey (Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001).

Participants and settings

The largest number of studies were performed in Canada (n = 6), followed by the United States of America (USA) (n = 3), the United Kingdom (UK) (n = 2), Australia (n = 2), multinational (n = 2), Burkina Faso (n = 1), the Netherlands (n = 1), Nigeria (n = 1), and Fiji (n = 1). Health topics where research implementation took place were varied in context. Decision makers were typically policy makers, commissioners, chief executive officers (CEO's), program managers, coordinators, directors, administrators, policy analysts, department heads, researchers, change agents, fellows, vice presidents, stakeholders, clinical supervisors, and clinical leaders, from government, academia, and non-government organisations (NGO's), of varying education and experience.

Table 0.1. Characteristics of included studies

Author, year, country	Study design	Health topic	Health organisation setting	Decision maker population	Control group	Research implementation group			Outcome measure
Beynon *et al*., 2012, multinational (Beynon et al., 2012)	Randomised controlled trial	Health in low and middle income countries	Public health	Professions from government and non-government organisations and academia (n=807)	Existing Institute of Development Studies publication from the In Focus policy briefing series	Basic 3-page policy brief	Basic 3-page policy brief plus an expert opinion piece	Basic 3-page policy brief plus an unnamed research fellow opinion piece	Online questionnaires (immediately, 1-week and 3-months post) Semi-structured interviews (in between 1-week and 3-month and after 3-month questionnaires)
Brownson *et al*., 2007, USA (Brownson et al., 2007)	Quasi-experimental	Guidelines for promoting physical activity	State and local health departments (n=8)	Health department program managers, administrators, division, bureau, or agency heads, and 'other' positions e.g., program planner, nutritionist (State n=58) (Local n=55) (Other n= 80)	Remaining states and the Virgin Islands served as the comparison group)	Workshops, ongoing technical assistance and distribution of an instructional CD-ROM			25-item questionnaire survey (2-years)
Bullock *et al*., 2012, UK (Bullock et al., 2013)	Programme evaluation case study	Non specific	NHS health service delivery organisations (n=10)	Management fellows (n=11) Chief investigators (n=10) Additional co-applicants from the research teams (n=3) Workplace line managers (n=12) (Total n=36)	None	UK Service Delivery and Organisation (SDO) Management Fellowship programme			Semi-structured face-to-face interviews
Campbell *et al*., 2011, Australia (D.	Program evaluation	Range of topics	State level policy	Policy makers (n=8)	None	'Evidence check' rapid policy relevant review and knowledge brokers			Structured interviews (2-3 years)

Campbell et al., 2011)		related to population health, health services organisation and delivery, and cost effectiveness	agencies, including both the New South Wales and Victorian Departments of Health (n=5)				
Chambers *el al*., 2012, UK (Chambers et al., 2012)	Case study	Adolescents with eating disorders	Primary care	Local NHS commissioners and clinicians (n=15)	None	Contextualised evidence briefing based on systematic review	Short evaluation questionnaire
Champagne *et al*., 2014, Canada (Champagne et al., 2014)	Case studies	Non specific	Academic health centres (n=6)	Extra fellows, SEARCHers, Colleagues, Supervisors, Vice-presidents and CEOs (n=84)	None	Executive Training for Research Application (EXTRA) program Swift, Efficient, Application of Research in Community Health (SEARCH) Classic program	Semi structured interviews and data from available organisational documents
Courtney *et al*., 2007, USA (Courtney et al., 2007)	Cohort study	Substance abuse treatment programs	Community based treatment units (n=53 units from n=24 multisite parent organisations)	Directors and clinical supervisors (n=309)	None	2-day workshop (entitled 'TCU Model Training-making it real')	Compliance with early steps of consulting and planning activities (1-month) Organisational Readiness for Change (ORC) assessment (1-month)
Dagenais *et al*., 2015, Burkina Faso (Dagenais, Somé, et al., 2015)	Implementation evaluation	Maternal health, malaria prevention, free healthcare, and family planning	Public health	Researchers; Knowledge brokers; health professionals; community based organisations; and local, regional, and national policy makers (n=47)	None	Knowledge broker	Semi structured individual interviews and participant training session questionnaires
Dobbins *et al*., 2001, Canada (Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001).	Cross-sectional follow up survey	Home visiting as a public health intervention, community based heart health promotion,	Public health units (n=41)	Public health decision makers (n=147)	None	Systematic reviews	Cross sectional follow up telephone survey

		adolescent suicide prevention, community development, and parent-child health						
Dobbins *et al*., 2009, Canada (Dobbins, Hanna, et al., 2009)	Randomised controlled trial	Promotion of healthy bodyweight in children	Public health departments (n=108)	Front line staff 35% Managers 26% Directors 10% Coordinators 9% Other 20% (n=108)	Access to an online registry of research evidence	Tailored, targeted messages Access to an online registry of research evidence	Knowledge broker Tailored, targeted messages Access to an online registry of research evidence	Telephone administered survey (knowledge transfer and exchange data collection tool) 1-3 months post completion of intervention (intervention lasted 12 months)
Dopp *et al*., 2013, Netherlands (Döpp et al., 2013)	Mixed methods process evaluation	Dementia	Home based community health	Managers (n=20) Physicians (n=36) Occupational therapists (n=36)	None	Multifaceted implementation strategy		Semi-structured telephone interviews with managers (3-5 months) Semi-structured focus groups with occupational therapists (2 months)
Flanders *et al*., 2009, USA (Flanders et al., 2009)	Implementation evaluation	Patient safety	Teaching and nonteaching, urban and rural, government and private, as well as academic and community settings (n=9)	Hospitalists or quality improvement staff, representatives from each institutions department of quality or department of patient safety (n=9)	None	The Hospitalists as Emerging Leaders in Patient Safety (HELPS) Consortium		Web based survey (post meetings)
Gagliardi *et al*., 2008, Canada (Gagliardi et al., 2008)	Mixed methods exploratory	Colorectal cancer	Not specified	Researchers (n=6) Clinicians (n=13) Manager (n=5) Policy maker (n=5)		Review of Canadian health services research in colorectal cancer based on published performance measures One-day workshop to prioritise research gaps, define research questions, and plan implementation of a research study.		Participant survey (prior to workshop) Observation of workshop participants (during workshop) Semi structured interviews and observation of workshop

				(Total n=29)			participants (during workshop)
Kitson *et al*., 2011, Australia (Kitson et al., 2011)	Project evaluation	7 clinical topic areas identified in The Older Person and Improving Care (TOPIC7) project	Large tertiary hospital (n=1)	Clinical nursing leaders (n=14) Team members (n=28) Managers (n=11)	None	Knowledge translation toolkit	Semi structured interviews and questionnaires
Moat et al., 2014, multinational, (Moat et al., 2014)	Survey evaluation	Health in low and middle income countries	Public health	Policy makers, stakeholders and researchers (n=530)	None	Evidence briefs Deliberative dialogues	Questionnaire surveys
Traynor *et al*., 2014, Canada (Traynor et al., 2014)	Single mixed methods study and a case study	Child obesity	Canadian public health departments (n=30) (Case studies n=3)	Health department staff (RCT n=108) (Case A n=258) (Case B n=391) (Case C n=155)	Access to an online registry of research evidence	Knowledge brokering	Knowledge broker journaling (baseline, interim, follow up) Qualitative interviews n=12 (1 year) Case study interviews n=37 (Baseline, interim and 22 month follow up)
Uneke *et al*., 2015, Nigeria (Uneke et al., 2015)	Implementation evaluation	Low and middle income country health	Public health	Directors from Ministry of Health (n=9) Senior researchers from the university (n=5) NGO executive director (n=1) Director of public health in the local government service commission (n=1)	None	Training workshop (HPAC) Certificate course (HPAC) Policy brief and hosting of a multi-stakeholder policy dialogue (HPAC)	Semi-structured interviews (end of each intervention) Group discussions

				Executive secretary of the AIDS control agency (n=1) State focal person of Millennium Development Goals (n=1) (Total n=18)			
Waqa *et al*., 2013, Fiji (Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013)	Process evaluation	Overweight and obesity	Public health government organisations (n=6) NGO'S (n=2)	Senior managers (n=20) Middle managers (n=22) Junior managers (n=7) (Total n=49)	None	Policy brief and hosting of a multi-stakeholder policy dialogue (HPAC)	Semi-structured interviews Process diaries
Wilson *et al*., 2015, Canada (M. G. Wilson et al., 2015)	Process evaluation	Non specific	Policy analysts (n=9) Health department units (n=6)	Senior analysts (n=8) Junior analysts (n=1)	None	Access to an online registry of research evidence	Semi-structured telephone interviews

Research implementation strategies

There was considerable variation in the research implementation strategies evaluated, see Table 2.2 for summary description. These strategies included: knowledge brokering (D. Campbell et al., 2011; Dagenais, Somé, et al., 2015; Dobbins, Hanna, et al., 2009; Traynor et al., 2014; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013), targeted messaging (Dobbins, Hanna, et al., 2009; M. G. Wilson et al., 2015), database access (Dobbins, Hanna, et al., 2009; M. G. Wilson et al., 2015), policy briefs (Beynon et al., 2012; Moat et al., 2014; Uneke et al., 2015), workshops (Brownson et al., 2007; Courtney et al., 2007; Gagliardi et al., 2008; Uneke et al., 2015), digital materials (Brownson et al., 2007) fellowship programs (Bullock et al., 2013; Champagne et al., 2014; Kitson et al., 2011), literature reviews/rapid reviews (D. Campbell et al., 2011; Chambers et al., 2012; Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001; Gagliardi et al., 2008), consortium (Flanders et al., 2009), certificate course (Uneke et al., 2015), multi-stakeholder policy dialogue (Uneke et al., 2015), and multifaceted strategies (Döpp et al., 2013).

Table 0.2. Implementation strategy summary description

Study (author, year)	Implementation strategy	Theoretical framework	Summary description
Dobbins, 2009, (Dobbins, Hanna, et al., 2009; Traynor et al., 2014)	Access to online registry of research evidence	Dobbins framework	Reference offered a link to a short summary and full text of each review
	Tailored, targeted messages and access to online registry of research evidence		Title of systematic review and link to full reference, including abstract sent via email Reference offered a link to a short summary and full text of each review
	Knowledge broker, tailored messages, and access to online registry of research evidence		Knowledge brokers ensured relevant evidence was transferred in useful ways to decision makers to assist skills and capacity development for translating evidence into local healthcare delivery. Activities included regular electronic and telephone communication, one face-to-face site visit, and invitation to a workshop. Title of systematic review and link to full reference, including abstract sent via email Reference offered a link to a short summary and full text of each review
Beynon, 2012, (Beynon et al., 2012)	Basic 3-page policy brief	A simple theory of change for a policy brief	Link to policy brief sent via email
	Basic 3-page policy brief plus an expert opinion piece		Same basic 3-page policy brief plus an expert opinion piece credited and written by a sector expert, Lawrence Haddad. Link to policy brief sent via email
	Basic 3-page policy brief plus an un-credited expert opinion piece		Same basic 3-page policy brief and expert opinion piece but credited to an unnamed research fellow. Link to policy brief sent via email
Brownson, 2007, (Brownson et al., 2007)	Workshops, ongoing technical assistance, and distribution of an instructional digital materials	Framework for a systematic approach to promoting effective physical activity programs and policies	Workshops included: formal presentations, case study applications, and 'real world' examples Ongoing technical assistance included: strategic planning, grant writing, tuition waivers, consultation for effective strategy planning, and dissemination guidance

			Digital materials included: additional information, prominent public health leader interviews, and resource tools
Courtney, 2007, (Courtney et al., 2007)	Workshop	The change book	Pre-workshop completion of organisational readiness for change assessment. Workshop included: conceptual overview presentations, personalised feedback, comparison with other agencies, and group work
Bullock, 2012, (Bullock et al., 2013)	Fellowship program	Programme evaluation framework (adapted from Kirkpatrick)	Practicing managers work within research teams for the duration of a funded project
Campbell, 2011, (D. Campbell et al., 2011)	'Evidence check' rapid policy relevant review and knowledge brokers	Van Kammen et al's approach to knowledge brokering	Pre-meeting commissioning tool completed prior to knowledge broker meetings, which clarified research question. Then a rapid review summary of evidence on policy area is performed
Chambers, 2012, (Chambers et al., 2012)	Contextualised evidence briefing based on systematic review	Facilitators of the use of research evidence identified by a systematic review (Innvaer et al, 2002)	Researcher attended meeting to clarify research question and prepared a concise evidence briefing on policy area
Champagne, 2014, (Champagne et al., 2014)	'Executive Training for Research Application (EXTRA) program	Knowledge creation logic model	Program included: residency sessions, projects, educational activities, networking, post program activities
	Swift, Efficient, Application of Research in Community Health (SEARCH) Classic program		Program included: modules, inter-module work, and application of knowledge to practice based projects
Dagenais, 2015, (Dagenais, Somé, et al., 2015)	Knowledge broker	Theoretical models for understanding health behaviour	Knowledge broker tasks included: liaison, information management and support, partner meetings, developing documentary research strategies, database set up for relevant information, drafting summary documents, workshops, developing and monitoring actions plans
Dobbins, 2001, (Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001)	Systematic reviews	-	Systematic reviews of the effectiveness of public health interventions disseminated to public health decision makers
Dopp, 2013, (Döpp et al., 2013)	Multifaceted implementation strategy	The model of Grol and Wensing	Educational materials, educational meetings, outreach visits, newsletters, and reminders
Flanders, 2009,	The Hospitalists as Emerging	-	Meetings on quality improvement methodology and sustentative patient

(Flanders et al., 2009)	Leaders in Patient Safety (HELPS) Consortium		safety related topics, and a final half day session drawing out learning's and next steps
Gagliardi, 2008, (Gagliardi et al., 2008)	Comprehensive review and workshop	Author's conceptual model of factors influencing effectiveness of knowledge exchange	Comprehensive review of Canadian health services research in colorectal cancer based on published performance measures, and workshop to prioritize research gaps, define research questions, and plan implementation of a research study
Kitson, 2011, (Kitson et al., 2011)	Knowledge translation toolkit	-	Team recruitment, clarification, stakeholder engagement, pre-strategy evaluation, training, support meetings, communication and feedback, process evaluation, dissemination (e.g. posters and presentations), future planning, and program evaluation
Moat et al., 2014, multinational, (Moat et al., 2014)	Evidence briefs	Theory of planned behaviour	Evidence briefs and deliberative dialogues across a range of issues and low and middle income countries
	Deliberative dialogues		
Uneke, 2015, (Uneke et al., 2015)	Training, workshop, certificate course, policy brief, and hosting of a multi-stakeholder policy dialogue	-	Workshop featuring training on the role of research evidence, preparation of policy briefs, how to organise and use policy dialogues, and how to set priorities. Certificate course aimed to foster research capacity, leadership, enhance capacity for evidence informed decision-making, and health policy monitoring / evaluation. Policy briefs were produced, and the multi-stakeholder policy dialogue between key stakeholders was then held
Waqa, 2013, (Waqa, Mavoa, Snowdon, Moodie, Nadakuitavuki, et al., 2013; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013)	Knowledge broker capacity building	-	Knowledge coordinated organisation recruitment, mapping policy environment, analysed organisational capacity and support for evidence informed policy making, developed evidence informed policy making skills, and facilitated development of evidence informed policy briefs
Wilson *et al*., 2015, Canada (M. G. Wilson et al., 2015)	Access to online registry of research evidence	Framework for assessing country level efforts to link research to action	The 'self serve' evidence service consisted only of database access
	Access to online registry of research evidence, email alerts, and full-text availability		The 'full serve' evidence service included (1) database access for research evidence addressing questions about governance, financial and delivery arrangements within which programs, services and drugs are provided and about implementation strategies; (2) monthly email alerts about new additions to the database; and (3) full text article availability

Quality/risk of bias

Experimental studies

The potential risk of bias for included experimental studies according to the Cochrane Collaboration tool for assessing risk of bias is presented in Table 2.3. None of the included experimental studies reported methods for allocation concealment, blinding of participants and personnel, and blinding of outcome assessment (Beynon et al., 2012; Brownson et al., 2007; Dobbins, Hanna, et al., 2009). Other potential sources of bias were identified in each of the included experimental studies including: (1) inadequate reporting of p-values for mixed effects models, results for hypothesis two, and comparison of health policies and programs (HPP) post-intervention on one study (Dobbins, Hanna, et al., 2009); (2) pooling of data from both intervention and control groups limited ability to evaluate the success of the intervention in one study (Brownson et al., 2007); and (3) inadequate reporting of analysis and results in another study (Beynon et al., 2012). Adequate random sequence generation was reported in two studies (Beynon et al., 2012; Dobbins, Hanna, et al., 2009) but not in one (Brownson et al., 2007). One study reported complete outcome data (Dobbins, Hanna, et al., 2009), however large loss to follow up was identified in two studies (Beynon et al., 2012; Brownson et al., 2007). It was unclear whether risk of selective reporting bias was present for one study (Beynon et al., 2012), as outcomes were not adequately pre-specified in the study. Risk of selective reporting bias was identified for one study that didn't report p-values for sub-group analysis (Dobbins, Hanna, et al., 2009), and another that only reported change scores for outcome measures (Brownson et al., 2007).

Non-experimental studies

The potential risk of bias for included non-experimental studies according to the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies from the National Heart, Lung, and Blood Institute, and the Critical Appraisal Skills Program (CASP) Qualitative Checklist is presented in Table 2.4 and Table 2.5.

Table 0.3. Risk of bias of included experimental studies using the Cochrane Collaboration tool for assessing risk of bias

	Dobbins *et al*., 2009, (Dobbins, Hanna, et al., 2009)	Beynon *et al*., 2012, (Beynon et al., 2012)	Brownson *et al*., 2007, (Brownson et al., 2007)
Random sequence generation	✔	✔	✘
Allocation concealment	✘	✘	✘
Blinding of participants and personnel	✘	✘	✘
Blinding of outcome assessment	✘	✘	✘
Incomplete outcome data	✔	?	?
Selective reporting	✘	?	✘
Other sources of bias	✘	✘	✘

Table 0.4. Risk of bias of included non-experimental studies using the Quality Assessment Tool for Observational, Cohort and Cross-Sectional Studies

	Courtney *et al*., 2007, (Courtney et al., 2007)	Dobbins *et al*., 2001, (Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001).
(1) Was the research question or objective in this paper clearly stated and appropriate?	✔	✔
(2) Was the study population clearly specified and defined?	✔	✔
(3) Was the participation rate of eligible persons at least 50%?	?	✔
(4) Were all subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study pre-specified and applied uniformly to all participants?	✔	✔
(5) Was a sample size justification, power description, or variance and effect estimates provided?	✕	✔
(6) For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	✔	✔
(7) Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcomes if it existed?	n/a	?
(8) For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	✔	✔
(9) Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	✔	✔
(10) Was the exposure(s) assessed more than once over time?	n/a	✕
(11) Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	✕	✔
(12) Were the measures of outcome assessors blinded to the exposure status of participants?	✕	✕
(13) Was loss to follow up after baseline 20% or less?	✔	n/a
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	n/a	✔
Overall rating (good, fair, or poor)?	Poor	Good

Table 0.5. Risk of bias of included non-experimental studies using the Critical Appraisal Skills Program (CASP) Qualitative Checklist

	Bullock *et al*., 2012, (Bullock et al., 2013)	Campbell *et al*., 2011, (D. Campbell et al., 2011)	Chambers *el al*., 2012, (Chambers et al., 2012)	Champagne *et al*., 2014, (Champagne et al., 2014)	Dagenais *et al*., 2015, (Dagenais, Somé, et al., 2015)	Dopp *et al*., 2013, (Döpp et al., 2013)	Flanders *et al*., 2009, (Flanders et al., 2009)	Gagliardi *et al*., 2008, (Gagliardi et al., 2008)	Kitson *et al*., 2011, (Kitson et al., 2011)	Moat *et al*., 2014, (Moat et al., 2014)	Traynor *et al*., 2014, (Traynor et al., 2014)	Uneke *et al*., 2015, (Uneke et al., 2015)	Waqa *et al*., 2013, (Waqa, Mavoa, Snowdon, Moodie, Nadakuitavuki, et al., 2013; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013)	Wilson *et al*., 2015, (M. G. Wilson et al., 2015)
(1) A clear statement of the aims of the research?	✔	✘	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
(2) Qualitative methodology appropriate?	✔	✘	?	✔	✔	✔	?	✔	✔	✔	✔	✔	✔	✔
(3) Research design appropriate to address the aims of the research?	✔	?	?	?	?	✔	?	✔	✔	✔	✔	✔	✘	✔
(4) Recruitment strategy appropriate to the aims of the research?	✔	✘	✘	?	✘	✔	?	✔	?	?	✔	?	✔	✔
(5) Data collected in a way that addressed the research issue?	?	✘	?	✔	?	✘	?	✔	✔	?	✔	✔	?	✔

(6) Relationship between researcher and participants been adequately considered?	✗	✗	✗	✗	✗	✔	✗	✗	✗	✗	✗	✗	✗	✗
(7) Ethical issues been taken into consideration?	?	✗	✗	✔	?	✔	✗	✔	?	✗	✔	?	?	✔
(8) Data analysis sufficiently rigorous?	✗	✗	✗	✔	✗	✔	?	✔	✔	?	✔	✔	?	✔
(9) Clear statement of findings?	✔	✗	✔	✔	✔	✔	?	✔	✔	?	✔	✔	?	✔
(10) Research valuable?	✔	✗	✔	?	✔	✔	?	✔	?	?	✔	✔	?	✔

Narrative synthesis results: effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare

Definitive estimates of implementation strategy effect are limited due to the small number of identified studies, and heterogeneity in implementation strategies and reported outcomes. A narrative synthesis of results is described for changes in reaction/attitudes/beliefs, learning, behaviour, and results. See Table 2.6 for a summary of study results.

Table 0.6. Summary of study results

Study (author, year)	Implementation strategy	Level 1: Change in reaction/attitudes/ beliefs	Level 2: Learning	Level 3: Behaviour
Randomised controlled trial				
Beynon, 2012, (Beynon et al., 2012)	Basic 3-page policy brief	High quality ratings Opinion about evidence strength or intervention effectiveness varies by health topic	-	Less likely to source other information and research related to the topic than control
	Basic 3-page policy brief plus an expert opinion piece	High quality rating Opinion about evidence strength or intervention effectiveness varies by health topic Increased intention to send policy brief to someone else and tell someone about key messages	-	Less likely to source other information and research related to the topic than control Trend towards intentions persisting to actions More likely to send policy brief to someone else
	Basic 3-page policy brief plus an un-credited expert opinion piece	High quality rating Opinion about evidence strength or intervention effectiveness varies by health topic	-	Less likely to source other information and research related to the topic than control
Dobbins, 2009, (Dobbins, Hanna, et	Tailored, targeted messages	-	-	Improved use of public health policies and programs

al., 2009)				compared to control
	Tailored, targeted messages plus a knowledge broker	-	-	Addition of knowledge broker potentially reduced use of public health policies and programs. However, improvements may have occurred in organisations with low research culture
Non-randomised controlled trial				
Brownson, 2007, (Brownson et al., 2007)	Workshops, ongoing technical assistance, and digital resources	Change in whether heard of recommendations and attended training Less likely to report state legislators were supportive of physical activity interventions No change in other outcomes from baseline	All knowledge and skill measurements improved Change larger for local than state health department decision makers in every category except methods in understanding cost. The largest change related to attitudes	Improvement in self reported individual adapted health behaviour change No difference in other behaviour change outcomes

Randomised controlled trials

Interestingly, the policy brief accompanied by an expert opinion piece was thought to improve both Level 1 change in reaction/attitudes/beliefs and Level 3 behaviour change outcomes. This was referred to as an 'authority effect' (Beynon et al., 2012). Tailored targeted messages also reportedly improved Level 3 behaviour change outcomes. However, the addition of a knowledge broker to this strategy may have been detrimental to these outcomes. When organisational research culture was considered, health departments with low research culture may have benefited from the addition of a knowledge broker, although no p-values were provided for this finding (Dobbins, Hanna, et al., 2009).

Non-randomised studies

The effect of workshops, ongoing technical assistance, and distribution of instructional digital materials on Level 1 change in reaction/attitudes/beliefs outcomes was difficult to determine, as many measures did not change from baseline scores and the direction of change scores was not reported. However, a reduction in perceived support from state legislators for physical activity interventions was reported after the research implementation strategy. All Level 2 learning outcomes were reportedly improved, with change scores larger for local than state health department decision makers in every category except methods in understanding cost. Results were then less clear for Level 3 behaviour change outcomes. Only self-reported individual adapted health behaviour change was thought to have improved (Brownson et al., 2007).

Thematic synthesis results: conceptualisation of factors perceived to be associated with effective strategies and the interrelationship between these factors

Due to the relative paucity of evidence for effectiveness studies, a thematic synthesis of non-experimental studies was used to explore the factors perceived to be associated with effective strategies and the interrelationship between these factors. Six broad, inter-related, analytic themes emerged from the thematic synthesis of data captured in this review (Figure 2.2). We developed a conceptualisation of how these themes inter-related from data captured both within and across studies. Some of these analytic themes were specifically mentioned in individual papers, but none of the papers included in this review identified all, nor developed a conceptualisation of how they interrelated. The six analytic themes were conceptualised as having a hierarchal flow from: (1) establishing an *imperative* for practice change, (2) building *trust* between implementation stakeholders, (3) developing a *shared vision*, and (4) actioning *change mechanisms*. These were underpinned by (5) employment of effective *communication strategies* and (6) provision of *resources* to support change.

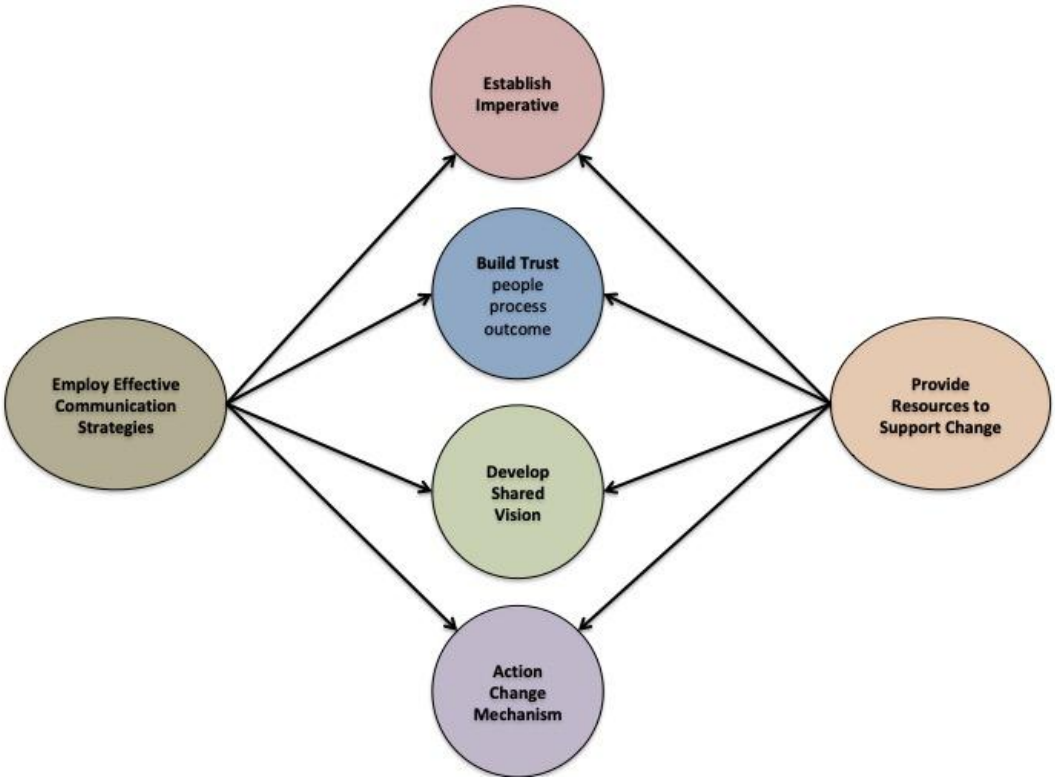


Figure 2.2. Conceptualisation of the interrelated themes (analytic themes) associated with effective strategies and the interrelationship between these factors

Establish imperative

Organisations and individuals were driven to implement research into practice when there was an imperative for practice change. Decision makers wanted to know why change was important to them, and their organisation and or community. Imperatives were seen as drivers of motivation for change to take place, and were evident both internal to the decision maker (personal gain), and external to the decision makers (organisational and societal gain).

2.4.1.3.0.1. Personal gain

Individuals were motivated to participate in research implementation projects where they could derive personal gain (Bullock et al., 2013; Gagliardi et al., 2008; Kitson et al., 2011). Involvement in research was viewed as an opportunity rather than an obligation (Gagliardi et al., 2008). This was particularly evident in one study by Kitson et al. (2011) where all nursing leaders unanimously agreed the potential benefit of supported, experiential learning was substantial, with thirteen of fourteen committing to leading further

interdisciplinary, cross-functional projects.

2.4.1.3.0.2. Organisational, societal gain

Decision makers supported research implementation efforts when they aligned to an organisational agenda or an area where societal health needs were identified (Bullock et al., 2013; Champagne et al., 2014; Döpp et al., 2013; Flanders et al., 2009; Kitson et al., 2011; M. G. Wilson et al., 2015). Practice change was supported if it was deemed important by decision makers and aligned with organisational priorities, where knowledge exchange was impeded if changes had questionable relevance to the workplace (Bullock et al., 2013; Flanders et al., 2009; M. G. Wilson et al., 2015). Individuals reported motivation to commit to projects they felt would address community needs. For example, in one study nursing leaders identified their passion for health topics as a reason to volunteer in a practice change process (Kitson et al., 2011). In another study, managers were supportive of practice change to improve care of people with dementia, as they thought this would benefit the population (Döpp et al., 2013).

Build trust

Relationships, leadership authority, and governance constituted the development of trust between stakeholder groups.

2.4.1.3.1.1. Relationships

The importance of trusting relationships between managers, researchers, change agents, and staff was emphasised in a number of studies (Bullock et al., 2013; Champagne et al., 2014; Kitson et al., 2011; Uneke et al., 2015; M. G. Wilson et al., 2015). Developing new relationships through collaborative networking and constant contact reportedly addressed mutual mistrust between policy makers and the researchers, and engaged others to change practice (Champagne et al., 2014; Uneke et al., 2015). Bullock et al. (2013) described how pre-existing personal and professional relationships might facilitate implementation strategy success through utilising organisational knowledge, and identifying workplace ‘gatekeepers’ to engagement with. In the same study no real link between healthcare managers and academic resources was derived from fellows that were only weakly connected to healthcare organisations.

2.4.1.3.1.2. Leadership authority

The leadership authority of those involved in research implementation influenced the development of trust between key stakeholders (Champagne et al., 2014; Dagenais, Somé, et al., 2015; Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001; Döpp et al., 2013; Kitson et al., 2011). Dagenais, Somé, et al. (2015) found recommendations and information was valued if credited from researchers and change agents whose input was trusted. The perception that individuals with senior organisational roles reduce perceived risk and resistance to change was supported by Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al. (2001) and other authors who reported that seniority of individuals is a predictor of systematic review use in decision-making (Champagne et al., 2014; Kitson et al., 2011). However, professional seniority should be related to the research implementation context, as the perceived lack of knowledge in content area was a barrier to providing managerial support (Döpp et al., 2013).

2.4.1.3.1.3. Governance

A number of studies expressed the importance of consistent and sustained executive support in order to maintain project momentum (Bullock et al., 2013; Champagne et al., 2014; Dagenais, Somé, et al., 2015; Flanders et al., 2009; Kitson et al., 2011; M. G. Wilson et al., 2015). In the study by Kitson et al. (2011) individuals expressed concern and anxiety around reputational risk if consistent organisation support was not provided. The corollary being individuals needed to trust that executive support would be provided consistently throughout an implementation project in order to protect them from reputational risk. Organisational capacity was enhanced with strong management support and policies (Traynor et al., 2014). Uneke et al. (2015) identified good stewardship in the form of governance to provide accountability, and protection for individuals and organisations in their study. Accountability is an important domain of trust in relation to protection of organisation and individual risks. Participants in this study unanimously identified the need for performance measurement mechanisms for the health policy advisory committee to promote sustainability and independent evidence to policy advice. Bullock et al. (2013) found that managers view knowledge exchange in a transaction manner and are keen to know and use project results as soon as possible. However, researchers and change agents may not wish to apply results due to the phase of the project (Bullock et al., 2013). This highlighted the importance of governance systems to support confidentiality and limiting the release of project results before stakeholders are confident of findings. If

managers cannot trust that results will be made available in a contemporaneous manner and researchers don't trust managers will keep result confidential then collaborative projects between healthcare providers and researchers may be hindered.

Develop shared vision

A shared vision for desired change and outcomes can be built around common goal through improving understanding, influencing behaviour change, and working with the characteristics of organisations.

2.4.1.3.2.1. Stakeholder understanding

Improving the understanding of research implementation was considered a precursor to building shared vision (Dagenais, Somé, et al., 2015; Döpp et al., 2013; Gagliardi et al., 2008; Kitson et al., 2011). Policy makers reported lack of time prevented them from performing an evidence review, and desired experientially tailored information, education and avoidance of technical language to improve understanding (Chambers et al., 2012; Dagenais, Somé, et al., 2015; Döpp et al., 2013). It was perceived that lack of clarity limited project outcomes in the study by Gagliardi et al. (2008), which emphasised the need for simple processes. When challenges arose in the study by Kitson et al. (2011), ensuring all participants understood their role from implementation outset was suggested as a process improvement.

2.4.1.3.2.2. Influence change

Knowledge brokers in D. Campbell et al. (2011) were able to elicit well defined research questions if they were open, honest, and frank in their approach to policy makers. Policy makers felt that knowledge brokering was more useful for shaping parameters, scope, budget, and format of projects, which provides guidance for decision making rather than being prescriptive. However, conclusive recommendations that aim for a consensus are viewed favourably by policy makers, which means a balance between providing guidance without being too prescriptive must be achieved (Moat et al., 2014). Interactive strategies may allow change agents to gain better understanding of evidence in organisational decisions and guide attitudes towards evidence informed decision-making. Champagne et al. (2014) observed fellows participating in this interactive, social process, and Dagenais, Somé, et al. (2015) reported practical exercises and interactive discussions were appreciated by knowledge brokers in their own training. Another study reported barriers in work practice challenges being viewed as criticism, despite this organisation staff valued leaders' ability to

inspire a shared vision and identified ‘challenging processes’ as the most important leadership practice (Kitson et al., 2011).

2.4.1.3.2.3. Characteristics of organisation

Context specific organisational characteristics such as team dynamics, change culture, and individual personalities can influence the effectiveness of research implementation strategies (Champagne et al., 2014; Flanders et al., 2009; Gagliardi et al., 2008; Kitson et al., 2011). Important factors that assisted alignment of team members towards a shared vision in Flanders et al. (2009) were clear lines of authority in collaborative and effective multidisciplinary teams. Organisation readiness for change was perceived as both a barrier and a facilitator to research implementation but higher staff consensus (shared vision) was associated with higher engagement in organisational change (Courtney et al., 2007). Strategies in the study by Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al. (2001) were thought to be more effective if they were implemented in organisations with learning culture and practices or facilitated an organisational learning culture themselves, suggesting stakeholders may be more likely to align behaviours based on learning new information. Where Flanders et al. (2009) reported solutions to hospital safety problems often created more work or change from long standing practices, which proved a barrier to overcome. Individuals may resist change if it requires more effort, which could lead to misalignment between the vision of those who wish to change and those who do not. Kitson et al. (2011) also identified this problem, where individual resistance to change in the form of process concerns led to higher levels of dissatisfaction.

Provide resources to support change

Individuals were conscious of the need for implementation strategies to be adequately resourced (Bullock et al., 2013; D. Campbell et al., 2011; Chambers et al., 2012; Champagne et al., 2014; Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001; Döpp et al., 2013; Gagliardi et al., 2008; Kitson et al., 2011). There was anxiety in the study by Döpp et al. (2013) around promoting research implementation programs, due to the fear of receiving more referrals than could be handled with current resourcing. Managers mention service pressures as a major barrier in changing practice, with implementation research involvement dependent on workload and other professional commitments (Gagliardi et al., 2008; Kitson et al., 2011). Lack of time prevented evidence reviews being performed, and varied access to human resources such as

librarians were also identified as barriers (Chambers et al., 2012; Champagne et al., 2014). Policy makers and managers appreciated links to expert researchers, especially those who had infrequent or irregular contact with the academic sector previously (D. Campbell et al., 2011). Managers typically viewed engagement with research implementation as a transactional idea, wanting funding for time release (beyond salary costs), while researchers and others from the academic sector consider knowledge exchange inherently valuable (Bullock et al., 2013). Vulnerability around leadership skills and knowledge in the study by Kitson *et al.* exposed the importance of training, education, and professional development opportunities. Ongoing training in critical appraisal of research literature was viewed as a predictor of whether systematic reviews influenced program planning (Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001).

Employ effective communication strategies

Studies and study participants expressed different preferences for the format and mode of contact for implementation strategies (Bullock et al., 2013; Champagne et al., 2014; Dagenais, Somé, et al., 2015; Döpp et al., 2013; Gagliardi et al., 2008; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013; M. G. Wilson et al., 2015). Face to face contact was preferred by the majority of participants in the study by Waqa, Mavoa, Snowdon, Moodie, Schultz, et al. (2013), and was useful in acquiring and accessing relevant data or literature to inform the writing of policy briefs. Telephone calls were perceived as successful in Döpp et al. (2013) because they increased involvement and opportunity to ask questions. Electronic communication formats in the study by Bullock et al. (2013) provided examples of evidence based knowledge transfer from academic settings to the clinical setting. Fellows spent time reading literature at the university and would then send that information to the clinical workplace in an email, while managers stated that the availability of website information positively influenced its use (Bullock et al., 2013). Regular contact in the form of reminders encouraged actions, with the study by Dagenais, Somé, et al. (2015) finding lack of ongoing, regular contact with knowledge brokers in the field limited research implementation programs.

Action change mechanism

Reviewers interpreted the domains (analytical themes) representing a model of implementation strategy success to lead to a change mechanism. Change mechanisms refer to the actions taken by study participants to implement research into practice. Studies did not explicitly measure the change mechanisms

that lead to the implementation of research into practice. Instead, implicit measurements of change mechanisms were reported such as knowledge gain and intention to act measures.

Discussion

This review found that there are numerous implementation strategies that can be utilised to promote evidence informed policy and management decisions in healthcare. These relate to the 'authority effect' from a simple low cost policy brief, and knowledge improvement from a complex multifaceted workshop with ongoing technical assistance and distribution of an instructional digital materials (Beynon et al., 2012; Brownson et al., 2007). The resource intensity of these strategies was relatively low. It was evident that providing more resource intensive strategies is not always better than less, as the addition of a knowledge broker to a tailored targeted messaging strategy was less effective than the messages alone (Dobbins, Hanna, et al., 2009). Due to the paucity of studies evaluating the effectiveness of implementation strategies, understanding why some implementation strategies succeed where other fail in different contexts is important for future strategy design. The thematic synthesis of the wider non-experimental literature included in our review has lead us to develop a model of implementation strategy design that may action a change mechanism for evidence informed policy and management decisions in healthcare (Bullock et al., 2013; D. Campbell et al., 2011; Chambers et al., 2012; Champagne et al., 2014; Courtney et al., 2007; Dagenais, Somé, et al., 2015; Maureen. Dobbins, Rhonda. Cockerill, Jan. Barnsley, et al., 2001; Döpp et al., 2013; Flanders et al., 2009; Gagliardi et al., 2008; Kitson et al., 2011; Moat et al., 2014; Traynor et al., 2014; Uneke et al., 2015; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013; M. G. Wilson et al., 2015).

Our findings were concordant with change management theories. The conceptual model of how themes inter-related both within and across studies includes similar stages to 'Kotter's 8 Step Change Model' (Kotter, 2007). Leadership behaviours are commonly cited as organisational change drivers due to the formal power and authority that leaders have within organisations (Downs et al., 2006; Trice & Beyer, 1991; Whelan-Berry & Somerville, 2010). This supports the 'authority effect' described in Beynon et al. (2012) and the value decision makers placed on information credited to experts they trust. Authoritative messages are considered a key component of an effective policy brief, and therefore organisations should consider partnering with authoritative institutions, research groups or individuals to augment the legitimacy of their message when

producing policy briefs (N. Jones & Walsh, 2008). Change management research proposes change related training improves understanding, knowledge and skills to embed a change vision at a group level (J. B. Bennett, Lehman, & Forst, 1999; Schneider, Gunnarson, & Niles-Jolly, 1994; Whelan Berry & Alexander, 2005). The results of our review support this view that providing adequate training resources to decision makers can improve understanding, knowledge and skills, leading to desired change. The results of our thematic synthesis appear to support knowledge broker strategies in theory. Multi-component research implementation strategies are thought to have greater effects than simple strategies (Mansouri & Lockyer, 2007; Marinopoulos et al., 2007). However, the addition of knowledge brokers to a tailored targeted messaging research implementation strategy in Dobbins, Hanna, et al. (2009) was less effective than the messages alone. This may indicate that in some cases, simple research implementation strategies may be more effective than complex, multi-component ones. Further development of strategies is needed to ensure a number of different implementation options are available, which can be tailored to individual health contexts. A previous review by Rebecca. LaRocca et al. (2012) supports this finding, asserting that in some cases, complex strategies may diminish key messages and reduce understanding of information presented. Further, the knowledge broker strategy in Dobbins, Hanna, et al. (2009) had little or no engagement from 30% of participants allocated to this group, emphasising the importance of tailoring strategy complexity and intensity to organisational need.

This systematic review was limited both in the quantity and quality of studies that met inclusion criteria. Previous reviews have been similarly limited in the paucity of high quality research evaluating the effectiveness of research implementation strategies in the review context area (Chambers et al., 2011; Rebecca. LaRocca et al., 2012; Mitton et al., 2007; Murthy et al., 2012). The limited number of retrieved experimental, quantitatively evaluated effectiveness studies, means the results of this review were mostly based on non-experimental qualitative data without an evaluation of effectiveness. Non-blinding of participants could have biased qualitative responses. Participants could have felt pressured to respond in a positive way if they did not wish to lose previously provided implementation resources and responses could vary depending on the implementation context and what changes were being made. For example, if additional resources were being implemented to fill an existing evidence-to-practice gap, versus the disinvestment of resources due to a lack of supportive evidence. Despite these limitations, we believe our

comprehensive search strategy retrieved a relatively complete identification of studies in the field of research. A previous Cochrane review in the same implementation context area recently identified only one study (also captured in our review) using their search strategy and inclusion criteria (Armstrong, 2011; Armstrong et al., 2011). A meta-analysis was unable to be performed due to the limited amount of studies and high levels of heterogeneity in study approaches, as such; the results of this synthesis should be interpreted with caution. However, synthesising data narratively and thematically allowed this review to examine not only the effectiveness of research implementation strategies in the context area but also the mechanisms behind interrelating factors perceived to be associated with effective strategies. Since our original search strategy, we have been unable to identify additional full texts from the 11 titles excluded due to no data reporting (e.g. protocol, abstract, etc.). However, the Developing and Evaluating Communication strategies to support Informed Decisions and practice based on Evidence (DECIDE) project has since developed a number of tools to improve the dissemination of evidence based recommendations (Treweek et al., 2013). In addition, support for the relationship development, face to face interaction, and focus on organisational climates themes in our conceptual model is supported by the full version (Phillips, 2008) of an excluded summary article (Lyons, Warner, Langille, & Phillips, 2006), identified after the original search strategy.

Studies measured behaviour changes considered on the third level of the Kirkpatrick Hierarchy but did not measure whether those behaviour changes led to their intended improved societal outcomes (level 4, Kirkpatrick Hierarchy). Future research should also evaluate changes in health and organisational outcomes. The conceptualisation of factors perceived to be associated with effective strategies and the interrelationship between these factors should be interpreted with caution as it was based on low levels of evidence according to the National Health and Medical Research Council (NHMRC) of Australia designations (Merlin, Weston, & Tooher, 2009). Therefore, there is a need for the association between these factors and effective strategies to be rigorously evaluated. Further conceptualisation of how to evaluate research implementation strategies should consider how to include health and organisation outcome measures to better understand how improved evidence informed decision making can lead to greater societal benefits. Future research should aim to improve the relatively low number of high quality randomised controlled trials evaluating the effectiveness of research implementation strategies for promoting evidence informed policy and

management decisions in healthcare. This might allow formal meta-analysis to be performed, providing indications of what research implementation strategies are effective in which context.

Conclusions

Evidence is developing to support the use of research implementation strategies for promoting evidence informed policy and management decisions in healthcare. A number of interrelating factors were thought to influence the effectiveness of strategies through establishing an imperative for change, building trust, developing a shared vision, and action change mechanisms. Employing effective communication strategies and providing resources to support change underpin these factors, which should inform the design of future implementation strategies.

Chapter 3 – Overview of aims and methodology

Introduction

This chapter commences by presenting an interpretation of the results from the Chapter 2 systematic review and a perspective on understanding implementation success in this setting. This is followed by an overview of thesis aims, structure and chapter outline with respective research questions, and methodology.

Understanding implementation success

The presented systematic review only identified three high level studies (two Level II randomised controlled trials and one Level III pseudo-randomised controlled trial) addressing the primary aim of evaluating the success of research implementation strategies on evidence informed policy and management decisions in healthcare. With so few high level studies identified, causal inferences regarding strategy effectiveness cannot be made. Implications for the body of work contributing to this thesis are limited to identifying what has been previously evaluated and how it was evaluated, but does not provide a good indication of strategy effectiveness. Secondary aims of the review were addressed using a thematic synthesis of low level studies (Level III and Level IV). Descriptions of factors perceived to be associated with effective strategies and the interrelationship between these factors were limited to mostly anecdotal, secondary sources of evidence. The implications of which will not be extrapolated beyond perceptions of association to causal mechanisms in this thesis. This relative paucity of evidence may reflect the difficulty in applying traditional research designs to policy level implementation studies, however, arguments' surrounding what works in which setting are not able to be answered using observational studies. Therefore, comparative effectiveness studies using randomised controlled study design are needed in order to justify investment of public health resources in research implementation strategies.

At this point it is important to return to the National Health and Medical Research Council Evidence Hierarchy (Table 1.1.1). When making evidence informed healthcare resource allocation decisions, all information sources available to a decision maker can be considered, however, the evidence hierarchy should guide

their ‘weighting’ or ‘level of influence’. This ensures potential risk of bias from evidence sources when making decisions. There is systematic risk of bias that can effect results from low level evidence sources (Burns, Rohrich, & Chung, 2011). Selection risk of bias and potential for sampling bias is high in non-randomised controlled trials, which can limit both the internal validity of results, and, in the case of sampling bias, can limit external validity (McKee et al., 1999). Without randomisation, the risk of allocation bias is always present (Kunz, Vist, & Oxman, 2007). Differences in baseline characteristics between study groups, and larger estimates of effect are implications of allocation bias, which can be minimised by double blinded randomisation procedures (Kunz et al., 2007). In addition, controlled study designs can reduce the potential risk of participants identifying what condition they have been allocated (performance bias), avoid high withdrawal rates (attrition bias), reduce measurement error (measurement and detection bias), and errors in self reported data (response bias) (Schulz, Chalmers, Hayes, & Altman, 1995).

Randomised controlled trials provide the highest level of evidence in efficacy and effectiveness studies (Merlin et al., 2009). Highly controlled in nature, randomised controlled trial designs are aimed at improving the internal validity of studies by minimising potential risk of bias (Higgins et al., 2011). However, the potential risk of random bias (random error) still exists even in highly controlled randomised study designs (Budescu, Erev, & Wallsten, 1997; Budescu, Wallsten, & Au, 1997). Ensuring adequate sample size to achieve adequate statistical power and using appropriate analysis are two ways of reducing the risk of random bias (Button et al., 2013). Therefore, a design-based approach to improve sample efficiency in participant recruitment rates that maximises statistical power would be desirable for implementation research. Chapter 8 will explore the development of such a design-based tool.

Thesis overview

The introductory chapter presented a background on evidence informed decision making for healthcare resource allocation decision-making. A systematic review on the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare was performed in Chapter 2, identifying a paucity of research in this setting. Gaps in the literature may be explained by the relative novelty of implementation as a scientific field, and/or this gap may be explained by the logistical

challenges in performing high quality randomised controlled trials using traditional methodology in implementation settings. These interpretations of the review findings lead to a pathway of enquiry; seeking to evaluate the effectiveness of research implementation strategies on policy and management resource allocation decisions using a traditional parallel cluster randomised controlled trial design, and developing and applying a novel study design for the evaluation of implementation efforts in clinician level resource allocation decision making settings.

Statement of research aims

The aim of this doctoral research is to explore different methodological approaches to determine the effectiveness of research implementation strategies for healthcare resource allocation decision-making.

Thesis structure

This thesis reports on a series of research to further develop the understanding of implementation success. A pathway of enquiry will commence with the comparative evaluation of two implementation strategies using a traditional cluster randomised controlled trial design; and conclude with the novel application of a helix counterbalanced study design in the implementation setting to efficiently evaluate multiple implementation strategies across different contexts.

Research questions and chapter outline

Chapter 4 will determine the efficacy of additional weekend allied health service provision to inpatient hospital wards for implementation in a prospective research implementation study to address the research question: what is the effectiveness and cost effectiveness of additional weekend allied health service for acute and subacute hospital wards? Chapter 5 will present a protocol for a comparative implementation study to address the research question: how to implement evidence based weekend service recommendations for allied health managers? Chapter 6 will describe a novel study design to efficiently evaluate multiple implementation strategies across different contexts, which will then be applied in a randomised controlled trial in Chapter 7 to address the research question: what is the success of video

versus written knowledge translation strategies for promoting knowledge translation in nursing and allied health?

Thesis scope

This body of research will focus on how to understand if research implementation strategies are successful at different levels of healthcare resource allocation decision-making. Allied health and nursing professions will be the healthcare professional groups of interest, comprising two of the three pillars of the healthcare system (Philip, 2015). Allied health includes professions such as physiotherapy, occupational therapy, speech pathology, dietetics, social work, podiatry, and exercise physiology (Victorian Department of Health and Human Services, 2016). These professionals work across settings (e.g. inpatient, outpatient, acute, subacute, community, primary care) and different specialty areas. There is inconsistency in how the allied health and nursing workforce is structured both between and within health services. Allied health professionals are commonly managed in profession specific groups (e.g. physiotherapy, occupational therapy) rather than specialty areas (e.g. plastics, respiratory, geriatrics), and similarly nursing staff are managed on a ward level, which often involves mixed patient groups (e.g. general medical, surgical, orthopaedic). This results in profession specific allied health managers and ward specific nursing unit managers having to decide on competing demands between specialty areas. Problems currently exist in allied health and nursing resource allocation within specialty areas, even before making comparisons between specialties. For example, inpatient hospital management of acute exacerbations of chronic obstructive pulmonary disease costs Australia >$550 million annually with significant staffing costs from allied health and nursing professionals (Marks, 2013). However, there is little evidence for allied health and nursing interventions in the acute inpatient setting, and some may even be harmful (Greening et al., 2014). In contrast, outpatient pulmonary rehabilitation programs led by allied health and nursing professionals are provided to less than 10% of people who would benefit, despite the possibility for this intervention to reduce disease related hospitalisations by up to 75% (Puhan, Scharplatz, Troosters, & Steurer, 2005).

Terminology used in this thesis

- ‘Implementation context’, also referred to as ‘health context’ or simply ‘context’ refers to the setting where an implementation strategy is delivered (for example, falls prevention, antibiotic prescription, medical/surgical, inpatients/outpatients).
- ‘Implementation strategy’, also referred to as ‘implementation approach’ or ‘strategy’ are interventions which employ a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge to promote more effective health services and products and strengthen the health care system (Straus et al., 2009).
- ‘Treatment’, or alternatively ‘healthcare practice’ or ‘program’, describes the interventions provided by individual healthcare professionals or organisations with the aim of improving health and wellbeing.
- ‘End point outcome’, including: ‘health outcome’, ‘organisational outcome’, and ‘societal outcome’, refers to clinically meaningful outcomes that directly measure the end goal of an intervention (for example, survival, quality of life, hospital length of stay).
- ‘Implementation success’, also referred to as ‘successful implementation’ or ‘success’ is an alternative term for ‘effectiveness’ meaning the propensity for an intervention to achieve desired outcomes.

Methodology

The policy and management resource allocation decision of interest for Chapters 4 and 5 relates to the provision of additional allied health services during weekends to hospital wards. Further justification for selecting this health context area is elaborated in the respective chapters. In short, two recent surveys indicate there is an unwarranted variation in allied health care provided during weekends in Australian hospitals (Caruana, Kuys, & Brauer, 2018; Shaw, Taylor, & Brusco, 2013). In this setting, a number of studies have been recently published evaluating the effect of weekend allied health service provision in acute general medical and surgical, and subacute rehabilitation wards (Caruana, Kuys, Clarke, & Bauer, 2016; Haas, O'Brien, Bowles, & Haines, 2018; T. P. Haines et al., 2017; Kinoshita, Momosaki, Kakuda, Okamoto, & Abo, 2017; Peiris, Shields, Brusco, Watts, & Taylor, 2013). This variation in care and recent

publication of research evidence, combined with the additional cost and logistical difficulties in providing allied health services during weekends (Deb. Mitchell, O'Brien, Bardoel, & Haines, 2017) warrants the exploration of what specific settings these services may be beneficial, where they may not be beneficial, and how we can best implement this evidence into policy and practice.

The clinician level resource allocation decisions of interest for Chapters 6 and 7 related to three areas of inpatient clinical practice. These were: exercise as an adjunct treatment following diagnosis of deep vein thrombosis (DVT), bed side/chair pressure sensor alarms to prevent falls, and falls prevention education materials alone without follow up from a health professional to reduce in-hospital falls. These health context areas were selected because falls and deep vein thrombosis are a substantial cause of death and injury for hospital inpatients (Assareh, Chen, Ou, Hillman, & Flabouris, 2016; McCarthy, 2016; Murray, Cameron, & Cumming, 2007). However, many falls prevention treatment approaches may not align with current research evidence (Deb Mitchell et al., 2018), and concerns regarding risk of pulmonary embolism have delayed implementation of safe adjunct treatments for deep vein thrombosis (Ellen. Hillegass et al., 2016; Trujillo-Santos et al., 2005).

Overarching research design

In order to synthesise the available evidence for additional inpatient weekend allied health service provision, a systematic review and meta-analysis was performed (Chapter 4). Systematic reviews are different from traditional narrative reviews. While narrative reviews are descriptive in nature and focus on a subset of studies, systematic reviews aim to answer specific questions by identifying relevant studies in a systematic way. They involve detailed planning established a priori to reduce potential risk of bias when identifying, appraising and synthesising literature (Uman, 2011). The addition of a meta-analysis involves using statistical approaches to synthesise relevant data from multiple studies into a single quantitative effect size estimate (Uman, 2011). This high level of rigor makes a systematic review the most appropriate design to determine the effect of additional weekend allied health services on patient outcomes.

Once the effectiveness of additional weekend allied health provision to hospital wards was known; a three group, parallel cluster randomised controlled trial protocol was developed (Chapter 5). The parallel comparison refers to the concurrent evaluation of two or more separate groups as part of the same study. Cluster randomised controlled trials involve the random allocation of groups of individuals to study conditions rather than independent individuals. These study designs are valuable in evaluating interventions or programs delivered at scale, where wards, hospitals, or health services are selected as the unit of randomisation. Individual allied health managers within the same organisation are likely to be in regular communication, therefore it is appropriate to cluster these individuals at the organisation level to avoid between group contamination. However, logistical difficulties in performing randomised controlled trials in complex healthcare environments and statistical inefficiency present challenges for using this study design (Donner, 1998). Findings will not be available until after the completion of this PhD candidature, due to delays outside of the PhD candidate's control relating to the size and complexity of this study.

A counterbalanced randomised controlled implementation trial was proposed to evaluate multiple implementation strategies applied across different health contexts (Chapters 6 and 7). The use of parallel design would have required three separate studies to be conducted (one for each health context), which could be considered an inefficient use of resources. Instead, a novel design was applied to counterbalance strategies within health context, allowing concurrent evaluation of multiple strategies across different contexts. Counterbalancing potentially minimises risk of confounding factors by randomly allocating strategies within different health contexts, so that exposure to one strategy in a particular context would not contaminate groups to another strategy in a different context. While a common design in social science disciplines, application to implementation science remains relatively novel. Detailed explanation is provided in Chapter 6 and application to a prospective randomised implementation study is presented in Chapter 7.

Participants and setting

In 2015, the Evidence Translation in Allied Health (EviTAH) partnership project was awarded funding from the National Health and Medical Research Council (NHMRC). This partnership between health services, universities, and a government department aims to help improve resource allocation decision-making in the

allied health professions. Much of the work from this program of research contributed to or was supported by this partnership project.

To achieve the research aims, the systematic review presented in Chapter 4 included hospital inpatients with and without access to weekend allied health services as participants; and the cluster randomised controlled trial protocol presented in Chapter 5 will include allied health managers and/or policy makers. This pathway of enquiry was broadly set in the Australian healthcare system. Applicability to other systems was also considered, with planned recruitment of New Zealand health services in the prospective trial. The Australian healthcare system involves a complex interaction between the public and private sectors, which often intersect, for example, some publically funded services may be delivered by private businesses. In this system, care is provided for people in the hospital setting for certain conditions and circumstances where management cannot be performed in the community.

The counterbalanced randomised implementation study presented in Chapter 7 was conducted across five hospitals in a major public health service organisation in Melbourne, Australia. In 2015, this health service provided inpatient care to over 260,000 people and conducted 48,000 surgical procedures. The hospitals include a mix of acute and subacute services, making them suitable sites to implement evidence into practice for the selected health context areas (falls prevention and DVT care), as these are relevant to clinicians in both the acute and subacute setting. Participants included nurses from all inpatient wards across the study sites as well as allied health professionals, due to their role as primary clinical decision makers or delegated providers of the interventions of focus for each health context.

Allied health

Allied health professionals represent a substantial proportion of the workforce in the hospital setting with an average of 45,597 diagnostic and allied health professionals employed full time at Australian public hospitals in 2016-17 (Australian Institute of Health and Welfare, 2018). Allied health encompasses a range of healthcare professions outside the medical and nursing workforce. Definitions of allied health differ interstate and internationally, therefore for this program of research, allied health was defined as per the Victorian Department of Health and Human Services Allied Health Categories Position Paper (Victorian Department of

Health and Human Services, 2016). Over 25 different allied health therapy and science professions are identified, which shows the diversity of this workforce. In the hospital setting, physiotherapy, occupational therapy, speech pathology, dietetics, social work, podiatry, and psychology represent major therapeutic allied health service providers. These professionals practice across a variety of settings and specialty areas, but are often organised and managed in profession specific departments. This form of management structure may contribute to variations in models of care delivery, particularly in relation to provision of weekend and after-hours services.

Health context: weekend allied health services

In Australian hospitals, most allied health therapeutic services are provided during business hours (Caruana et al., 2018; Shaw et al., 2013). Limited services are available during weekends, with the goal of facilitating patient discharge, preventing adverse events and escalation of care, and delivering care thought to benefit patients where no alternative models of delivery are available. There is a variety in weekend allied health provision both within (T. P. Haines et al., 2017) and between health services (Caruana et al., 2018; Shaw et al., 2013). Within services, allied health departments have different levels of availability during weekends based on perceived benefits (Deb. Mitchell et al., 2017; O'Brien et al., 2017). Between services, there is a large unwarranted variation in care, with approximately 43-61% of acute hospitals and 30-53% of subacute hospitals providing weekend services (Caruana et al., 2018; Shaw et al., 2013). Variations in care can often be ascribed to uncertainty around the effectiveness of certain healthcare approaches (Eddy, 1984), emphasising the importance of evidence dissemination and implementation into policy and practice.

Health contexts: falls and deep vein thrombosis

The top seven current falls prevention approaches at the study sites included the use of physiotherapy treatment, continuous patient observers, falls assessment screening, falls prevention alarms, informal falls prevention patient education, placing patients with 'high falls risk' in high visibility area, and occupational therapy treatment (Deb Mitchell et al., 2018). Interestingly, a substantial proportion of falls prevention resources are directed towards activities with little known benefit, such as bedside pressure sensor alarms and patient education alone without one-on-one follow up from a health professional (Terry. P. Haines et al., 2011; Ronald. I. Shorr et al., 2012). For example, approximately 11% of total falls prevention resource

allocation was directed towards purchasing, locating, and responding to falls prevention alarms, costing an estimated AU$909 per bed per year. Similarly, around eight per cent of total falls prevention resource allocation was allocated to informal falls prevention patient education, costing an estimated AU$695 per bed per year (Deb Mitchell et al., 2018). Scientific data on current approaches to treatment of deep vein thrombosis during an inpatient admission at the study sites was not available.

Implementation strategies

Strategies to implement evidence based weekend allied health service recommendations in Chapter 5 were informed by key findings from the systematic review presented in Chapter 2 (Sarkies et al., 2017). This review reported that policy briefs and tailored targeted messages might improve behaviour change outcomes, the mechanism of which may involve 'tailoring' and an 'authority effect'. But the effectiveness of adding knowledge brokering as an implementation strategy remains unclear. Two research implementation strategies were selected for the prospective implementation study (Chapter 5). One involved the provision of an evidence based policy recommendation document incorporating components of policy briefs and targeted messaging. The other strategy included provision of the same recommendation, with addition of a knowledge broker. These strategies were tailored according to the thematic synthesis results from the review identifying factors thought to be associated with effective strategies and the interrelationship between these factors. Factors identified include: establishing an imperative for change, building trust, developing a shared vision, and actioning a change mechanism, underpinned by effective communication and provision of resources to support change. Detailed description of the strategies designed to implement evidence based weekend service recommendations for allied health managers is presented in Chapter 5.

The two strategies of focus in the helix counterbalanced randomised implementation study (Chapter 7) were video and written evidence summaries. Written evidence summaries have been the traditional way researchers communicate and disseminate findings for the purpose of knowledge translation. The most common of which has been publishing in scientific journals. Increasingly, video is now being used for evidence dissemination. The Three Minute Thesis (3MT®) competition developed by the University of Queensland is an example of a video compatible medium where candidates use one presentation slide and language appropriate to a non-specialist audience to disseminate their research. This medium has increased

in popularity since 2011 with over 600 universities and institutions worldwide competing in the 3MT competition. Journals are also including video abstracts to accompany full text articles (Groves & Godlee, 2008). These videos can include the author directly explaining their findings in-person, use animation and info-graphics, or a combination of both. However, the impact of video abstracts has been difficult to measure using traditional approaches such as journal impact factor (Ladher & Jarvies, 2013). A detailed description of the strategies designed to implement evidence informed nursing and allied health practice for falls prevention and DVT care is presented in Chapter 7.

Outcomes and analysis

A description of outcome measures used in the studies comprising this thesis is presented in each chapter. While it was not always possible to measure direct impacts on end point health outcomes, this was considered the most important measure of implementation success. Analysis approaches for each study are also presented in the respective chapters. As each study used a different approach, it was not deemed appropriate to provide an overall outline of analytical approaches in the methods chapter.

Chapter 4 – Additional weekend allied health services reduce length of stay in subacute rehabilitation wards but their effectiveness and cost effectiveness is unclear in acute general medical and surgical wards: a systematic review

Preamble to Chapter 4 systematic review

In Chapter 2, a substantial evidence gap was identified for implementation strategies in healthcare policy and management settings. In response to this evidence gap, a traditional cluster randomised controlled trial design will be applied to implement evidence based weekend allied health service recommendations for healthcare policy makers and managers. A review of current evidence is needed to inform recommendations prior to implementation.

The following systematic review is adapted from an article published during 2018 in the Journal of Physiotherapy. The article citation is: Sarkies, M. N., White, J., Henderson, K., Haas, R., & Bowles, J., & Evidence Translaton in Allied Health (EviTAH) Group. (2018). Additional weekend allied health services reduce length of stay in subacute rehabilitation wards but their effectiveness and cost effectiveness are unclear in acute general medical and surgical hospital wards: a systematic review. *Journal of Physiotherapy, 64*(3), 142-158. doi:10.1016/j.jphys.2018.05.004. (Mitchell. N. Sarkies et al., 2018)

Abstract

Background

Health outcomes can be improved by providing earlier, additional, and higher intensity allied health services. However, the benefits of routinely delivering additional services using weekend allied health staffing models are not clear. The aim of this systematic review and meta-analysis was to synthesise available evidence on

the effectiveness and cost effectiveness of additional weekend allied health services for acute general medical and surgical hospital wards, and subacute rehabilitation hospital wards.

Methods

A search was conducted to identify studies published between January 2000 and May 2017. Two reviewers independently screened studies for inclusion, extracted data, and assessed methodological quality. Meta-analyses were conducted for relative measures of effect estimates. Participants included patients admitted to acute general medical and surgical wards, and subacute rehabilitation wards. Interventions included all services delivered by allied health professionals during weekends (Saturday and/or Sunday). This study limited allied health professions to: occupational therapy, physiotherapy, social work, speech pathology, dietetics, art therapy, chiropractic, exercise physiology, music therapy, oral health (not dentistry), osteopathy, podiatry, psychology, and allied health assistants. Outcomes included: hospital length of stay, hospital re-admission, adverse events, discharge destination, functional independence, health related quality of life, and cost of hospital care.

Results

Nineteen articles (20 studies) were identified, comprising 10 randomised and 10 non-randomised trials. Physiotherapy was the most commonly investigated profession. A meta-analysis of randomised, controlled trials showed that providing additional weekend allied health services in subacute rehabilitation wards reduced hospital length of stay by 2.35 days (95% CI 0.45 to 4.24, I^2 = 0%), and may be a cost effective way to improve function (SMD 0.09, 95% CI –0.01 to 0.19, I^2 = 0%), and health related quality of life (SMD 0.10, 95% CI –0.01 to 0.20, I^2 = 0%). For acute general medical and surgical hospital wards, it was unclear whether the weekend allied health service model provided in the two identified randomised trials led to significant changes in measured outcomes.

Conclusion

The benefit of providing additional allied health services is clearer in subacute rehabilitation settings than for acute general medical and surgical wards in hospitals.

Background

Allied health services, in conjunction with medicine and nursing, are considered to comprise three pillars of the health care system (Philip, 2015). Allied health professionals provide diagnostic and therapeutic services across different settings (Turnbull et al., 2009), representing a large proportion of the health workforce internationally (Dorning & Bardsley, 2014; Levit & Patlak, 2009). Allied health is often organised and managed in professional groups including: physiotherapy, psychology, occupational therapy, speech pathology, dietetics, podiatry, and social work, within an overriding inter-professional comprehensive care model (M. E. Morris et al., 2015; S.-E. Soh, M. E. Morris, J. J. Watts, J. L. McGinley, & R. Iansek, 2016).

The routine provision of weekend allied health services is variable across hospitals in Australia and worldwide. For example, a survey of tertiary care hospitals in Canada reported that 97% of facilities provided routine weekend physiotherapy services, with diversity in the amount and focus of service delivery (L. Campbell et al., 2010). In Australia, 61% of hospitals provided physiotherapy on Saturdays as a matter of course, and 45% on Sundays, with more provided in metropolitan and acute hospitals than regional and subacute hospitals (Shaw et al., 2013). Aside from physiotherapy, comparatively little is known about the practices of other allied health professions. The evidence about the effects of providing these services during weekends is unclear. Providing earlier (Haas, Sarkies, Bowles, O'Brien, & Haines, 2016; Schweickert et al.), additional (Beder, 2008; Ellen. Mills, Vicki. Hume, & Kathy. Stiller, 2017; Peiris, Taylor, & Shields, 2012b), and higher intensity (Cifu, Kreutzer, Kolakowsky-Hayner, Marwitz, & Englander) allied health services can improve health outcomes. However, these benefits are not clear for using weekend allied health staffing models to deliver additional services on a routine basis (Scrivener, Jones, Schurr, Graham, & Dean, 2015). Providing weekend allied health services has been identified as having increased costs and being more logistically difficult when compared to services during traditional business hours, with uncertainty around the experience of staff, appropriateness of referrals, and whether the mix of professions achieves intended benefits (Deb. Mitchell et al., 2017).

The aim of this review was to synthesise available evidence examining the effectiveness and cost effectiveness of providing additional weekend allied health services to patients on acute general medical and surgical hospital wards, and subacute rehabilitation hospital wards.

Question

Are additional weekend allied health services effective and cost effective for acute general medical and surgical, and subacute rehabilitation hospital wards?

Methods

Identification and selection of studies

This systematic review was registered with Prospero (record number 76771) and was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Liberati et al., 2009). Ovid MEDLINE (all fields), PubMed (all fields), CINAHL (keyword, title, CINAHL subject headings, abstract, and instrumentation fields), Cochrane library (title, abstract, keywords), and Scopus (title, abstract, keywords) were searched from 01/01/2000 to 05/05/2017 to retrieve contemporary literature. Terms relevant to the population and intervention were combined and results were limited to English language publications; see Appendix 5.1 for the full search strategy.

Electronic database searches were supplemented by crosschecking the reference list of included articles and relevant systematic reviews identified during the screening process. Publication lists from key authors in the field were also hand searched to identify additional studies.

Study selection

Study design

All experimental, quasi-experimental and observational study designs were considered.

Population

Patients admitted to acute general medical and surgical wards, and subacute rehabilitation wards. For the purposes of this review, acute general medical and surgical wards included: general medical, general surgical, medical assessment unit (MAU), orthopaedic, vascular, plastics, ear nose and throat (ENT), thoracic, respiratory, coronary care unit (CCU), renal, rheumatology, neurology (including stroke units), infectious diseases, colorectal, endocrine, urological, and gastroenterology. Excluded acute wards comprised of emergency department (ED), intensive care unit (ICU), high dependency unit (HDU), burns, spinal, maternity, paediatrics, mental health, and palliative wards. These wards were excluded as the allied health role was considered to be potentially different in these settings compared to acute general medical and surgical wards.

For the purposes of this study subacute rehabilitation wards included inpatient rehabilitation (both mixed and condition specific wards), and geriatrics evaluation and management (GEM) wards. Excluded subacute wards comprised mental health and psychiatric, chronic and long-term care, alternative level of care, and extended care patients. The goals of care on these wards were considered to be different to those on inpatient rehabilitation and geriatric evaluation and management wards.

Interventions

Interventions focused upon in this review included all services delivered by allied health professionals during weekends (Saturday and/or Sunday). This study limited allied health professions to: occupational therapy (OT), physiotherapy (PT), social work (SW), speech pathology (SP), dietetics (DT), art therapy, chiropractic, exercise physiology, music therapy, oral health (not dentistry), osteopathy, podiatry, psychology, and allied health assistants (AHA's) (Victorian Department of Health and Human Services, 2016). Weekends were defined as complementary to the traditional workweek, as per the country the study was performed in. Studies that reported data relating to the provision of additional allied health services as part of changing timing of commencement, intensity, frequency or duration with a weekend component were included, but only if data relating specifically to weekend services with appropriate controls could be extracted.

Outcomes

All patient and health service outcomes as reported in included studies.

Screening

The web based application Covidence (Covidence, Melbourne, Victoria, Australia) was used for reference management (Covidence, 2018). Two reviewers (MS and JW) screened titles and abstracts independently (see Appendix 5.2 for inclusion and exclusion criteria). Studies determined to be potentially relevant, or whose eligibility was uncertain, were retrieved for full text review. Two reviewers (MS and JW) independently assessed the full text articles to ascertain eligibility for inclusion. Where there was any disagreement during the screening, a third independent reviewer (KH) was consulted. Authors of studies whose full text article retrieval was not possible were contacted. In the cases of non-response, these articles were excluded.

Quality assessment

One (JW) and either of two other reviewers (KH or JB) independently assessed the risk of bias for randomised controlled trials using the Cochrane Collaboration's tool for assessing risk of bias (Higgins et al., 2011), and the Newcastle – Ottawa Quality Assessment Scale for observational studies (Wells et al., 2014). Any discrepancy in risk of bias assessment was resolved by discussion, and if discrepancies were unable to be resolved, a fourth independent reviewer was consulted (RH).

Data extraction

Data were extracted using a customised pro-forma, developed and piloted for this review. One (JW) and either of two other reviewers (KH or JB) independently extracted data relating to the study details, design, setting, population, intervention, outcomes, and results for all included studies. Discrepancies in extracted data were resolved by discussion, and where agreement could not be reached a fourth independent reviewer was consulted (MS).

Data analysis

Analysis was performed using Stata 13 (StataCorp, 2013. Stata Statistial Software: Release 13. College Station; TX: StataCorp LP). Relative measures of effect estimates were pooled according to study setting and design (separate for acute and subacute settings, and randomised and non-randomised study designs). Random effect meta-analysis accounted for differences in populations, interventions and outcomes across studies, and was performed where data were available for similar outcomes evaluated in more than one study.

A majority of analyses used summative, study level data. Weighted mean difference (WMD) effect size estimates were used for continuous outcomes, where measurements were reported in the same units (e.g. length of stay and cost). The standardised mean difference (SMD) was used to estimate effect size for function and health related quality of life outcomes where measures used different scales. The effect size for SMD was interpreted according to Cohen's d, with 0.2 considered small, 0.5 moderate, and 0.8 a large effect size (Cohen, 1988). Risk ratios (RR) were used for dichotomous outcomes (e.g. number of adverse events, patients discharged home, and delayed discharge).

Authors were contacted to request additional data for studies not reporting sufficient outcome data for inclusion in the meta-analysis. Data were pooled from sub-groups to estimate the total population effect size where data were only reported according to sub-groups within an individual trial. Proportion of patients discharged to supported residential aged-care facility reported in sub-groups according to level of care were summed to create a total proportion of patients discharged to a supported residential aged care facility. The first mentioned control group was selected as the comparator when two control groups were used for non-randomised controlled trials. This applied only to observational studies where multiple time periods / cohorts were reported within the study. If study results were reported as medians and range or inter-quartile range, and the mean and standard deviation could not be obtained, means and standard deviation were estimated using the methods of Wan, Wang, Liu, and Tong (2014). A sensitivity analysis was undertaken to assess the effect of excluding studies where data were estimated due to inadequate reporting.

Heterogeneity in study results was represented using the I-squared statistic (I^2), with values over 50% considered substantial (Higgins, Thompson, Deeks, & Altman, 2003). An iterative approach was used to explore possible explanations for heterogeneity by sub-grouping studies according to variables such as allied health profession, patient population, and potential sources of bias. A formal meta-regression was not planned due to the anticipated low number of studies for inclusion in the meta-analysis.

Two of the studies identified and included in this review were stepped-wedge cluster randomised trials, conducted in succession at the same research location (hospitals and wards). These were the only randomised trials identified in the acute setting. We used data available from this study at the participant level (for continuous outcomes) and cluster level (for proportion outcomes) rather than summative data. This was done to incorporate the dependency of observations gathered from the same wards between the two trials. Weighted mean difference (WMD) was used for continuous outcomes, and risk difference (RD) for proportional outcomes.

Results

Search results

A total of 3,413 titles were identified, with 3,405 from the electronic search strategy and eight from hand searching publication lists of prominent authors. Duplicates (n=293) were removed using Endnote (n=224) and Covidence (n=69), resulting in 3120 titles remaining for screening (Figure 4.1).

After title and abstract screening, 72 full text articles were considered potentially eligible for inclusion (see Appendix 5.3 for list of excluded full texts). Full texts were screened, and 19 articles (n=20 studies) were included in this review (Boxall, Sayers, & Caplan, 2004; Natasha. K. Brusco, Shields, Taylor, & Paratz, 2007; Natasha. K. Brusco, Watts, Shields, Chan, & Taylor, 2014; Natasha. K. Brusco, Watts, Shields, & Taylor, 2014; Natasha. K Brusco, Watts, Shields, & Taylor, 2015; Caruana et al., 2016; David, Price, Price, Sheeran, & Mulherin, 2003; DiSotto-Monastero, Chen, Fisch, Donaghy, & Gomez, 2012; English et al., 2015; English, Bernhardt, & Hillier, 2014; Haas et al., 2018; T. P. Haines et al., 2017; Hakkennes, Lindner, & Reid, 2015;

Kinoshita et al., 2017; Maidment, Hordacre, & Barr, 2014; Peiris et al., 2013; Peiris, Taylor, & Shields, 2012a; Pengas, Khan, Bennett, & Rankin, 2015; Pua, Ong, Chong, & Lo, 2011).

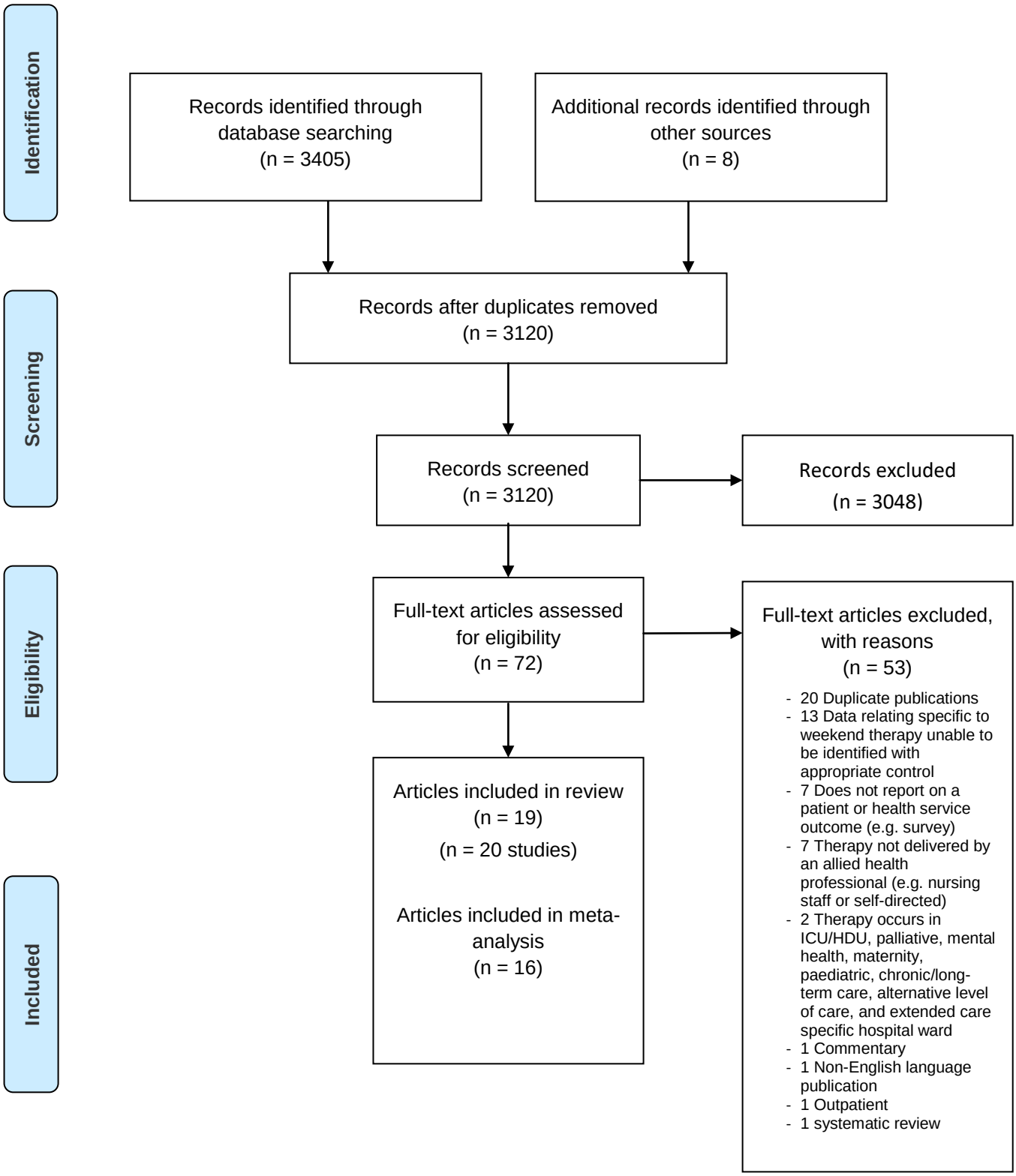


Figure 4.1. PRISMA flow diagram

Characteristics of included studies

Study details are presented in Table 4.1.

Study design

Ten randomised controlled trials (nine articles) evaluated the effect of providing allied health services during weekends. Two studies were performed in acute general medical and surgical hospital ward settings (T. P. Haines et al., 2017; T. P. Haines et al., 2015). Eight were within subacute rehabilitation hospital wards; including mixed patient groups (Natasha. K. Brusco et al., 2007; Natasha. K. Brusco, Watts, Shields, Chan, et al., 2014; Natasha. K. Brusco, Watts, Shields, & Taylor, 2014; Natasha. K Brusco et al., 2015; Peiris et al., 2013), orthopaedic (Peiris et al., 2012a), and stroke rehabilitation (English et al., 2015; English et al., 2014). Ten non-randomised controlled trials were also identified (10 articles). Seven were cohort studies in acute general medical and surgical hospital wards, including orthopaedic (Boxall et al., 2004; Haas et al., 2018; Maidment et al., 2014; Pengas et al., 2015; Pua et al., 2011), rheumatology (David et al., 2003), and stroke (Kinoshita et al., 2017). Two cohort studies were performed in mixed rehabilitation subacute hospital wards (Caruana et al., 2016; Hakkennes et al., 2015), and one cross sectional study was conducted in a mixed rehabilitation setting (DiSotto-Monastero et al., 2012).

Participants and settings

The majority of studies were performed in Australia (n = 14) (Boxall et al., 2004; Natasha. K. Brusco et al., 2007; Natasha. K. Brusco, Watts, Shields, Chan, et al., 2014; Natasha. K. Brusco, Watts, Shields, & Taylor, 2014; Natasha. K Brusco et al., 2015; Caruana et al., 2016; English et al., 2015; English et al., 2014; Haas et al., 2018; T. P. Haines et al., 2017; Hakkennes et al., 2015; Maidment et al., 2014; Peiris et al., 2013; Peiris et al., 2012a), with one study in England (David et al., 2003), Canada (DiSotto-Monastero et al., 2012), Japan (Kinoshita et al., 2017), Singapore (Pua et al., 2011), and Scotland (Pengas et al., 2015). Provision of physiotherapy during weekends was the most examined allied health profession (n = 9) (Boxall et al., 2004; Natasha. K. Brusco et al., 2007; Caruana et al., 2016; David et al., 2003; English et al., 2015; English et al., 2014; Maidment et al., 2014; Pengas et al., 2015; Pua et al., 2011); followed by combinations

of physiotherapy and occupational therapy (n = 7) (Natasha. K. Brusco, Watts, Shields, Chan, et al., 2014; Natasha. K. Brusco, Watts, Shields, & Taylor, 2014; Natasha. K Brusco et al., 2015; DiSotto-Monastero et al., 2012; Kinoshita et al., 2017; Peiris et al., 2013; Peiris et al., 2012a); physiotherapy, occupational therapy and social work (n = 1) (Hakkennes et al., 2015); and physiotherapy, occupational therapy, speech pathology, dietetics, and social work) (n=3) (Haas et al., 2018; T. P. Haines et al., 2017).

Weekend allied health service

Ten studies compared a Monday to Friday allied health service with a model that incorporated Saturday and Sunday services (Boxall et al., 2004; David et al., 2003; DiSotto-Monastero et al., 2012; English et al., 2015; English et al., 2014; Haas et al., 2018; T. P. Haines et al., 2017; Maidment et al., 2014; Pengas et al., 2015), eight compared Monday to Friday with a Saturday service (Natasha. K. Brusco et al., 2007; Natasha. K. Brusco, Watts, Shields, Chan, et al., 2014; Natasha. K. Brusco, Watts, Shields, & Taylor, 2014; Natasha. K Brusco et al., 2015; Caruana et al., 2016; Hakkennes et al., 2015; Peiris et al., 2013; Peiris et al., 2012a), one compared a Monday to Saturday service with a Sunday service (Kinoshita et al., 2017). One study compared a Monday to Friday (no weekend allied health) service with a 'new stakeholder driven' weekend model including Friday, Saturday, Sunday and Monday services (T. P. Haines et al., 2017). In this 'new stakeholder driven service' weekend services were distributed across Friday, Saturday, Sunday and Monday. Further details of intervention and control conditions are presented in Table 4.1.

Table 0.1. Detailed characteristics of the included studies

Study	Setting	Participants [a]	Control	Intervention	Outcome
Haines et al 2017 Study A RCT	Australia Acute	Mixed general medical and surgical (hospitals = 2; wards = 12; n = 14834) Con: n = 6796, age = 61 (20) Exp: n = 8038, age = 59 (21) Hospital 1, 6 inpatient wards: orthopaedic surgery, stroke, thoracic/vascular/general surgery & medical, general medicine, head/neck/plastics, and surgical Hospital 2, 6 inpatient wards: medical (2 wards), infectious diseases/respiratory, plastics/ENT/head/neck surgery, general surgery/colorectal/breast/endocrine/ urology, and general surgery/ vascular/thoracic/upper gastrointestinal	No allied health services on weekends	Usual care allied health services on weekends Hospital 1 *(hours per hospital)* Sat: PT 8, OT 3, SP 3.5, DT 2, SW 1, AHA 4 Sun: PT 11, OT 3, SP 3, DT 2, SW 1, AHA 4 Hospital 2 *(hours per hospital)* Sat: PT 3.25, OT 3.5 Sun: PT 3.25	Primary • Hospital length of stay • Length of stay longer than expected length of stay • Hospital readmission • Adverse events Secondary • Compliments and complaints • Discharge destination • Occasions of allied health service • Cost of hospital admission • Clinical exceptions • Staff absenteeism
Haines et al 2017 Study B RCT	Australia Acute	Mixed general medical and surgical (hospitals = 2; wards = 11; n = 12674) Con: n = 6869, age = 60 (21) Exp: n = 5805, age = 60 (20) Hospital 1, 6 inpatient wards: orthopaedic surgery, stroke, thoracic / vascular / general surgery & medical, general medicine, head / neck / plastics, and surgical Hospital 2, 5 inpatient wards: medical (2 wards), infectious diseases / respiratory, plastics / ENT	No allied health services on weekends	Newly developed stakeholder driven weekend allied health service Hospital 1 *(hours per hospital)* Fri: PT 8, OT 4, AHA 4 Sat: PT 3.5, OT 2, SP 3.5, DT 1, SW 1 Sun: PT 7, OT 2, SP 3, DT 1, SW 1, AHA 4 Mon: PT 4, OT 4 Hospital 2 *(hours per hospital)* Sat: ICU PT 1, IRS 4, SP 2 Sun: ICU PT 1	Primary • Hospital length of stay • Length of stay longer than expected length of stay • Hospital readmission • Adverse events Secondary • Compliments and complaints • Discharge destination • Occasions of allied health service • Cost of hospital admission • Clinical exceptions • Staff absenteeism

		/ head / neck surgery, general surgery / colorectal / breast / endocrine / urology, and general surgery / vascular / thoracic / upper gastrointestinal			
Brusco et al 2007 RCT	Australia Subacute	Mixed rehabilitation (wards = 2; n = 262) Con: n = 132, age = 77 (13) Exp: n = 130, age = 77 (13)	5-day weekday physiotherapy *(daily hours per patient)* PT 1	Additional Saturday physiotherapy *(hours per patient)* PT 1	Primary • Hospital length of stay • Physiotherapy length of stay Secondary • EuroQol • Functional Independence Measure • Functional reach • 10 Meter Walk Test • Timed Up and Go Test • Motor Assessment Scale • Knee and Hip Range Of Motion • Discharge destination • Adverse events • Follow up therapy
Brusco et al 2014 RCT	Australia Subacute	Mixed rehabilitation (hospitals = 2; beds = 90; n = 996) Con: n = 500, age = 74 (13) Exp: n = 496, age = 75 (13)	5-day weekday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	Additional Saturday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	• Health service and therapy utilisation (30-day follow up) • Cost of inpatient rehabilitation (30-day follow up)
Brusco et al 2014B RCT	Australia Subacute	Mixed rehabilitation (hospitals = 2; beds = 90; n = 137) Con: n = 63, age = 61 (13) Exp: n = 74, age = 63 (12)	5-day weekday physiotherapy and occupational therapy (daily hours per patient) PT 1, OT 1	Additional Saturday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	Primary • Return to work • Average hours worked • Paid income Secondary • Functional Independence Measure • EuroQol-5D • Hospital length of stay
Brusco et al 2015 RCT	Australia Subacute	Mixed rehabilitation (hospitals = 2; beds = 90; n = 996) Con: n = 500, age = 74 (13) Exp: n = 496, age = 75 (13)	5-day weekday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	Additional Saturday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	• Health service and therapy utilisation (12-month follow up) • Cost of inpatient rehabilitation (12-month follow up)
English et al 2014 RCT	Australia Subacute	Stroke rehabilitation (centres = 5; n = 21) Con: n = 10, age = N/S Exp: n = 11, age = N/S	Usual care physiotherapy (recruitment sites)	7-day physiotherapy *(daily duration per patient)* PT (matched to preceding week)	• Therapy duration • Reasons for shortened therapy • Reasons for non-attendance • Activity across day • Activity during therapy

			Individual therapy 5 days per week (3/5 sites) Individual or group therapy between 1-4 days per week (2/5 sites) Weekend therapy for some patients (2/5 sites)		• Activity outside therapy • Activity location • Activity with people present
English et al 2015 RCT	Australia Subacute	Stroke rehabilitation (centres = 5; n = 190) Con: n = 94, age = 68 (13) Exp: n = 96, age = 72 (12)	Usual care physiotherapy (recruitment sites) Individual therapy 5-days per week (3/5 sites) Individual or group therapy between 1-4 days per week (2/5 sites) Weekend therapy for some patients (2/5 sites)	7-day physiotherapy *(daily duration per patient)* PT (matched to preceding week)	Primary • Six-minute was test Secondary • Walking speed • Functional ambulation category • Functional Independence Measure • Wold Motor Function test • Stroke Impact Scale physical subscale • Hospital length of stay • Assessment of Quality of Life • Adverse events • Resource utilisation
Peiris et al 2012 RCT	Australia Subacute	Mixed rehabilitation (hospitals = 2; beds = 90; n = 105) Con: n = 54, age = 73 (13) Exp: n = 51, age = 75 (12)	5-day weekday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	Additional Saturday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	Primary • Steps per day • Time spent upright Secondary • Time spent inactive • Activity completed in therapy
Peiris et al 2013 RCT	Australia Subacute	Mixed rehabilitation (hospitals = 2; beds = 90; n = 996) Con: n = 500, age = 74 (13) Exp: n = 496, age = 75 (13)	5-day weekday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	Additional Saturday physiotherapy and occupational therapy *(daily hours per patient)* PT 1, OT 1	Primary • Functional Independence Measure • EuroQol-5D • Hospital length of stay Secondary • Personal Care-Participation Assessment and Resource Tool • 10 Metre Walk Test • Timed Up and Go Test • Modified Motor Assessment Scale • Discharge destination • Follow up therapy • Adverse events
Boxall et al 2004	Australia Acute	Orthopaedic (wards = 1; n = 240) Con: n = 120, age = 68 Exp: n = 120, age = 68	5-day weekday physiotherapy	7-day physiotherapy service	• Hospital length of stay • Days to independent transfers • Days to independent mobility • Reasons for delayed discharge

Cohort					• Discharge destination • Pre-admission clinic attendance
David et al 2003 Cohort	England Acute	Rheumatology (wards = 1; beds = 28; n = 361) Con: n = 146, age = N/S Exp: n = 215, age = N/S	5-day weekday physiotherapy *(total EFT)* PT 2, AHA 0.3	Additional weekend physiotherapy *(total EFT)* PT 0.2, AHA 0.4	• Number of Rheumatology admissions • Hospital length of stay • Day of admission and discharge • Staff cost and utilisation
Haas et al 2018 Cohort	Australia Acute	Orthopaedic (wards = 2; beds = 48; n = 276) Con: n = 146, age = 69 (10) Exp: n = 130, age = 68 (11)	5-day weekday allied health service: physiotherapy, occupational therapy, speech pathology, dietetics, and social work	Saturday and Sunday allied health: physiotherapy, occupational therapy, speech pathology, dietetics, and social work	• Hospital length of stay • Adverse events • Discharge destination • Time till first post-operative transfer • Staff profession assisting first post-operative transfer • Physiotherapy session rate • Time till first post-op physiotherapy session • Modified Barthel Index • De Morton Mobility Index • EuroQol-5D utility • EuroQol-5D VAS • Patient satisfaction • Pain • Opioid use
Kinoshita et al 2017 Cohort	Japan Acute	Stroke (hospitals = 14; n = 3072) Con: n = 1997, age = 73 (13) [b] Exp: n = 1075, age = 74 (12) [b]	5-day or 6-day physiotherapy and occupational therapy	7-day physiotherapy and occupational therapy	• Modified Rankin Scale • Hospital length of stay • Adverse events • Discharge destination
Maidment et al 2014 Cohort	Australia Acute	Orthopaedic (ward = 1; n = 145) Con: n = 59, age = 72 (8) [b] Exp: n = 86, age = 69 (7) [b]	5-day physiotherapy service	7-day physiotherapy service	• Physiotherapy length of stay • Hospital length of stay • Number of physiotherapy sessions • Reasons for delayed discharge
Pengas et al 2015 Cohort	Scotland Acute	Orthopaedic (n = 792) Con: n = 600, age = N/S Exp: n = 192, age = N/S	5-day weekday physiotherapy	Additional Saturday and Sunday physiotherapy provided by an allied health assistant *(daily hours)* AHA 3	• Days to mobilising with 2-sticks • Hospital length of stay • Time to achieve 90° knee flexion • Range of Motion
Pua et al 2011 Cohort	Singapore Acute	Orthopaedic (n = 155) Con: n = 82, age = 65 (7) Exp: n = 73, age = 66 (8)	6-day Monday to Saturday physiotherapy *(daily OOS)* PT 1	Additional Sunday physiotherapy	• Hospital length of stay • Passive Range of Motion- knee • Straight Leg Raise

					• Independent mobility
Caruana et al 2016 Cohort	Australia Subacute	Mixed rehabilitation (ward = 1; beds = 40; n = 270) Con: n = 108, age = 75 (4) Exp: n = 162, age = 78 (12)	5-day Monday to Friday physiotherapy, occupational therapy, speech pathology, and dietetics	Additional Saturday physiotherapy *(daily hours)* PT and AIN 4	Primary • Hospital length of stay Secondary • Functional Independence Measure • Timed Up and Go Test • 10 Metre Walk Test • Functional reach • Step test • Feet Together Eyes Closed • Balance Outcome Measure for Elder Rehabilitation
DiSotto-Monastero et al 2012 Cross-sectional	Canada Subacute	Mixed rehabilitation (n = 3500) Con: n = 1692, age = 72 (13) Exp: n = 1808, age = 72 (14)	5-day physiotherapy and occupational therapy	7-day physiotherapy and occupational therapy	• Functional Independence Measure • Number of admissions and discharges • Hospital length of stay • Rehabilitation workload
Hakkennes et al 2015 Cohort	Australia Subacute	Mixed rehabilitation (hospital = 1; beds = 100; n = 976) Con: n = 499, age = 78 (10) [b] Exp: n = 477, age = 78 (12) [b]	5-day weekday therapy	Additional Saturday physiotherapy, occupational therapy, and social work *(daily hours per hospital)* PT 20, OT 16, SW 8, AHA 6	• Functional Independence Measure • Hospital length of stay • Number of admissions on Saturday

[a] Age is presented as mean (SD) in years.

[b] Converted from median (range/inter-quartile range) to mean (SD).

AHA = allied health assistant, AIN = assistant in nursing; Con = control group, DT = dietician, Exp = experimental group, ICU = Intensive Care Unit; IRS = Immediate Response Service; n = number of patients, N/S = not stated OOS = occasions of service; OT = occupational therapist PT = physiotherapist, RCT = randomised controlled trial, SP = speech pathologist, SW = social work

Quality and risk of bias assessment

The Cochrane Collaboration tool for assessing risk of bias in the included randomised controlled trials is presented in Figure 4.2. Eight studies reported adequate methods of random sequence generation (Natasha. K. Brusco, Watts, Shields, Chan, et al., 2014; Natasha. K. Brusco, Watts, Shields, & Taylor, 2014; Natasha. K Brusco et al., 2015; English et al., 2015; English et al., 2014; T. P. Haines et al., 2017; Peiris et al., 2013; Peiris et al., 2012a). All studies reported adequate allocation concealment; however, blinding of participants and personnel was not possible in any included studies. Hospital length of stay was unable to be blinded in any included studies (Natasha. K. Brusco et al., 2007; Natasha. K. Brusco, Watts, Shields, Chan, et al., 2014; Natasha. K. Brusco, Watts, Shields, & Taylor, 2014; Natasha. K Brusco et al., 2015; English et al., 2015; English et al., 2014; T. P. Haines et al., 2017; Peiris et al., 2013; Peiris et al., 2012a), although the stepped-wedge cluster randomised trials limited this as a potential source of bias (T. P. Haines et al., 2017). Risk of bias for selective reporting was identified in two studies (English et al., 2015; Peiris et al., 2013), with another study reporting further outcomes to be reported in other publications (T. P. Haines et al., 2017). No potential other sources of bias were identified for any of the included studies.

For non-randomised controlled trials assessed using the Newcastle - Ottawa quality assessment scale (Table 4.2), eight studies reported adequate methods to control for potential risk of selection bias (Boxall et al., 2004; David et al., 2003; DiSotto-Monastero et al., 2012; Haas et al., 2018; Hakkennes et al., 2015; Kinoshita et al., 2017; Maidment et al., 2014; Pua et al., 2011), with two studies potentially at risk of selection bias (Caruana et al., 2016; Pengas et al., 2015). There was adequate reporting of methods to control for potential risk of comparability bias for all studies. Seven studies reported adequate methods to control for potential outcome or exposure risk of bias (David et al., 2003; DiSotto-Monastero et al., 2012; Haas et al., 2018; Hakkennes et al., 2015; Kinoshita et al., 2017; Maidment et al., 2014; Pua et al., 2011), with three studies potentially at risk of outcome bias (Boxall et al., 2004; Caruana et al., 2016; Pengas et al., 2015).

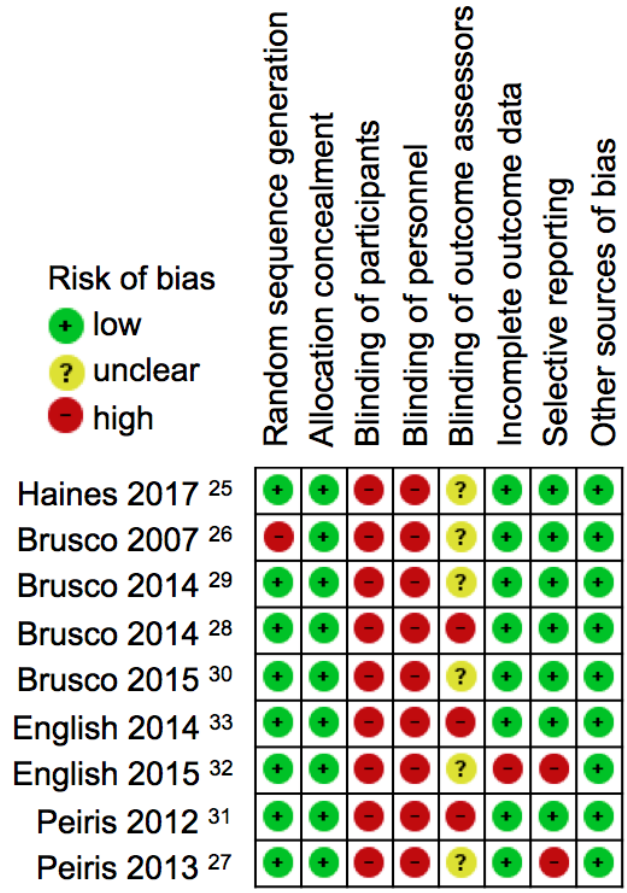


Figure 4.2. Risk of bias of the included trials, assessed using the Cochrane Risk of Bias tool

Table 0.2. Risk of bias of the nine included cohort studies and one included cross-sectional study, assessed using the Newcastle-Ottawa quality assessment scale for observational studies

Cohort study	Selection	Comparability	Outcome
Boxall 2004	****	*	**
David 2003	****	*	***
Haas 2018	****	*	***
Kinoshita 2017	****	*	***
Maidment 2014	****	*	***
Pengus 2015	***	*	**
Pua 2011	****	*	***
Caruana 2016	***	*	**
Hakkennes 2015	****	*	***
Cross-sectional study	Selection	Comparability	Exposure
DiSotto-Monastero 2012	****	*	***

Four stars is the highest number that can be received for ‘selection’, one star is the highest that can be received for ‘comparability’, and three stars is the highest for ‘outcome’. The higher the number of stars in each column indicates lower risk of bias.

Different scale version used for cross-sectional studies, where ‘outcome’ is replaced with ‘exposure’.

Effect of additional weekend allied health

Meta-analyses, subgroup, and sensitivity analyses are presented in Tables 4.3, 4.4, 4.5 and 4.6.

Outcome: Hospital Length of Stay

Setting: Acute

Two acute stepped-wedge, randomised controlled trials (n=27,508) were identified (T. P. Haines et al., 2017). Meta-analysis of individual participant level data in these trials demonstrated no difference between intervention and control conditions for hospital length of stay (WMD 0.08 days; 95% CI -0.15 to 0.32; I^2=98.7%) (Figure 4.3(a)). When patient diagnosis was taken into account, there was no difference in the proportion of patients whose hospital length of stay was longer than their expected length of stay between intervention and control conditions using cluster level data (RD 0.00 days; 95% CI -0.02 to 0.02; I^2=78.5%) (Figure 4.4). High levels of heterogeneity in the study results were examined by post-hoc exploratory analysis in the study by T. P. Haines et al. (2017) suggesting that there was a significant change in hospital length of stay outcomes between control conditions, but when intervention conditions were compared; there was no significant difference between patient hospital length of stay outcomes.

These meta-analyses results were somewhat concordant with those involving non-randomised studies. Meta-analysis (n = 4,676) of six acute non-randomised controlled trials showed no effect of providing weekend allied health services on hospital length of stay (WMD 0.24 days; 95% CI -0.17 to 0.66; I^2=95.5%) (Boxall et al., 2004; David et al., 2003; Haas et al., 2018; Kinoshita et al., 2017; Maidment et al., 2014; Pengas et al., 2015; Pua et al., 2011) (Figure 4.3(b)). Heterogeneity levels were reduced when sub-group analysis of only total hip arthroplasty patients was performed (WMD 0.08 days; 95% CI -0.12 to 0.29; I^2=23.7%) (Table 4.4) (Boxall et al., 2004; Maidment et al., 2014; Pengas et al., 2015).

Setting: Subacute

Meta-analysis (n = 1,437) of three randomised controlled trials conducted in the subacute setting indicated that weekend allied health services reduced subacute hospital length of stay (WMD 2.35 days; 95% CI 0.45 to 4.24; I^2=0.0%) (Figure 4.3(c)) (Natasha. K. Brusco et al., 2007; English et al., 2015; Peiris et al., 2013).

The results from the randomised trials in the subacute setting were somewhat concordant with non-randomised studies. A meta-analysis (n = 5,012) of three subacute non-randomised controlled trials showed a trend towards reduced hospital length of stay in favour of weekend allied health provision (WMD 0.49 days 95% CI -0.87 to 1.85; I^2=82.7%) (Figure 4.3(d)) (Caruana et al., 2016; DiSotto-Monastero et al., 2012; Hakkennes et al., 2015). However, high levels of heterogeneity in study results were observed between studies.

Outcome: Hospital Re-Admission

Setting: Acute

Meta-analysis (n = 27,508) of cluster level data from two acute stepped wedge randomised controlled trials showed no difference in the proportion of patients who had an unplanned hospital re-admission within 28-days post hospital discharge between groups with weekend allied health services available and not available (RD 0.01; 95% CI -0.00 to 0.02; I^2=42.6%) (Figure 4.5) (T. P. Haines et al., 2017).

This was consistent with the results of one non-randomised trial that also demonstrated no difference in unplanned hospital re-admission within 6 weeks of discharge between groups (Kinoshita et al., 2017).

Setting: Subacute

Meta-analysis was unable to be performed for this outcome in randomised or non-randomised trials in the subacute setting. However, one subacute randomised control trial reported no difference between intervention and control conditions for hospital re-admission within 30-days post discharge (Natasha. K. Brusco, Watts, Shields, & Taylor, 2014).

Outcome: Adverse Events

Setting: Acute

Meta-analysis (n = 27,508) of cluster level data from two acute stepped wedge randomised controlled trials indicated no statistically significant difference in the proportion of patients experiencing adverse events (n=2,464) for the events measured (falls, pressure injuries, pulmonary embolism, deep vein thrombosis, rapid response medical team call, transfer to intensive care or high dependency unit, and death) between those receiving weekend allied health and not receiving weekend allied health services (RD 0.00; 95% CI -0.01 to 0.01; I^2=82.7%) (Figure 4.6(a)) (T. P. Haines et al., 2017). High levels of heterogeneity in the study results were examined by post-hoc exploratory analysis in T. P. Haines et al. (2017) suggesting that there was a significant change in patients experiencing any adverse event between control conditions, but when intervention conditions were compared, there was no significant difference.

This result was concordant with those from two acute non-randomised controlled trials whose meta-analysis (n = 3,348) showed no effect of weekend allied health on the number of adverse events, n=135 (falls, pressure injuries, pulmonary embolism, deep vein thrombosis, rapid response medical team calls, transfer to intensive care or high dependency unit, and deaths) (RR 1.18; 95% CI 0.51 to 2.73; I^2=78.3%) (Figure 4.6(b)) (Haas et al., 2018; Kinoshita et al., 2017). However, high levels of heterogeneity in study results were observed between studies.

Setting: Subacute

Meta-analysis (n = 1,437) of three subacute randomised controlled trials indicated no difference between weekend and no weekend allied health for the number of adverse events, n=303 (falls, skin tears, infections, re-admission to acute service, and death) (RR 1.13; 95% CI 0.92 to 1.39; I^2=0.0%) (Figure 4.6(c)) (Natasha. K. Brusco et al., 2007; English et al., 2015; Peiris et al., 2013).

Outcome: Discharge Destination

Setting: Acute

Meta-analysis (n = 27,508) of cluster level data from two acute stepped wedge randomised controlled trials indicated no difference in the proportion of patients discharged to aged-care between those receiving weekend allied health and not receiving weekend allied health services (RD 0.00; 95% CI -0.00 to 0.01; I^2=31.2%) (Figure 4.7(a)) (T. P. Haines et al., 2017).

This result was somewhat discordant with those from three acute non-randomised studies (n = 3,588), where a meta-analysis showed patients receiving weekend allied health may have been more likely to be discharged home to private residence from hospital (RR 1.19; 95% CI 1.03 to 1.38; I^2=58.7%) (Figure 4.7(b)) (Boxall et al., 2004; Haas et al., 2018; Kinoshita et al., 2017). However, high levels of heterogeneity in study results were observed between studies.

Setting: Subacute

Meta-analysis was not possible for randomised trials in the subacute setting. However, one subacute randomised control trial reported no difference between intervention and control conditions for the number of patients discharged to aged-care (Natasha. K. Brusco et al., 2007).

This result was concordant with those from two subacute non-randomised studies (n = 4,476) where meta-analysis showed no effect of weekend allied health on the relative risk of patients being discharged to aged care (RR 1.00; 95% CI 0.75 to 1.34; I^2=0.0%) (Figure 4.7(d)) (DiSotto-Monastero et al., 2012; Hakkennes et al., 2015).

Outcome: Functional Independence

Setting: Acute

Meta-analysis was not possible for this outcome in randomised trials in the acute setting.

Functional activities of daily living were measured in three acute non-randomised controlled trials (Boxall et al., 2004; Haas et al., 2018; Pengas et al., 2015). The Barthel Index, 'days to mobilising with two sticks', and 'days to independent mobility' were transformed to conform to the same effect direction, these were then pooled and categorised as functional activities of daily living outcomes. Meta-analysis of three acute non-randomised studies (n = 1,201) showed no difference in functional independence between those who had weekend allied health services available and those who didn't (SMD 0.19; 95% CI -0.12 to 0.50; I^2=77.1%) (Figure 4.8(b)). Heterogeneity levels were reduced when sub-group analysis of only total hip arthroplasty patients (SMD 0.31; 95% CI 0.12 to 0.51; I^2=0.0%), total knee arthroplasty patients (SMD 0.39; 95% CI 0.15 to 0.64; I^2=0.0%), or studies examining only physiotherapy (no other professions) was performed (SMD 0.34; 95% CI 0.19 to 0.49; I^2=0.0%) (Table 4.4).

Setting: Subacute

The Functional Independence Measure (FIM) was pooled and categorised as a functional activity of daily living outcome measured in three subacute randomised controlled trials (Natasha. K. Brusco et al., 2007; English et al., 2015; Peiris et al., 2013). The Timed Up and Go Test (TUGT), and the Wolf Motor Function Test (WMFT) were transformed to conform to the same effect direction, these were then pooled and

categorised as functional mobility outcomes measured in three subacute randomised controlled trials (Natasha. K. Brusco et al., 2007; English et al., 2015; Peiris et al., 2013). Walking speed and 10-Metre Walk Test (10MWT) were transformed to conform to the same effect direction, these were then pooled and categorised as functional walking speed outcomes measured in three subacute randomised controlled trials (Natasha. K. Brusco et al., 2007; English et al., 2015; Peiris et al., 2013). The Motor Assessment Scale (MAS) and the physical dimension of the Stroke Impact Scale (SIS) were transformed to conform to the same effect direction, these were then pooled and categorised as stroke specific functional outcomes in three subacute non-randomised controlled trials (Natasha. K. Brusco et al., 2007; English et al., 2015; Peiris et al., 2013). Measurement time points were grouped prior to inpatient discharge.

Meta-analysis (n = 1,437) showed a trend towards improved functional activities of daily living taken prior to hospital discharge in favour of weekend allied health service provision, though this was not statistically significant (SMD 0.09; 95% CI -0.01 to 0.19; I^2=0.0%) (Figure 4.8(c)). No difference was identified between intervention and control conditions in meta-analyses of functional mobility (n = 335), walking speed (n = 438), and stroke specific outcome measures (n = 210).

The Functional Independence Measure (FIM) was pooled and categorised as a functional activity of daily living outcome measure in three subacute non-randomised controlled trials (Caruana et al., 2016; DiSotto-Monastero et al., 2012; Hakkennes et al., 2015). Results from meta-analysis of randomised controlled trials were somewhat concordant with meta-analysis of three subacute non-randomised controlled trials (n = 4,746), which showed no statistically significant difference between weekend and no weekend allied health for functional activities of daily living outcome measures (SMD 0.05; 95% CI -0.17 to 0.28; I^2=89.4%) (Figure 4.8(d)). However, high levels of heterogeneity in study results were observed between studies.

Outcome: Health Related Quality of Life

Setting: Acute

Meta-analysis was not possible for this outcome in randomised or non-randomised trials in the acute setting. No randomised trials reported health related quality of life in the acute setting, but one non-randomised trial demonstrated no difference in quality of life (EQ-5D) at four days post-operatively between the weekend and no weekend allied health groups (Haas et al., 2018).

Setting: Subacute

The EuroQol Five Dimensions questionaire (EQ-5D) and Assessment of Quality of Life (AQoL) were pooled and categorised as health related quality of life outcome measures taken prior to discharge in three subacute randomised controlled trials (Natasha. K. Brusco et al., 2007; English et al., 2015; Peiris et al., 2013). Meta-analysis (n = 1,423) indicated a trend towards improved health related quality of life in favour of weekend allied health service provision (SMD 0.10; 95% CI -0.01 to 0.20; I^2=0.0%) (Figure 4.9). Although this result was not statistically significant, it indicates possible improved efficiency, as improvements in quality of life may have been achieved during a shorter length of hospital stay.

Outcome: Cost of Hospital Care

Setting: Acute

Meta-analysis (n = 27,508) of individual participant level data from two acute stepped wedge randomised controlled trials indicated no difference in patient cost to healthcare system per hospital admission between those with weekend allied health services available and not available (WMD $AUD 118; 95% CI -274.5 to 510.5; I^2=98.5%) (Figure 4.10) (T. P. Haines et al., 2017). Clinical costing data was captured using routinely applied hospital data collection and resource allocation procedures, largely driven by hospital length of stay and procedures performed, which does not take into consideration cost relative to patient diagnosis. High levels of heterogeneity in the study results were explained by exploratory analysis in Haines et al (2017)

indicating that there was a significant change in total cost favouring the original weekend allied health service delivery model, though these outcomes did not account for differences in patient diagnosis categories between phases (T. P. Haines et al., 2017).

Setting: Subacute

Meta-analysis was not possible for this outcome in randomised or non-randomised trials in the subacute setting. However, one subacute randomised controlled trial reported economic outcomes at 3-month, 6-month and 12-month follow up (Natasha. K. Brusco, Watts, Shields, & Taylor, 2014; Natasha. K Brusco et al., 2015). At 3-month follow up post hospital discharge, there was a mean cost saving of AUD$1,673 favouring weekend allied health service provision. An incremental cost utility ratio saving of AUD$41,825 per quality of life year (QALY) gained, and an incremental cost effectiveness ratio (ICER) found a saving of AUD$16,003 in achieving a minimal clinically important difference (MCID) in functional independence for the group receiving additional weekend allied health service provision. If willingness to pay per QALY gained or MCID in functional independence was zero AUD$, the probability of cost effectiveness was 96% and 95% respectively. A sensitivity analysis removing the Saturday penalty rate salary loading of 50% did not alter the results of the primary analysis. At 6-month follow up there was a mean cost saving of AUD$6,445 favouring weekend allied health service provision, however this saving was no longer significant at 12-month follow up. The ICER found a saving of AUD$41,825 (95% CI −2,817 to 74,620) per QALY gained for the weekend allied health group at 6 months.

Table 0.3. Randomised controlled trial meta-analysis investigating the effect of weekend allied health on acute general medical and surgical wards

Outcome	Weighted mean difference (95% CI) I^2	Risk difference (95% CI) I^2
Hospital length of stay *(days)*	–0.08 (–0.32 to 0.15) 99%	
Hospital length of stay *(log transformed)*	–0.02 (–0.05 to 0.02) 88%	
Proportion of patients staying longer than expected		0.00 (–0.02 to 0.02) 78%
Unplanned hospital readmissions within 28 days		0.01 (0.00 to 0.02) 43%
Proportion of patients with any adverse event		0.00 (–0.01 to 0.01) 83%
Proportion of patients discharged to aged care		0.00 (0.00 to 0.01) 31%
Cost to healthcare system per admission *(AUD$)*	–118 (–511 to 274) 99%	

* Total effect size for continuous outcomes calculated from participant level data, and total effect size for proportion outcomes were calculated from cluster level data. Positive values favour intervention. Negative values favour control. No sub-group or sensitivity analysis was performed because only two randomised trials in the acute setting were identified.

Table 4.4. Non-randomised controlled trial meta-analysis, subgroup meta-analysis and sensitivity analysis investigating the effect of weekend allied health services on acute general medical and surgical hospital wards

Outcome	Total effect size (95% CI) I^2	Sub-group analyses (95% CI) I^2					Sensitivity analyses (95% CI) I^2		
		Orthopaedic	Orthopaedic total knee arthroplasty	Orthopaedic total hip arthroplasty	Neurological	Studies with PT service only (no other professions)	Studies with identified selection bias removed	Studies with identified outcome bias removed	Studies where data were estimated due to inadequate reporting removed
Hospital length of stay, WMD *(days)*	0.24 (–0.17 to 0.66) 96%	0.51 (0.26 to 0.76) 84%	0.49 (0.11 to 0.87) 90%	0.08 (–0.12 to 0.29) 24%	–0.50 (-0.74 to -0.26) N/A[a]	0.66 (0.49 to 0.83) 68%	0.22 (–0.27 to 0.72) 96%	0.18 (-0.33 to 0.69) 97%	–0.04 (–1.45 to 1.38) 49%
Adverse events, RR	1.18 (0.51 to 2.73) 78%	0.74 (0.39 to 1.41) N/A[a]	No studies	No studies	1.75 (1.11 to 2.75) N/A[a]	No studies	1.18 (0.51 to 2.73) 78%	1.18 (0.51 to 2.73) 78%	1.75 (1.11 to 2.75) N/A[a]
Patients discharged home, RR	1.19 (1.03 to 1.38) 59%	1.22 (0.87 to 1.72) 80%	No studies	No studies	1.17 (1.08 to 1.38) N/A[a]	1.04 (0.86 to 1.25) N/A[a]	1.19 (1.03 to 1.38) 59%	1.27 (1.03 to 1.57) 66%	1.19 (1.03 to 1.38) 59%
Functional independence, SMD	0.19 (–0.12 to 0.50) 77%	0.19 (–0.12 to 0.50) 77%	0.39 (0.15 to 0.64) 0%	0.31 (0.12 to 0.51) 0%	No studies	0.34 (0.19 to 0.49) 0%	0.09 (–0.33 to 0.52) 71%	–0.10 (–0.35 to 0.15) N/A[a]	0.09 (–0.33 to 0.52) 71%

N/A = not applicable, PT = physiotherapist, SMD = standardised mean difference, WMD = weighted mean difference.

Positive values favour intervention. Negative values favour control.

[a] I^2 could not be calculated where data from only one study were available.

Table 4.5. Randomised controlled trial meta-analysis, subgroup meta-analysis and sensitivity analysis investigating the effect of weekend allied health services on subacute rehabilitation wards

Outcome	Total effect size (95% CI) I^2	Sub-group analyses (95% CI) I^2		Sensitivity analyses (95% CI) I^2					
		Mixed rehabilitation	Neurological rehabilitation	Studies with PT service only (no other professions)	Studies with identified bias for random sequence generation removed	Studies with identified bias for blinding of outcome assessment removed	Studies with identified bias for incomplete outcome data removed	Studies with identified bias for selective reporting removed	Studies where data estimated due to inadequate reporting removed
Hospital length of stay, WMD *(days)*	2.35 (0.45 to 4.24) 0%	2.33 (0.42 to 4.25) 0%	3.00 (–11.12 to 17.12) N/A[a]	3.19 (–0.32 to 6.70) 0%	2.03 (–0.20 to 4.25) 0%	2.03 (–0.20 to 4.25) 0%	2.33 (0.42 to 4.25) 0%	3.20 (–0.43 to 6.83) N/A[a]	2.35 (0.45 to 4.24) 0%
Adverse events, RR	1.13 (0.92 to 1.39) 0%	1.18 (0.95 to 1.46) 0%	0.77 (0.38 to 1.53) N/A[a]	1.01 (0.70 to 1.46) 0%	1.08 (0.75 to 1.45) 30%	1.08 (0.75 to 1.45) 0%	1.18 (0.95 to 1.46) 0%	1.12 (0.73 to 1.73) N/A[a]	1.13 (0.92 to 1.40) 0%
Functional independence, SMD	0.09 (–0.01 to 0.19) 0%	0.09 (–0.02 to 0.20) 0%	0.07 (–0.22 to 0.37) N/A[a]	0.06 (–0.13 to 0.24) 0%	0.10 (–0.01 to 0.21) 0%	0.10 (–0.01 to 0.21) 0%	0.09 (–0.02 to 0.20) 0%	0.04 (–0.20 to 0.29) N/A[a]	0.09 (0.01 to 0.19) 0%
Function walking speed, SMD	3.36 (0.56 to 6.15) 100%	5.07 (–4.89 to 15.04) 100%	0.12 (–0.17 to 0.42) N/A[a]	5.14 (–4.71 to 14.98) 100%	0.03 (–0.11 to 0.16) 0%	0.03 (–0.11 to 0.16) 0%	5.07 (–4.89 to 15.04) 100%	10.17 (9.26 to 11.08) N/A[a]	3.36 (0.56 to 6.15) 100%
Function stroke outcomes, SMD	0.03 (–0.20 to 0.26) 0%	–1.05 (–4.95 to 2.86) 43%	0.07 (–0.26 to 0.40) N/A[a]	–1.03 (–5.04 to 2.97) 45%	0.03 (–0.20 to 0.26) 0%	0.03 (–0.20 to 0.26) 0%	–1.05 (–4.95 to 2.86) 43%	–4.83 (–11.98 to 2.31) N/A[a]	0.03 (–0.20 to 0.26) 0%
Function mobility, SMD	0.06 (–0.09 to 0.21) 18%	0.01 (–0.13 to 0.14) 0%	0.27 (–0.03 to 0.57) N/A[a]	0.16 (–0.08 to 0.38) 14%	0.10 (–0.15 to 0.36) 59%	0.10 (–0.15 to 0.36)	0.01 (–0.13 to 0.14) 0%	0.03 (–0.27 to 0.34) N/A[a]	0.06 (–0.09 to 0.21) 0%

						59%			
Quality of life, SMD	0.10 (–0.01 to 0.20) 0%	0.12 (0.00 to 0.23) 0%	–0.03 (–0.33 to 0.28) N/A[a]	0.08 (–0.11 to 0.27) 0%	0.09 (–0.03 to 0.20) 0%	0.09 (–0.03 to 0.20) 0%	0.12 (–0.01 to 0.23) 0%	0.15 (–0.10 to 0.39) N/A[a]	0.10 (–0.01 to 0.20) 0%

N/A = not applicable, PT = physiotherapist, SMD = standardised mean difference, WMD = weighted mean difference.

Positive values favour intervention. Negative values favour control.

[a] I^2 could not be calculated where data from only one study were available.

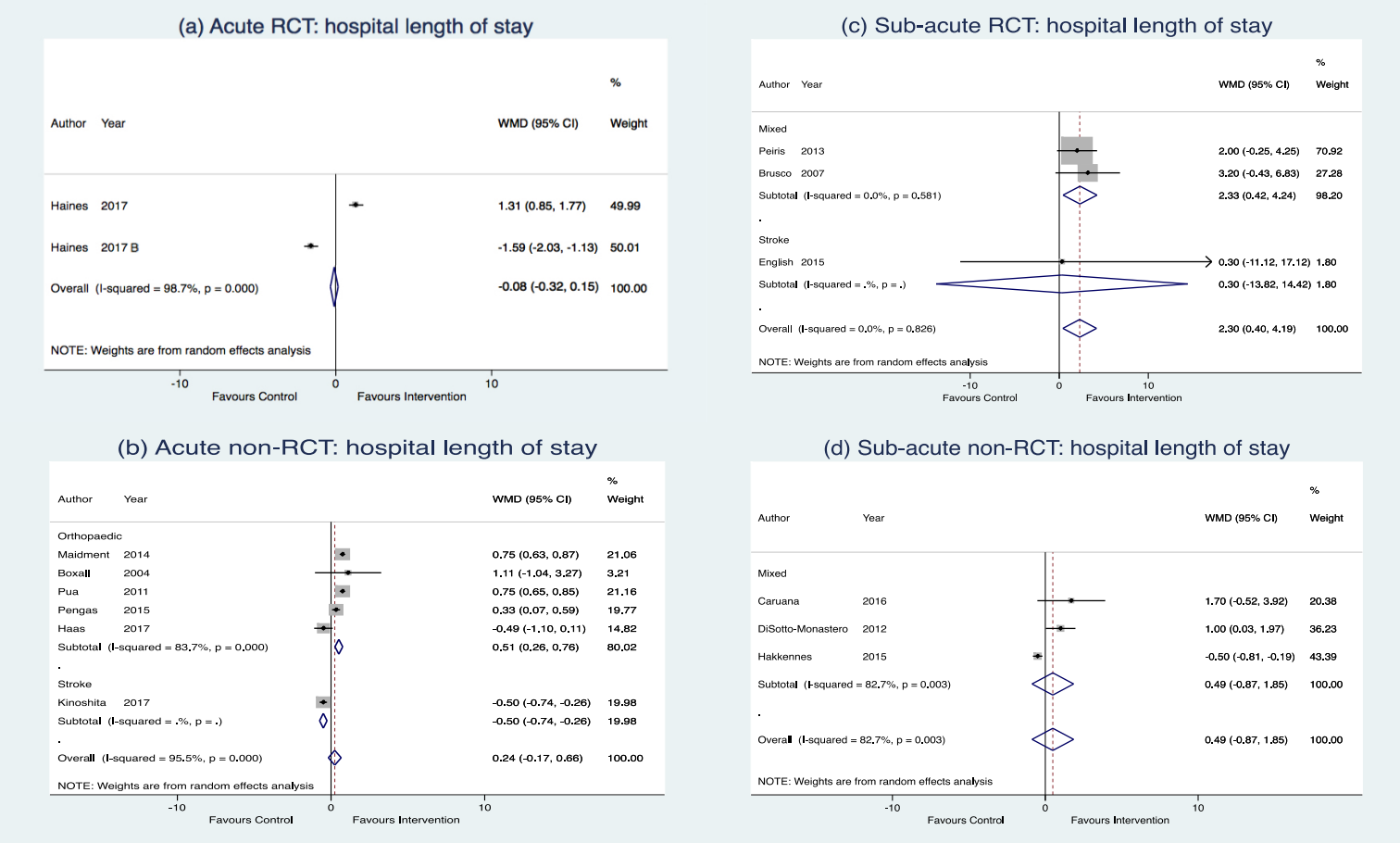
Table 4.6. Non-randomised controlled trial meta-analysis and sensitivity analysis investigating the effect of weekend allied health services on subacute rehabilitation wards

Outcome	Total effect size (95% CI) I^2	Sensitivity analyses (95% CI) I^2			
		Studies with PT service only (no other professions)	Studies with identified selection bias removed	Studies with identified outcome bias removed	Studies where data were estimated due to inadequate reporting removed
Hospital length of stay, WMD *(days)*	0.49 (–0.87 to 1.85) 83%	1.70 (–0.52 to 3.92) N/A[a]	0.18 (–1.29 to 1.64) 88%	0.18 (–1.29 to 1.64) 88%	1.11 (0.22 to 2.00) 0%
Patients discharged to aged care, RR	1.00 (0.75 to 1.34) 0%	No studies	1.00 (0.75 to 1.34) 0%	1.00 (0.75 to 1.34) 0%	1.00 (0.75 to 1.34) 0%
Functional independence, SMD	0.05 (–0.17 to 0.28) 89%	–0.21 (–0.45 to 0.04) N/A[a]	0.15 (–0.11 to 0.42) 93%	0.15 (–0.11 to 0.42) 93%	–0.06 (–0.28 to 0.16) 69%

N/A = not applicable, PT = physiotherapist, SMD = standardised mean difference, WMD = weighted mean difference.

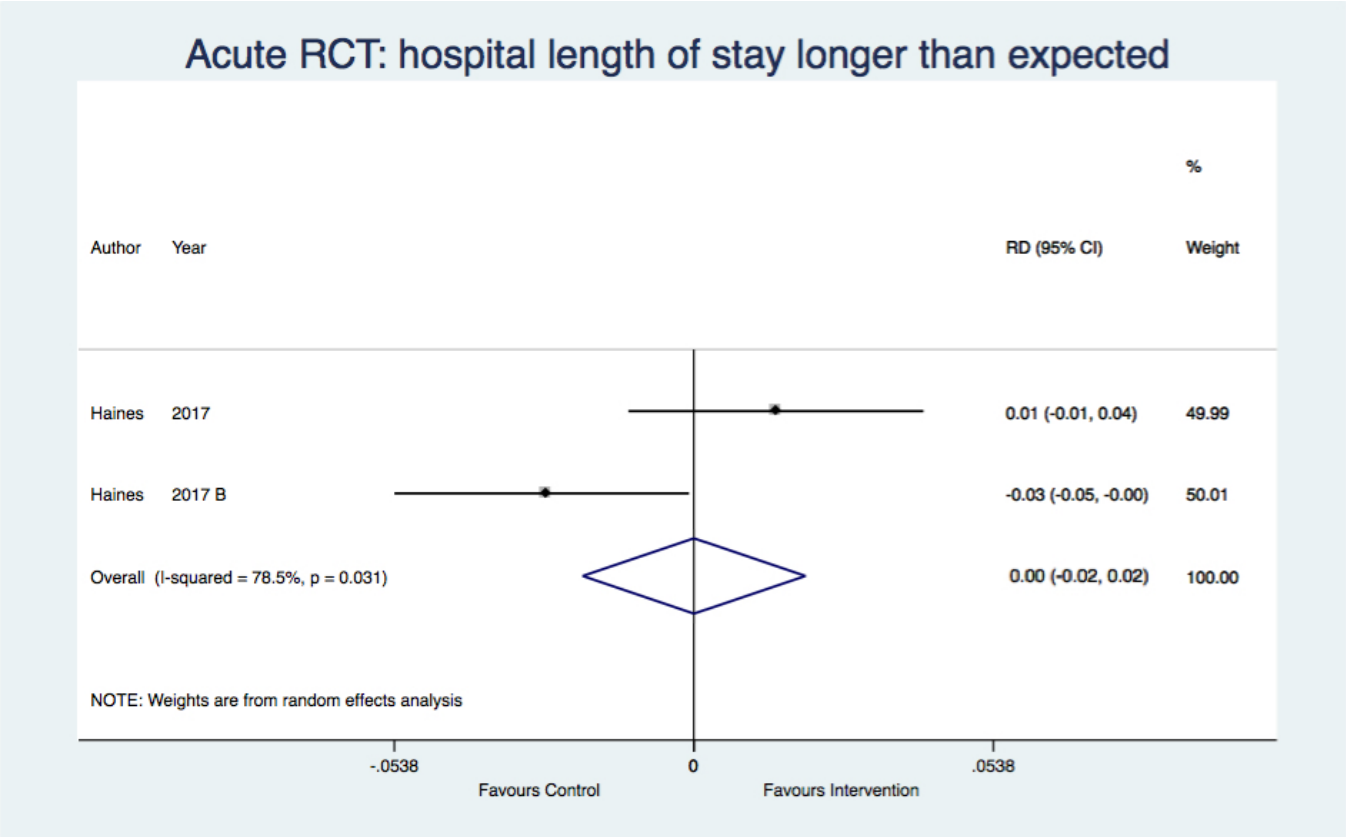
Positive values favour intervention. Negative values favour control.

[a] I^2 could not be calculated where data from only one study were available.



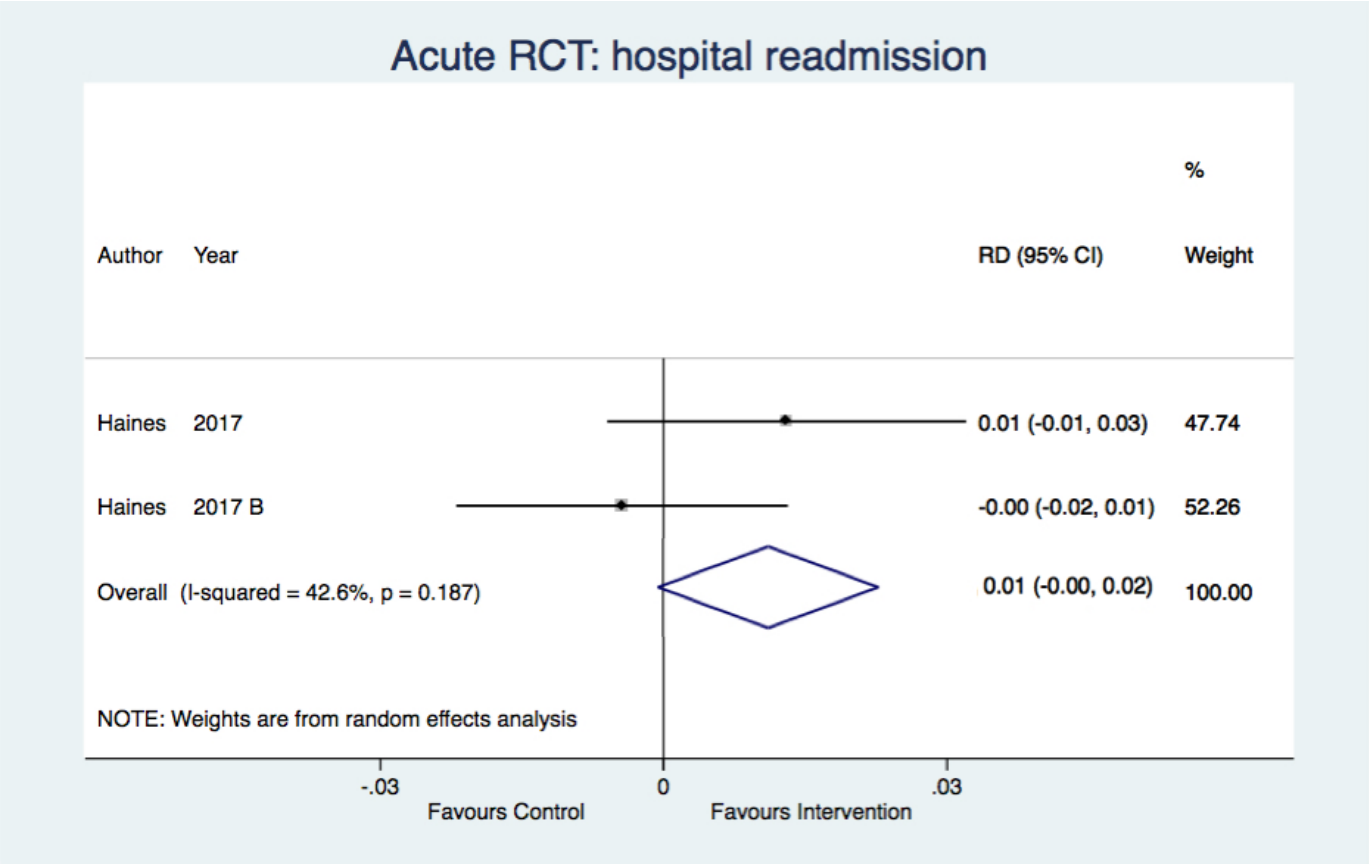
* (a) Acute RCT: calculated from participant level data

Figure 4.3. Forest plot for effect of weekend allied health on hospital length of stay: (a) acute RCT; (b) acute non-RCT; (c) subacute RCT; (d) subacute non-RCT



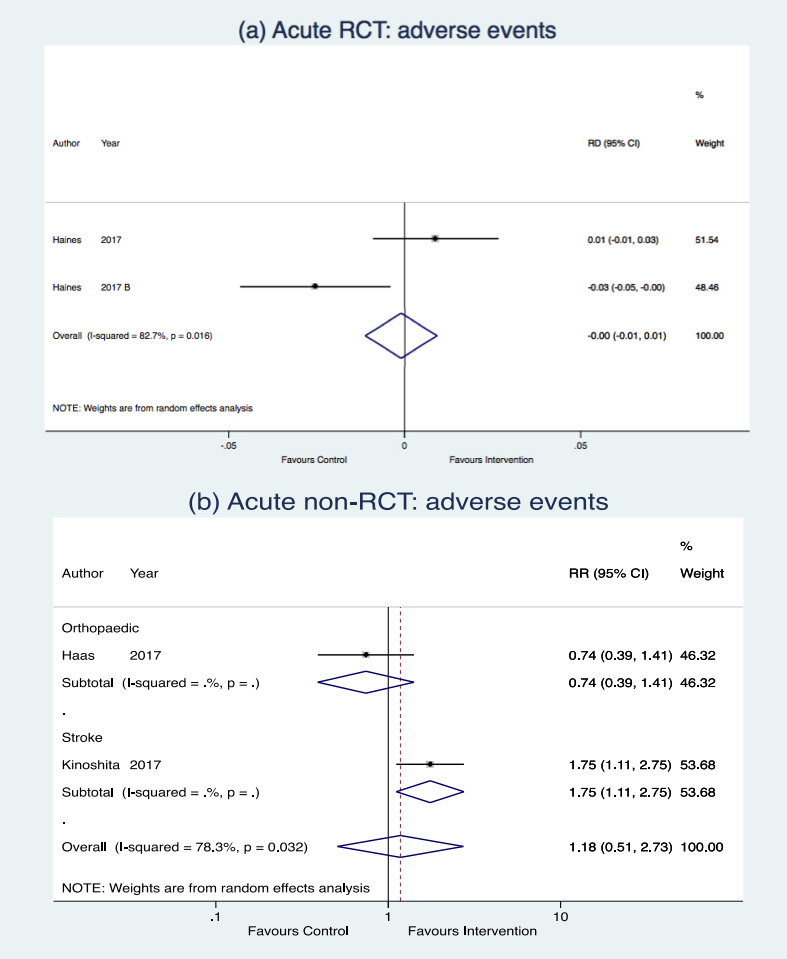
* Acute RCT: calculated from cluster level data

Figure 4.4. Forest plot of acute RCT's for effect of weekend allied health on proportion of patients whose hospital length of stay was longer than their expected length of stay



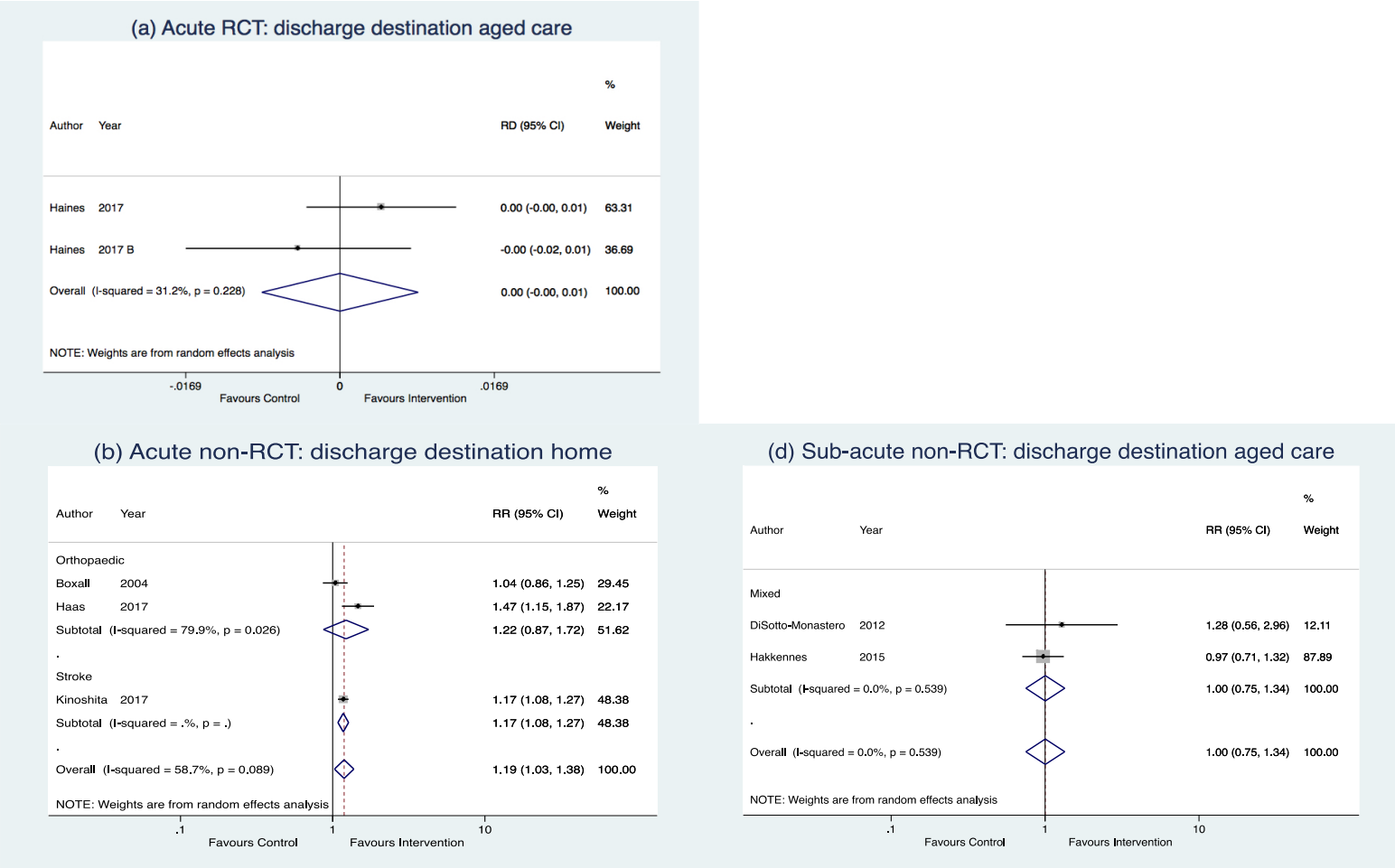
* Acute RCT: calculated from cluster level data

Figure 4.5. Forest plot for effect of weekend allied health on hospital readmission



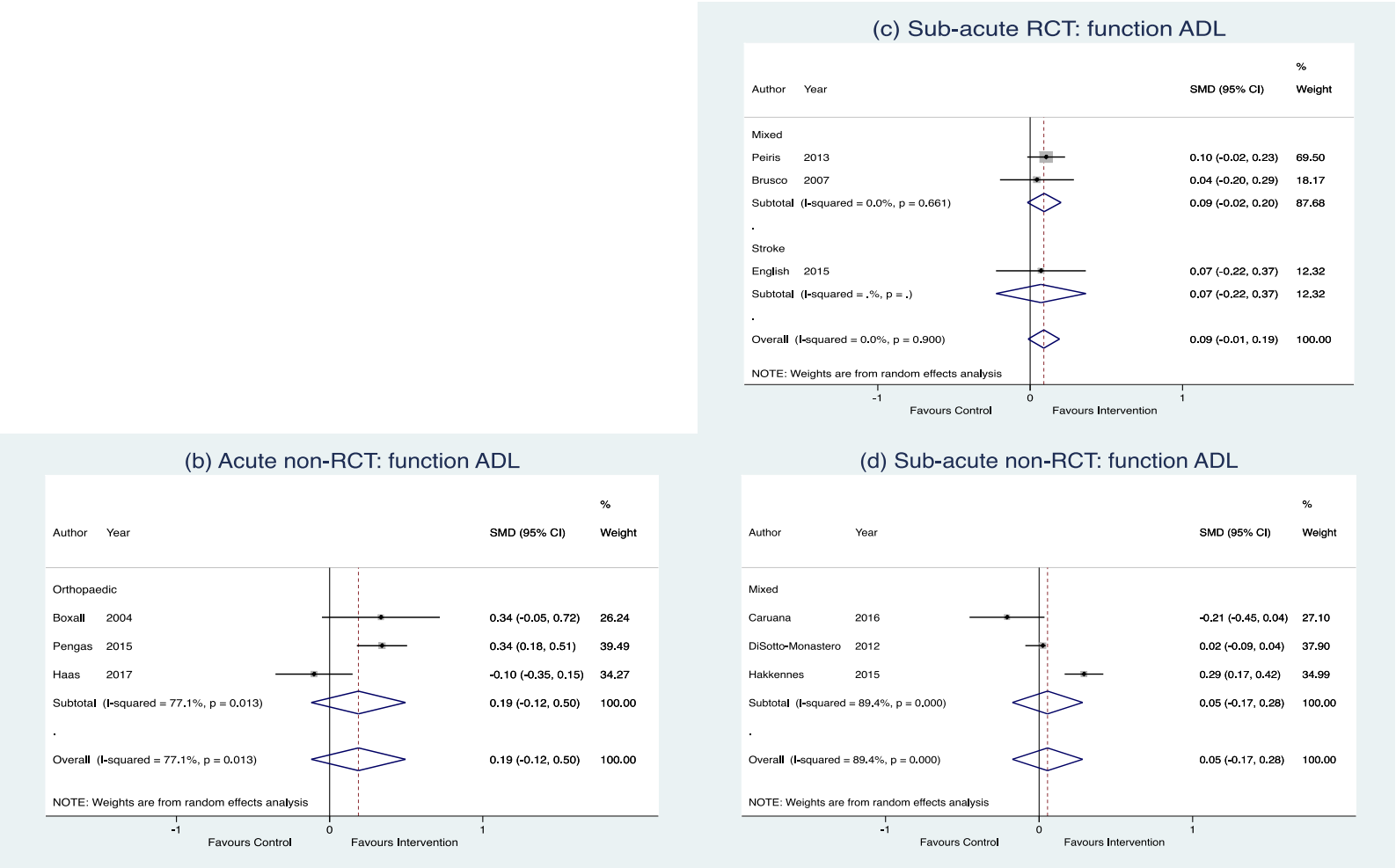
* Acute RCT: calculated from cluster level data

Figure 4.6. Forest plot for effect of weekend allied health on adverse events: (a) acute RCT; (b) acute non-RCT; (c) subacute RCT



* Acute RCT: calculated from cluster level data. Subacute RCT is not displayed, as meta-analysis was unable to be performed

Figure 4.7. Forest plot for effect of weekend allied health on discharge destination: (a) acute RCT; (b) acute non-RCT; (d) subacute non-RCT



* Acute RCT is not displayed, as meta-analysis was unable to be performed

Figure 4.8. Forest plot for effect of weekend allied health on ADL function: (b) acute non-RCT; (c) subacute RCT; (d) subacute non-RCT

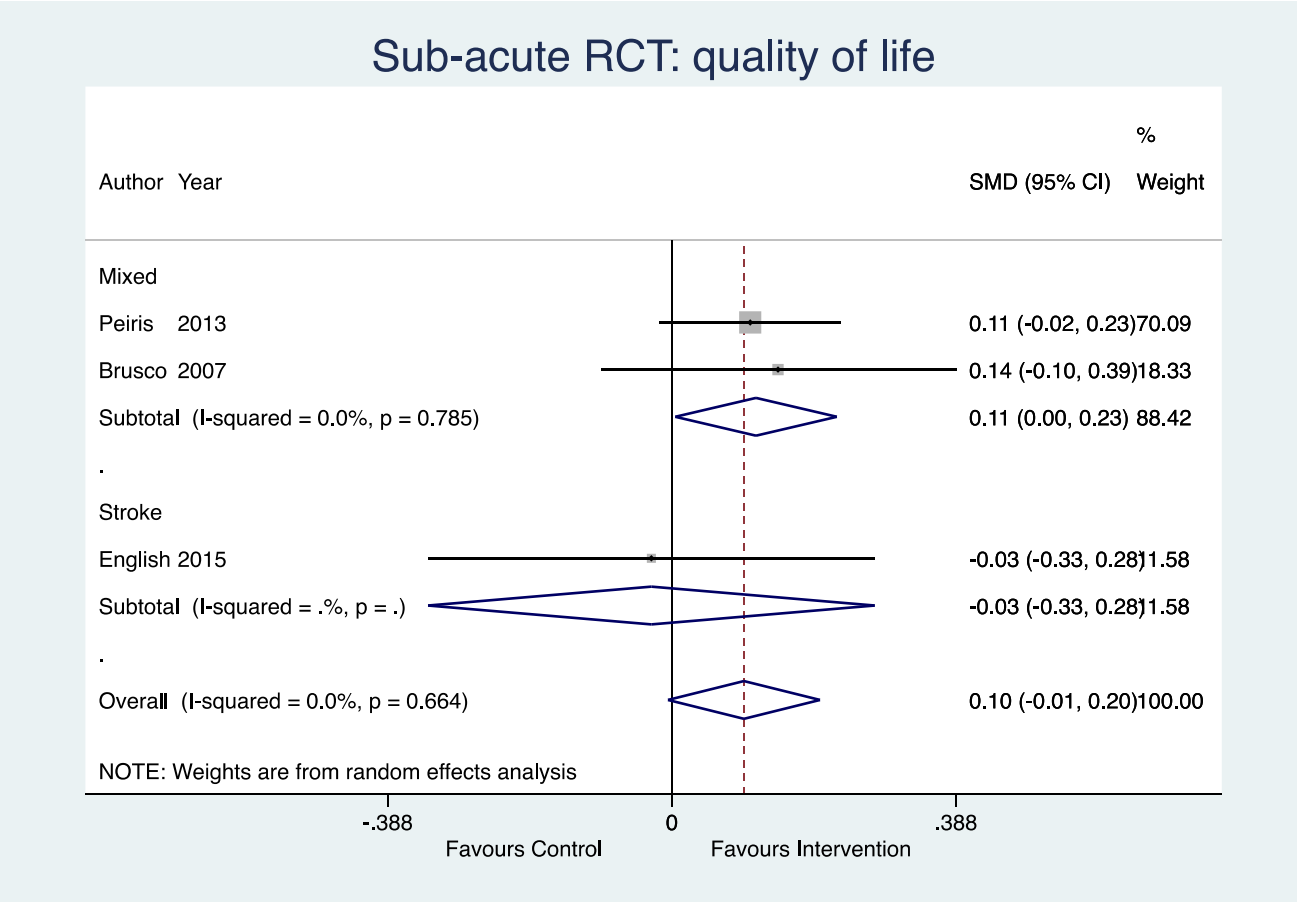
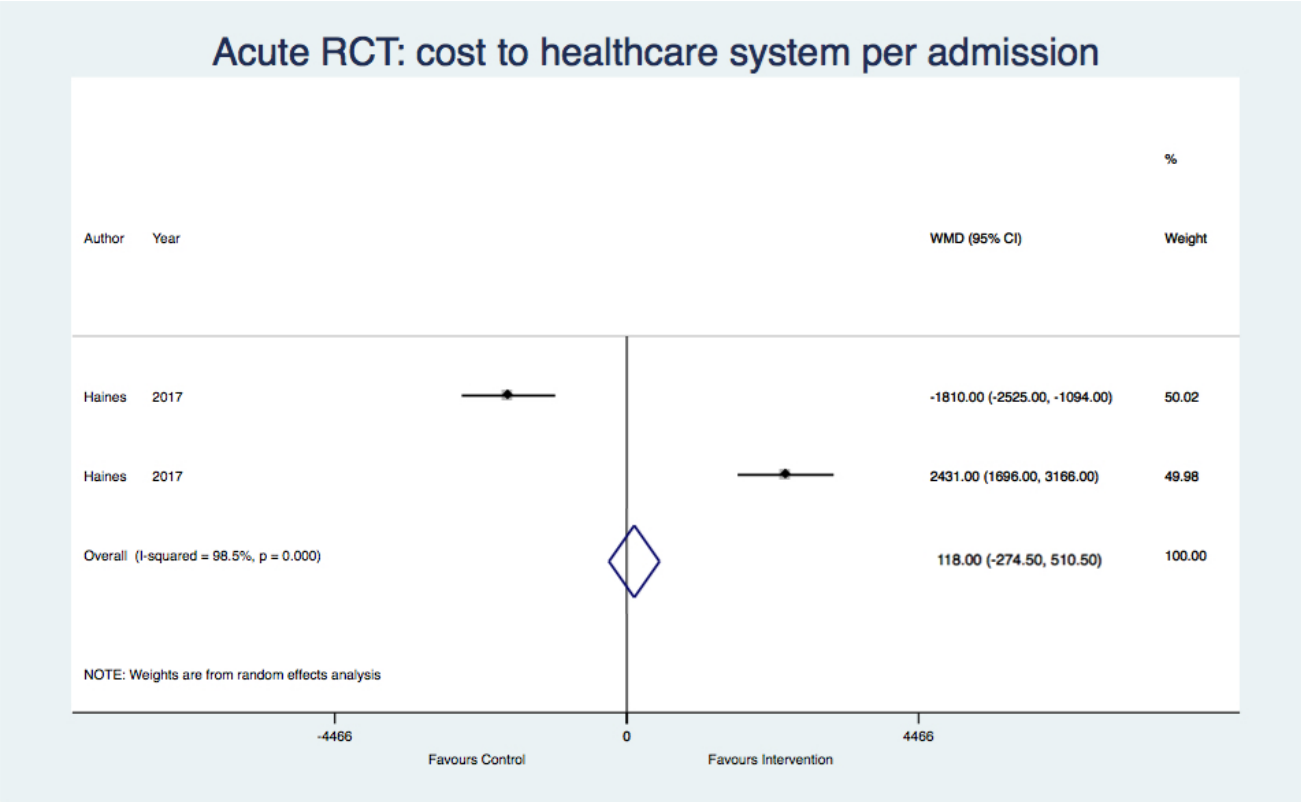


Figure 4.9. Forest plot for the effect of weekend allied health on health related quality of life



* Acute RCT: calculated from participant level data

Figure 4.10. Forest plot for the effect of weekend allied health on cost

Discussion

The results from this meta-analysis indicate that additional weekend allied health services reduced hospital length of stay on subacute rehabilitation wards. However, benefits were not identified for other outcomes or in other settings. These findings support previous syntheses showing that allied health rehabilitation therapy services improve patient outcomes (Kwakkel et al., 2004; Peiris et al., 2012b; Scrivener et al., 2015). This is the first review to show that benefits can be achieved in the subacute rehabilitation setting by providing additional allied health services on weekends. Additional weekend nursing and medical staffing in the subacute rehabilitation setting has not demonstrated the same benefits. A previous study examining the effect of additional rehabilitation provided by nursing did not produce favourable results (Davidson, Hillier, Waters, Walton, & Booth, 2005), and there remains a paucity of research on medical staffing models in subacute rehabilitation settings. Evidence towards improved patient outcomes from additional weekend allied health service models may assist resource allocation decisions by healthcare policy makers and managers considering the implementation of out of hours and seven day healthcare service models, as improved patient function and health related quality of life during shorter hospital length of stay indicates increased rehabilitation efficiency is achievable. Further, the reduced hospital length of stay may also provide incentives for investment in additional weekend allied health service provision because reductions in subacute rehabilitation hospital length of stay can improve patient flow in acute services and contribute to improved economic efficiency (Poulos & Eagar, 2007).

In contrast, there was insufficient evidence to conclude that routinely using a weekend allied health model to provide additional services in the acute general medical and surgical ward setting would achieve intended benefits for all patients. It is possible that difference in outcomes between acute and subacute ward types is due to variability in the focus of allied health activities in these settings. For example, physiotherapy services for chronic obstructive pulmonary disease in the acute hospital ward setting may focus on preventing respiratory failure by providing non-invasive ventilation (Keenan et al., 2011), where in the subacute rehabilitation ward setting, these services may emphasise therapies specifically aiming to improve functional independence (Puhan et al., 2005). Therefore, an evaluation of providing weekend allied health services in either the acute or subacute ward setting should reflect these outcomes of interest. Another possible explanation for unclear results in the acute setting is that providing additional allied health services in

isolation may not change outcomes due to limited medical and nursing staffing. A recent study in the acute general medical setting incorporated a multi-disciplinary seven-day medical, nursing, and allied health staffing model, which reported improvements in hospital length of stay, reduced general medical bed occupancy days, and improved weekend discharges (Gilfillan, Newnham, Nagappan, Evans, & Compton, 2016). However, comprehensive seven-day medical, nursing, and allied health service provision may not improve outcomes in all circumstances (Gan, Wong, Dean, & Hall, 2017). Unclear results in the acute setting could also be explained by previously examined logistical difficulties in implementing weekend allied health service models. This may be due to the employment of less experienced staff during weekends to reduce cost (Deb. Mitchell et al., 2017); employing staff who work external to the organisation during normal business hours (Deb. Mitchell et al., 2017); reduced medical and nursing staffing over the weekend (Chow & Szeto, 2005; Schilling, Campbell Jr, Englesbe, & Davis, 2010; Varnava, Sedgwick, Deaner, Ranjadayalan, & Timmis, 2002); unavailability of services from community based organisations needed to facilitate discharge on weekends; and patient expectation of rest on the weekend (Peiris, Taylor, & Shields, 2012c). Findings in the acute general medical and surgical ward setting should not be extrapolated to weekday, after-hours, on-call, or seven-day per week service provision models, and only applies to relevant wards as defined in our review. However, it should also be noted that only two randomised controlled trials (one article) from a single country has been published evaluating acute weekend allied health services (T. P. Haines et al., 2017); considering weekend service variability, it is possible that other targeted models of weekend allied health service not tested could provide benefit. Future studies could consider whether alternative models have the potential to deliver cost-effective weekend allied health services.

To our knowledge, this is the first systematic review examining the effectiveness of providing additional allied health services to acute and subacute hospital wards during weekends. It was also the first meta-analysis to include a stepped-wedge randomised controlled trial design. This design is valuable because it provides a statistically powerful, methodologically rigorous approach for evaluating weekend allied health services where provision is considered usual care. Our comprehensive search strategy resulted in the identification of 19 articles (20 studies), with 38,732 participants, the largest and most contemporaneous review to be conducted in the topic area. The pooling of results according to study design and setting may assist the understanding of how non-randomised trials can be compared with the results from randomised studies, and applied to clinical areas of interest. However, a number of excluded studies exploring interventions that

include a weekend allied health service component must be acknowledged (Babu, Noone, Haneef, & Samuel, 2010; Duncan, Hudson, & Heck, 2015; Ellen Mills, Vicki Hume, & Kathy Stiller, 2017; Said, Morris, Woodward, Churilov, & Bernhardt, 2012). In most cases these were excluded as the effect of weekend therapy was unable to be isolated from concurrent weekday interventions within the trials (e.g. increased weekday, after-hours, or on-call service in addition to a weekend service). Future research should focus on implementing additional allied health through different models such as increasing frequency, intensity, time, and type of services during normal departmental operating hours; seven-day service provision; evaluating outreach models; on-call services; comprehensive care compared to discipline specific models; and after-hours provision.

Limitations

The large number of analyses conducted might have inflated the risk of a Type 1 error, meaning a beneficial outcome could potentially be identified where none exists. Additionally, despite the large number of trials identified the relatively small number of studies with randomised and non-randomised designs in acute and subacute settings limited the generalisability of these findings. This was particularly evident for the acute randomised controlled trials, where there were only two studies. However, a large number of participants were included in the acute randomised trial meta-analysis (n = 27,508), and there were relatively narrow confidence intervals for effect size estimates and the overall meta-analysis. Heterogeneity in the acute randomised study level results for hospital length of stay and adverse event outcomes was examined via exploratory analysis in the original study, suggesting that there was a significant change in outcomes between control conditions, and when intervention conditions were compared, there was no significant difference in outcomes (T. P. Haines et al., 2017) . However, this post-hoc analysis was hypothesis generating, suggesting the need for additional research in this setting. Data relating to the frequency, intensity, time and type of additional weekend allied health service provision were unable to be extracted due to limitations in reporting. Therefore, the results of this meta-analysis should be interpreted as applying to staffing models, rather than specific allied health assessments and particular interventions.

Due to the nature of providing additional allied health services during weekends, blinding of participants and allied health personnel was not possible. Blinding of outcome assessors was used to reduce risk of bias in

some studies, however, there was a potential risk of bias for outcomes unable to be blinded such as hospital length of stay, where allied health personnel could delay or expedite hospital discharge for either the intervention or control groups, thereby affecting the hospital length of stay outcome data. The use of a stepped-wedge randomised controlled trial design in the acute setting may have reduced this risk of bias, as service demands would be prohibitive to interference across extended control and intervention periods. Also, use of outcome measures such as hospital length of stay and cost to the health service per admission was potentially problematic in some of the included studies. It was not always clear whether the data for hospital length of stay and cost were relative or absolute because patient cohorts varied over time. Changes in these outcome variables could have resulted from changing cohorts, as well as improvements from interventions. One way to control for this would be to consider outcomes relative to diagnoses using coding data, for example hospital length of stay relative to expected length of stay.

Conclusion

Providing additional allied health services to patients in subacute rehabilitation wards on the weekend reduced hospital length of stay, and may be a cost effective way to improve functional independence and health-related quality of life. However, for acute general medical and surgical hospital wards, the impact of weekend allied health services is not clear. This synthesis of evidence to date suggests the benefits of routinely providing additional allied health services on subacute rehabilitation wards is clearer than in the acute general medical and surgical ward setting. Future studies are required to further investigate the effect of targeted weekend allied health services. However, the goals of care for weekend allied health service provision may differ between acute and subacute hospital ward settings, and should therefore be reflected in outcomes evaluated in future studies.

Chapter 5 – Implementation of evidence based weekend service recommendations for allied health managers: a cluster randomised controlled trial protocol

Preamble to Chapter 5 protocol

Upon project conception, it was planned to include the findings from this study in the presented thesis. However, due to circumstances beyond the control of the candidate, study timelines are incompatible with timely PhD completion. This trial remains ongoing and is anticipated for completion in early 2020. The following protocol is adapted from an article published during 2018 in Implementation Science. The article citation is: Sarkies, M. N., White, J., Morris, M. E., Taylor, N. F., Williams, C., O'Brien, L., . . . Haines, T. P. (2018). Implementation of evidence based weekend service recommendations for allied health managers: a cluster randomised controlled trial protocol. *Implementation Science, 13*(1), 60. doi:10.1186/s13012-018-0752-7. (Mitchell N. Sarkies et al., 2018)

Abstract

Background

It is widely acknowledged that health policy and practice do not always reflect current research evidence. Whether knowledge transfer from research to practice is more successful when specific implementation approaches are used remains unclear. A model to assist engagement of allied health managers and clinicians with research implementation could involve disseminating evidence based policy recommendations, along with the use of knowledge brokers. We developed such a model to aid decision making for the provision of weekend allied health services. This protocol outlines the design and methods for a multi-centre cluster randomised controlled trial to evaluate the success of research implementation strategies to promote evidence informed weekend allied health resource allocation decisions, especially in hospital managers.

Methods

This multi-centre study will be a three-group parallel cluster randomised controlled trial. Allied health managers from Australian and New Zealand hospitals will be randomised to receive either: (1) an evidence based policy recommendation document to guide weekend allied health resource allocation decisions, (2) the same policy recommendation document with support from a knowledge broker to help implement weekend allied health policy recommendations, or (3) a usual practice control group. The primary outcome will be alignment of weekend allied health service provision with policy recommendations. This will be measured by the number of allied health service events (occasions of service) occurring on weekends as a proportion of total allied health service events for the relevant hospital wards at baseline and 12-month follow up.

Discussion

Evidence based policy recommendation documents communicate key research findings in an accessible format. This comparatively low cost research implementation strategy could be combined with using a knowledge broker to work collaboratively with decision makers to promote knowledge transfer. The results will assist managers to make decisions on resource allocation, based on evidence. More generally, the findings will inform the development of an allied health model for translating research into practice.

Introduction

Background and rationale

One of the challenges of evidence-based healthcare worldwide is to effectively and efficiently translate the findings of research into practice. Patient outcomes, patient satisfaction, cost-effectiveness and quality outcomes benefit from evidence informed decision-making (Richard. Grol, 2001; Slade et al., 2018; Woolf, Grol, Hutchinson, Eccles, & Grimshaw, 1999). Local healthcare policies that foster the timely translation of research findings to behaviour change can facilitate evidence-based practice (T. P. Haines et al., 2010; Hyder, Bloom, Leach, Syed, & Peters, 2007; Labonté, 2010; Lane, Sarkies, Martin, & Haines, 2016). In some

cases, allied health policy and practice do not directly reflect current research evidence (Harding, Porter, Horne-Thompson, Donley, & Taylor, 2014; Jette et al., 2003; Lizarondo, Grimmer-Somers, & Kumar, 2011; Salls, Dolhi, Silverman, & Hansen, 2009; Stevenson, Lewis, & Hay, 2006). The delay in the translation of research into practice has also been documented for the medical (Hanney et al., 2015) and nursing (Wallin, 2009) professions, where it can take over 10 years for new scientific discoveries to enter day to day clinical practice (Z. S. Morris et al., 2011; J. M. Westfall et al., 2007).

Allied health professionals generally have positive attitudes towards evidence informed decision making (Sally. Bennett et al., 2003; Harding et al., 2014; Iles & Davidson, 2006; Jette et al., 2003; Lizarondo et al., 2011; Metcalfe et al., 2001). Research receptivity and capability among allied health professionals are also influenced by organisational characteristics such as team dynamics, a culture of acceptance or resistance to change, and managerial support (Döpp et al., 2013; Elizabeth. H. Skinner, Hough, et al., 2015; Elizabeth. H. Skinner, Williams, & Haines, 2015). Allied health policy makers and managers can influence these organisational factors and facilitate the translation of research into policy and practice (Sarkies et al., 2017). However, they do not always have the training or access to knowledge transfer resources to assist them to engage effectively with research implementation (Borkowski, McKinstry, Cotchett, Williams, & Haines, 2016; Williams et al., 2015).

Implementation research has sought to develop strategies to reduce the gap between scientific evidence and practice (J. M. Grimshaw et al., 2012). A recently published systematic review identified 32 studies examining a number of different research implementation strategies for allied health professionals (Scott et al., 2012). Education as a single strategy was most frequently evaluated, yet was not always successful in facilitating desired behaviour change (Scott et al., 2012). Isolated educational strategies targeting individual professionals may not always meet the needs of complex organisational structures and multiple levels of decision-making involved in adopting an innovation. Providing resources to assist evidence informed healthcare policy and management decisions may also facilitate behaviour change (Damschroder et al., 2009). Slade et al. (2018) highlighted the importance of allied health managers in fostering a research culture to embed evidence based practice (Slade et al., 2018).

Developing evidence based policy recommendations for allied health decision makers has the potential to increase engagement with research implementation (Grimshaw et al., 2004). Short documents which communicate key research findings in an accessible format, are one of the few research implementation strategies evaluated for use by resource allocation decision makers, such as allied health managers (Beynon et al., 2012; N. Jones & Walsh, 2008; Sarkies et al., 2017; Slade et al., 2018). Single research implementation strategies have been reported as less successful than multifaceted approaches in some settings (Rebecca. LaRocca et al., 2012).

More interactive strategies may complement the provision of evidence based policy recommendations, particularly in health services without a strong research culture (Dobbins, Hanna, et al., 2009). One such interactive strategy is the use of knowledge brokers to work collaboratively with stakeholders, promoting the transfer and exchange of information (Bornbaum, Kornas, Peirson, & Rosella, 2015). Indeed, in Canada, many public health organisations have adopted knowledge broker roles as linking agents and capacity builders (Dagenais, Laurendeau, & Briand-Lamarche, 2015). This is despite limited evidence to support their benefits (Dobbins, Robeson, et al., 2009). Further high quality empirical research is needed to evaluate this particular implementation resource that could be provided to allied health policy makers and managers to support the translation of research into practice.

Implementation context

One area of allied health policy and practice that could better align with the current research evidence is the provision of allied health services to hospital wards during weekends. Routinely throughout the world, allied health services including physiotherapy, speech and language therapy, occupational therapy, social work, nutrition and dietetics and podiatry, are delivered Monday to Friday. In some parts of the world, allied health services are also provided on Saturdays and Sundays (L. Campbell et al., 2010; Haas et al., 2016; T. P. Haines et al., 2017; T. P. Haines et al., 2015). Saturday physiotherapy services are the most common form of allied health provided outside business hours internationally (L. Campbell et al., 2010; Shaw et al., 2013). Only 30% of subacute hospitals provide weekend physiotherapy, despite evidence suggesting the provision of after-hours or weekend rehabilitation improves outcomes in the subacute rehabilitation setting (Peiris et al., 2012b; Scrivener et al., 2015; Shaw et al., 2013). Research implementation strategies could inform

weekend allied health resource allocation decisions to better align policy and practice with contemporary research evidence.

Objectives

This protocol outlines the design and methods for a multi-centre cluster randomised controlled trial to evaluate the success of select research implementation strategies for promoting evidence informed weekend allied health resource allocation decisions by hospital managers. The implementation strategies will guide allied health managers in deciding how resources for provision of allied health services on weekends can be allocated between general medical and surgical, and subacute rehabilitation wards.

The resource allocation decision will be based on the following question: 'How should resources for the provision of allied health services on weekends be allocated between general acute medical / surgical and subacute rehabilitation wards?'

Methods

Trial design

This multi-centre study will be evaluated using a three-group matched (based on health service regional status) parallel cluster randomised controlled trial. A three-group design will allow the comparison of two different research implementation strategies with a control. Stratification will be based on self reported health service geographical classification as metropolitan or regional (including rural and remote), and clustering will occur at the level of weekend allied health resource allocation decision making within each health service (e.g. health service level or hospital level).

This evaluation will be based on the Kirkpatrick Evaluation Model Hierarchy framework, which has four outcome levels that are designed as a sequence of ways to evaluate training programs (Kirkpatrick, 1954, 1975). This study will focus on behaviour change outcomes in the third category.

Study setting

The study sample will be drawn from Australian and New Zealand hospitals. Public or private, acute and subacute hospitals providing inpatient allied health services will be eligible for inclusion, with a representation of hospitals from both metropolitan and regional geographic classifications sought. Specialist hospitals such as maternity hospitals, paediatric hospitals, cancer centres, mental health and palliative care hospitals will be excluded. These hospitals will be excluded as no research regarding weekend allied health provision has been identified in these settings.

Eligibility criteria

Allied health managers responsible for weekend allied health resource allocation decisions will be eligible for inclusion. All allied health professions currently providing an inpatient service to acute general medical and surgical wards, and subacute rehabilitation wards are eligible. A representation of the different allied health professions (e.g. physiotherapy, occupational therapy, speech pathology, dietetics, podiatry, psychology, exercise physiology, and social work) will be sought. We shall include those who currently provide weekend allied health services as well as those who do not currently provide services, but could potentially introduce these services.

Interventions

Three intervention groups will be compared: Control Strategy Group, Implementation Strategy Group 1, and Implementation Strategy Group 2. A summary of the intervention conditions described according to the Template for Intervention Description and Replication (TIDieR) guidelines is provided in Table 5.1 (Tammy. C. Hoffmann et al., 2014). The two research implementation strategies were designed according to factors perceived to be associated with effective strategies and the interrelationship between these factors to establish an imperative for change, build trust, develop a shared vision, and action a change mechanism, supported by effective employment of communication strategies and provision of resources to support change (Sarkies et al., 2017).

Control Strategy Group

The Control Strategy Group will involve a 12-month wait-list for the provision of an evidence based policy recommendation document at trial completion. This group will involve usual practice conditions, as per each health services usual decision-making process.

Implementation Strategy Group 1: provision of an evidence based policy recommendation document

Participants will be provided with an electronic evidence based policy recommendation document via email after random group allocation. This will have specific recommendations as to how the proportion of total allied health services should be delivered during weekends to align with current research evidence. Project investigators will develop draft recommendations through a consensus building approach based on the results of a systematic review and meta-analysis of the effectiveness and cost-effectiveness of inpatient weekend allied health services for improving patient and health service outcomes (Mitchell. N. Sarkies et al., 2018). In addition, a key stakeholder committee comprised of health professionals, managers, consumers, carer representatives, policy makers and academics will review draft recommendations and provide feedback before document finalisation. The document will be constructed in a simple format based on the Canadian Health Services Research Foundation (Davies, 2012). This format allows for a one-page outline of key messages that have come from the research, a three-page executive summary, and 25-pages presenting the report findings and methodology.

Implementation Strategy Group 2: provision of an evidence based policy recommendation document and access to a knowledge broker

Participants will be provided with the same electronic evidence based policy recommendation document as Implementation Strategy Group 1 via email after random group allocation. In addition, participants in Implementation Strategy Group 2 will have access to a knowledge broker who will facilitate the transfer and exchange of relevant information between researchers and healthcare decision makers to promote evidence informed decision-making (EIDM) (Bornbaum et al., 2015; Dobbins, Robeson, et al., 2009). A single knowledge broker with a Post-Honorary Doctorate (PhD) level qualification, from an allied health professional background, with research experience, currently employed as a post doctoral research fellow will be

recruited. The knowledge broker will offer a 60-minute initial consultation with the allied health manager on a one-on-one basis via telephone, videoconference, or face to face (where able) to perform an individual, organisational, and external environment (e.g. government policy) needs assessment. Where required, the knowledge broker will assist development of a 12-month plan to address individual and organisational capacity for evidence informed decision-making. One 60-minute group based webinar session will be offered within the first 6-months of the intervention period depending on allied health manager availability. Follow up contact will be offered on a monthly basis via email or telephone, according to the manager's preference, throughout the 12-month intervention period. Knowledge broker dosage (frequency, intensity, time and type) was based on the description of a knowledge broker role implemented as part of a randomised controlled trial evaluating three knowledge translation strategies by Dobbins et al. (2009) (Dobbins, Robeson, et al., 2009). The knowledge broker will follow an iterative process, with prompting questions informed by the COM-B (Capacity, Opportunity, Motivation, and Behaviour) model (Susan. Michie et al., 2011). The number and format of contacts between the allied health manager and knowledge broker will record engagement with the knowledge broker implementation strategy.

Table 0.1. Intervention conditions according to the TIDieR guidelines

TIDieR criteria	Control group	Implementation Strategy Group 1	Implementation Strategy Group 2
Item 1. 'Brief name: provide the name of a phrase that describes the intervention'	Usual practice control group	Evidence based policy recommendation document	Evidence based policy recommendation document and a knowledge broker
Item 2. 'Why: describe any rationale, theory, or goal of the elements essential to the intervention'	Usual practice is the model of weekend allied health resource allocation decision making at the research location. This serves as a pragmatic reference standard for implementation research	The evidence based policy recommendation document will communicate research findings in an accessible format to facilitate evidence informed decision making (N. Jones & Walsh, 2008). This will be achieved by: embedding an understanding of the political context within design, providing quality evidence communicated through a credible messenger, and fostering active engagement and linkages between policy makers and researchers (H. Jones, Jones,	The evidence based policy recommendation document will be the same as that provided to Implementation Strategy Group 1. In addition, the knowledge broker will act as an intermediary agent to facilitate the transfer and exchange of relevant information between researchers and healthcare decision makers to promote evidence informed decision-making (Bornbaum et al., 2015; Dobbins, Robeson, et al., 2009). The knowledge broker will

		Walker, & Walsh, 2009).	undertake activities focused on: identifying and engaging with decision makers, facilitating collaboration, identifying and obtaining relevant information, facilitating development of analytic and interpretive skills, creating research implementation resources, project coordination, communication and information sharing, network development, evaluating change, and supporting sustainability (Bornbaum et al., 2015).
Item 3. 'What (materials): Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL).'	There will be no materials provided to the control group during the study period. Participants will be able to use materials ordinarily available for resource allocation decisions at their discretion.	The evidence based policy recommendation document provided will be constructed in a simple 1:3:25 format developed by the Canadian Health Services Research Foundation (Davies, 2012). It allows for a one-page outline of key messages, a three page executive summary, and 25 pages presenting the report findings and methodology.	Participants will be provided with the same evidence based policy recommendation document as Implementation Strategy Group 1. Participants in Implementation Strategy Group 2 will also be provided with access to a knowledge broker who may deliver educational materials including plain English summaries, slides, and handouts. Scientific abstracts and full text journal articles relevant to the weekend allied health resource allocation decision may also be provided as applicable.
Item 4. 'What (procedures): Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities.'	Weekend allied health resource allocation decisions will follow usual practice conditions according to pre existing individual and organisational processes.	The evidence based policy recommendation document will be emailed to participants after random group allocation. This document was developed by project investigators through a consensus building approach and reviewed by a key stakeholder committee comprised of health professionals, managers, consumers, carer representatives, policy makers and academics.	The same version of the evidence based policy recommendation document provided to Implementation Strategy Group 1 will be emailed to participants after random group allocation. The knowledge broker will offer an initial consultation to perform an individual, organisational, and external environment (e.g. government policy) needs assessment, and develop a 12-month plan. One webinar session will be offered within the first 6-months depending on allied health manager availability, and monthly follow up contact will

			also be offered.
Item 5. 'Who: For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given.'	Participants may consult a variety of individuals at their discretion.	A team of tertiary qualified academics, clinicians, and policy makers from healthcare and business management backgrounds in Victoria, Australia produced and endorsed the evidence based policy recommendation document.	A team of tertiary qualified academics, clinicians, and policy makers from healthcare and business management backgrounds in Victoria, Australia produced and endorsed the evidence based policy recommendation document. In addition, one knowledge broker with a PhD level qualification, from an allied health professional background, with research experience, currently employed as a postdoctoral research fellow will be recruited for this implementation strategy.
Item 6. 'How: Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group.'	Usual practice conditions may involve participants accessing information via internet, telephone, or face to face when making resource allocation decisions.	An electronic evidence based policy recommendation document will be provided via email.	An electronic evidence based policy recommendation document will be provided via email. The 1:1 initial knowledge broker consultation will be offered via telephone, videoconference, or face to face (where available) as per participant preference. The group based webinar session will be offered via video or audio and follow up contact will be offered via email or telephone (as per participant preference).
Item 7. 'Where: Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features.'	Usual practice conditions are likely to involve participants making decisions at their place of work.	An electronic version of the evidence based policy recommendation document will be delivered via email. Therefore, participants may be able to access at the location of their choice. This is most likely to be accessed at their place of work, in an acute or subacute hospital.	An electronic version of the evidence based policy recommendation document will be delivered via email. Therefore, participants may be able to access at the location of their choice. This is most likely to be accessed at their place of work, in an acute or subacute hospital. The knowledge broker contact will occur via webinar, telephone, or email. Therefore, participants may be able to access at the location of their choice. This is most likely to be accessed at their place of work

			in an acute or subacute hospital. If the initial consultation can be arranged face to face, this will occur at a location convenient to both the participant and the knowledge broker, most likely at the participant's place of work.
Item 8. 'When and How Much: Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.'	12-month wait list of usual practice conditions. The evidence based policy recommendation document will be provided upon study completion.	One evidence based policy recommendation document will be provided to participants after random group allocation for the duration for the 12-month intervention period.	One evidence based policy recommendation document will be provided to participants after random group allocation for the duration for the 12-month intervention period. The knowledge broker will provide one 60-minute initial consultation, one 60-minute group webinar, and one follow up contact each month for the 12-month intervention period.
Item 9. 'Tailoring: If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how.'	Usual practice conditions allow participants to take various approaches when making resource allocation decisions. These can be altered at participant discretion as per organisation policy and practice.	There is no adaptation planned for the evidence based policy recommendation document during the study period.	There is no adaptation planned for the evidence based policy recommendation document during the study period. The knowledge broker role is iterative in nature. Interaction will be tailored to the needs of the participants at the discretion of the knowledge broker based on their professional judgement.
Item 10. 'Modifications: If the intervention was modified during the course of the study, describe the changes (what, why, when, and how).'	Not applicable for protocol	Not applicable for protocol	Not applicable for protocol
Item 11. 'How Well (planned): If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them.'	Adherence or fidelity will not be assessed in the usual practice control group, as no implementation strategy will be provided during the study period.	Whether or not participants read the evidence based policy recommendation document will be explored in the 12-month follow up qualitative interviews.	Whether or not participants read the evidence based policy recommendation document will be explored in the 12-month follow up qualitative interviews. Adherence to the knowledge broker component of the Implementation Strategy Group 2 intervention will be monitored via the knowledge broker diary kept for the 12-month period.

Item 12. 'How Well (actual): If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.'	Not applicable for protocol	Not applicable for protocol	Not applicable for protocol

Outcomes

Primary outcome: alignment of weekend allied health service provision with policy recommendations at 12-month follow up

Allied health service events (occasions of service) occurring during weekends, as a proportion of total allied health service events for the relevant hospital wards over a one-month period will be used to determine alignment with the policy recommendation. This information will be collected at baseline for the preceding calendar month and the same corresponding calendar month at the 12-month follow up. Allied health service events will be defined as per the 2017 National Allied Health Data Working Group (NAHDWG) endorsed National Allied Health Best Practice Data Sets (Appendix 6.1). Where data relating to allied health service events during weekends and weekdays is not available, data relating to allied health staffing levels or budgetary allocations during the weekend as a proportion of total allied health staffing levels or budgetary allocations for the relevant wards at each hospital for the preceding month will be used. Each participant cluster (hospital/health service) will receive a single classification as either: (1) practice fully aligned with policy recommendation for both acute and subacute hospital wards; (2) practice partially aligned with policy recommendations (e.g. if practice on acute wards is completely aligned with the policy recommendation but not on subacute wards, and vice versa); or (3) practice not aligned with policy recommendation.

Secondary outcome 1: mean hospital length of stay at 12-month follow up

The mean hospital length of stay for relevant wards over the one-month period preceding random group allocation, and the same corresponding month 12 months later. Hospital length of stay is a key driver of hospital efficiency (Brasel, Lim, Nirula, & Weigelt, 2007; Morgan & Beech, 1990; Sarkies et al., 2015; Shojania, Showstack, & Wachter, 2001), and provides a measure of benefit or non-inferiority for weekend

allied health provision (Natasha. K. Brusco et al., 2007; T. P. Haines et al., 2017; T. P. Haines et al., 2015).

Secondary outcome 2: opportunity cost to make the decision during the intervention period at 12-month follow up in AUD$ (time to make decision, resources used, and knowledge broker time attributable to each participant in Implementation Strategy Group 2)

Participants will record self-reported time (person hours) taken to make the resource allocation decision, and any resources used (e.g. librarian to conduct literature search). For Implementation Strategy Group 2, the self reported data will be combined with time contributed by the knowledge broker to each decision maker. The opportunity costs involved in making a decision (e.g. staff time and resources used) will be captured using interviews with allied health managers and logs of staff time recorded by research personnel. Measures of staff time will be valued using market salary rates in AUD$, with a 33% salary 'on-cost' loading to account for allowances, leave and other employee entitlements. Understanding the cost and benefits of providing research implementation strategies can assist healthcare governance agencies making implementation resource allocation decisions.

Process measures

Semi-structured interviews performed by a researcher who has not been involved in delivering the intervention at 12-month follow up will be used to explore participant experiences concerning: (1) perceptions of the trustworthiness and sufficiency of evidence of the evidence base to guide clinical practice in this area of allied health service delivery, (2) the sources of information relied upon by allied health managers when deciding upon the model of weekend allied health service delivery they used in acute and subacute hospital wards and why they chose to use those sources, (3) perceived most influential source of information encountered by allied health managers when deciding upon the model of weekend allied health service delivery they used in acute and subacute hospital wards and why they thought this source was the most influential, and (4) perceived potential improvements to the intervention received and how it was provided. This information will be used to inform future allied health research implementation strategies.

Qualitative measure: perceived risks, barriers and facilitators to adopting evidence based policy recommendations at 12-month follow up (Implementation Strategy Group 1 and

2) and during knowledge broker interactions (Implementation Strategy Group 2 only)

Semi-structured interviews will explore what participants perceived as being the risks, barriers and facilitators encountered in adopting or not adopting the policy recommendation. Control group participants will not be invited to participate in this final qualitative interview.

Participant timeline

The Consolidated Standard of Reporting Trials (CONSORT) study flow diagram is provided in Figure 5.1 (Moher, Schulz, & Altman, 2001). Baseline data collection, and implementation strategy group allocation are planned to occur following the participant information and consent process. A 12-month period will then be provided between initial implementation strategy provision and follow up to allow sufficient time, on pragmatic grounds, to initiate changes required to align weekend allied health resource allocation with the evidence based policy recommendation. Follow up data will then be collected after the 12-month intervention period upon trial completion. The Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) flow diagram schedule of enrolment, interventions, and assessment procedures is described in Table 5.2 (A.-W. Chan et al., 2013).

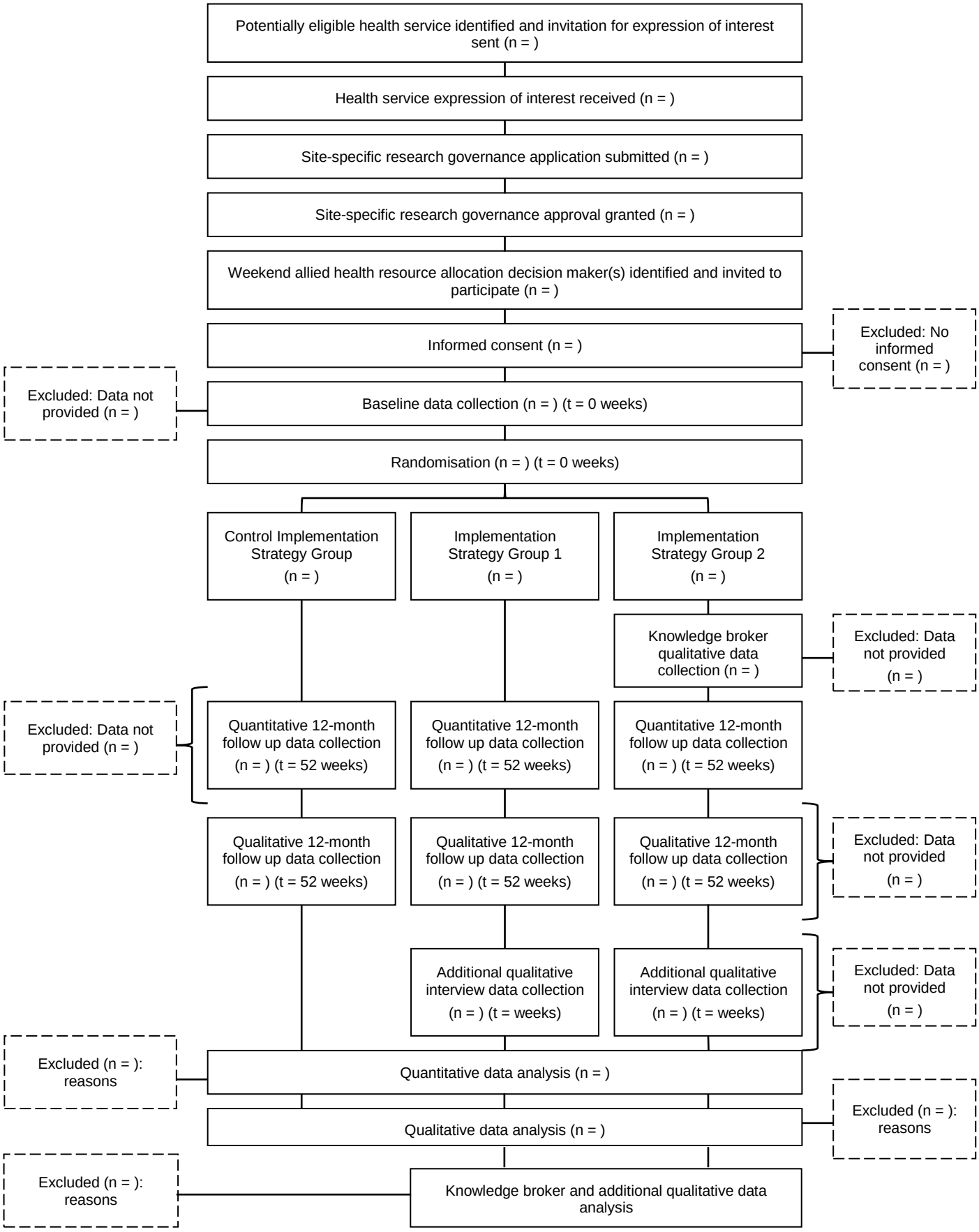


Figure 5.1. CONSORT study flow diagram

Table 5.2. SPIRIT Flow Diagram: schedule of enrolment, interventions, and assessment procedures

ACTIVITY	STUDY PERIOD			
	T -1	T 0	T 1	T 2
	Pre-allocation	Baseline	Intervention period	12-month follow up
Enrolment:				
Organisation expression of interest	X			
Site-specific research governance approval	X			
Participant information and consent	X			
Random group allocation		X		
Interventions:				
Control Group: *usual practice*		—	—	—
Implementation Strategy 1: *evidence based policy recommendation document*		—	—	—
Implementation Strategy 2: *evidence based policy recommendation document and knowledge broker*		—	—	—
Outcomes:				
Data collection (all groups): - Demographic data - Allied health service events - Hospital length of stay - Cost to make decision - Semi-structured interviews	 X X X			 X X X X X
Knowledge broker qualitative data collection (implementation strategy group 2 only)			X	
Qualitative interview data collection (implementation strategy group 1 and 2)				X

Sample size

The sample size estimate was calculated based on the units of assessment of the primary outcome 'alignment of weekend allied health service provision with policy recommendations at 12-month follow up'. The most conservative unit of assessment for this outcome will be clustered at individual hospitals/health services with geographically distinct decision makers. We therefore conducted our power analysis at this 'cluster level' rather than at the ward level or individual decision maker level (as one hospital/health service may have multiple decision makers involved). A sample size of 25 clusters (hospitals/health services) per group will provide greater than 80% power under the assumption that 50% of participants in an intervention group and 10% in the control group will completely align with the policy recommendation. We will aim to recruit 27 clusters (hospitals/health services) per group to allow for approximately 5-10% loss to follow up in each group. Assumptions regarding statistical power and expected loss to follow up were derived from a similar randomised controlled trial by Dobbins, Hanna, et al. (2009). Based on data from a survey of physiotherapy services provided outside business hours in Australian hospitals by Shaw et al. (2013), and allied health staffing levels for health service inpatients in Victoria (Department of Health and Human Services, 2016), it is anticipated that none of the recruited health services will be completely aligned with the evidence based policy recommendation at baseline. This analysis was performed using Stata 13 (StataCorp, 2013. Stata Statistial Software: Release 13. College Station; TX: StataCorp LP).

Recruitment

Project investigators will identify potentially eligible hospitals/health services using pre-existing professional networks and publicly available resources (e.g. government websites). Members of the research team will contact the allied health management either face-to-face, via telephone or email and provide information regarding the study. The allied health management will then be asked if they support the research being conducted at their organisation. If support is provided, the potential participant/s responsible for weekend allied health resource allocation decisions at the health service will be identified via the allied health management. Potential participants (weekend allied health resource allocation decision makers) will be contacted, provided with information on the study, and written informed consent will be sought for participation.

Assignment and concealment of implementation strategy group allocation

Study investigators will consult with health service representatives to determine decision-making structure for weekend allied health services within their health network. Some health services in Australia are comprised of multiple geographically separated hospitals that report to the same board but have independent decision making processes in relation to weekend allied health service provision decisions. They will be treated as separate units of recruitment and randomisation, where health service representatives report that decision making for geographically distinct hospitals is independent and that they anticipate ability to prevent contamination of the intervention between sites within their network. Units of randomisation (hospitals or health services) will then be stratified according to geographic location. A random number sequence will be generated using an online software application (Sealed Envelope Ltd. 2018. Create a blocked randomisation list. [Online] Available from: https://www.sealedenvelope.com/simple-randomiser/v1/lists), incorporating permuted blocks of randomly selected sizes of three, six, or nine, and stratified according to metropolitan or regional status. This random number sequence will be generated and held by a single investigator (TPH) in a secure location so that investigators conducting recruitment and data collection are blinded to the allocation status of participating sites and the allocation of the next site to be recruited.

Blinding

Participant weekend allied health decision makers will not be blinded to group allocation. It will be clear to participants which implementation strategy group they have been allocated due to the nature of the trial, thus it is not possible to blind participants. In order to maintain allocation concealment, site allocation to Implementation Strategy Group 2 will only be revealed to the knowledge broker once the site has been recruited and baseline data collected. Investigators performing data collection will be blinded to participant implementation strategy group allocation for the duration of the study. Investigators performing qualitative interviews will not be blinded. The trial data analyst will be blinded to group allocation. Three mock codes representing different sequence allocation will be used to blind the statistician conducting the final quantitative data analysis from the identity of each hospital/health service and the implementation strategy group allocation.

Data collection

Project investigators will collect the primary outcome data by requesting an allied health activity statistics report for the relevant wards at each hospital from the weekend allied health decision maker/s at each health service. It will be requested that this report contains the minimum variables: number of allied health service events, date of each allied health service event, as well as hospital and ward location of each allied health service event. Where these data are not available, allied health staffing levels or budgetary allocations during weekdays and weekends for the relevant wards at each hospital in the preceding month will be requested. The mean hospital length of stay for relevant wards will be collected as reported by the hospital electronic patient management systems. Previous research has shown this data collection method for hospital length of stay provides completeness of data capture when compared to other methods (Sarkies et al., 2015). Allied health managers will be encouraged to record the amount of time (person hours) taken and other resources used (e.g. librarian) to make the resource allocation decision in a log. For Implementation Strategy Group 2, these data will be combined with knowledge broker records of the amount of time attributed to each participant during the intervention period. Project investigators will perform audio-recorded semi-structured interviews either face to face, via telephone, or videoconference as per participant preference. Qualitative data from knowledge broker conversations will be audio-recorded and regular communication (e.g. email, phone, online forums) with the knowledge broker will be captured.

Analysis

Quantitative

Primary outcome: alignment with policy recommendation will be analysed with pairwise comparisons (intervention group 1 vs control, intervention group 2 vs control, and intervention group 1 vs intervention group 2) performed using the sign rank test for ordinal data amongst matched pairs. This primary analysis will be conducted at both the cluster level and ward level. Analysis will be undertaken according to ‘as randomised’ (intention-to-treat) principles. Where it is identified that participants have moved between-clusters allocated to different intervention groups during the study period, we will undertake a contamination adjusted intention-to-treat analysis.

Qualitative

Semi-structured interview and data from knowledge broker interactions will be transcribed verbatim, with identifying data removed. An inductive thematic analysis process including constant comparison will used to analyse qualitative data (Braun & Clarke, 2006). Rigor in this qualitative study will be ensured by the strategies of immersion in data, reflexive analysis, memo writing, peer debriefing and consensus coding between team members (Morse, 2015).

Economic evaluation

The economic analysis will calculate the 'incremental cost per additional cluster and ward that completely align with the policy recommendation' of Implementation Strategy Group 1 versus Control, and Implementation Strategy Group 2 versus Control. The opportunity costs involved in making a decision, captured using interviews with decision makers and research personnel logs of staff time involved, will be valued using market salary rates with a 33% on-cost loading to account for leave and other employee entitlements. This analysis will be a trial based evaluation. The analysis will then be fed into a net-benefit analysis which will incorporate data relating to the amount of allied health events captured at the baseline and 12-month follow up assessments and changes in hospital length of stay. These data will then be modelled into a 5-year time horizon assuming that weekend service levels at the 12-month follow up assessment are maintained 5 years into the future. One-way sensitivity analyses will be conducted to model the effects of having different numbers of allied health managers involved with making this decision at both the cluster and ward level.

Monitoring study conduct

Monitoring of study progress will be performed at regular meetings between study investigators. Strategic governance oversight will review study recruitment progress, quality of data collection and management, and the occurrence of any unintended effects identified throughout study conduct. Adjustments shall be made to aspects of trial conduct as necessary, however funding sources will not be involved in study monitoring or decisions regarding adjustment of trial conduct. Data collection at baseline and 12-months will provide an opportunity for monitoring of study progress. The knowledge broker shall also be able to provide feedback to the wider research team as to the study progress in Implementation Strategy Group 2. There is no planned

interim analysis, as only one study follow up period has been planned.

Ethics and dissemination

Research ethics approval

Approval to conduct this study has been obtained from the Monash Health Research Ethics Committee (HREC/17/MonH/44) and has been registered with the Australian New Zealand Clinical Trials Registry (ANZCTR) (ACTRN12618000029291). Universal Trial Number (UTN): U1111-1205-2621. Site specific research governance approval will be sought from each requesting health service upon review of the study protocol, participation information and consent form, and other requested documents (including subsequent modifications). Subsequent to initial review and approval, investigators will make safety and progress reports as requested.

Protocol amendments

Amendments to the study protocol will require approval from study investigators and the human research ethics committee. Any amendments will be communicated via trial registration updates, and reported in any published manuscripts associated with the study as necessary.

Consent

Potential participating allied health decision makers will be provided with information regarding the study via the participant information and consent form. They will be provided with the opportunity to discuss the project with study investigators and time to consider their response. Return of a signed participant information and consent form will constitute informed consent for study participation. A copy of the signed participant information and consent form will be provided to the participant and the researchers will retain a copy for their records. The Version 2, Master Participation Information and Consent Form (PICF) is presented in Appendix 6.2.

Confidentiality

The researchers will conduct themselves in accordance with the Declaration of Helsinki and the Principles of Ethical Conduct outlined in the National Statement on Ethical Conduct in Research Involving Humans (Phelan, 1999). All forms where the participant is identified (e.g. consent forms) will be kept in a locked filing cabinet in a lockable room, accessible by only the research team. Electronic data will be stored in password access folders on Monash University 'LabArchives'. The details of data storage will be made available to participants who will not be identifiable in any literature published from the findings of this study.

Access to data

Information relating to the participation in the trial will not be available to any persons outside the study team. De-identified results data can be made available upon request to study investigators.

Ancillary and post-trial care

Usual practice control group participants will receive the evidence based policy recommendation document upon trial conclusion.

Dissemination policy

A forum for allied health managers will be organised for the purpose of communicating the findings from this research. The results from the research will be reported in scientific journals and presented at conferences and workshops with personal information omitted. Participants will be advised they may request a copy of any results once available. De-identified data will be made available upon request to study investigators. Authorship eligibility will be determined according to the International Committee of Medical Journal Editors (ICMJE) recommendations.

Discussion

Implementing research evidence into health policy and practice is actively promoted (Orton et al., 2011; Sarkies et al., 2017). The continuous process of disinvesting from low value healthcare practice and

reinvesting in new approaches that are more efficacious, accurate and safe, requires the integration of local expertise with the best available external evidence from systematic research (Sackett, 1997). Research in the allied health professions has identified the benefits of many healthcare interventions, such as strength and functional sensory discrimination training to reduce impairments for patients following stroke (Ada, Dorsch, & Canning, 2006; Carey, Macdonell, & Matyas, 2011; Harris & Eng, 2010; S. L. Morris, Dodd, & Morris, 2004; Taylor, Dodd, & Damiano, 2005). Innovations in allied health service delivery have also been made to improve access to, and reduce cost of interventions. Recent studies suggest that rehabilitation and exercise programs for chronic health conditions may be equally effective when delivered in home based settings compared with centre based settings, providing a potential alternative for those who cannot access centre based programs (Anne. E. Holland et al., 2016; Jansons, Robins, O'Brien, & Haines, 2017; Zwisler et al., 2016). The benefits of these research findings are clear. Yet, in order to produce desired outcomes at scale, evidence must be disseminated and implemented across healthcare organisations (Milat, Bauman, & Redman, 2015; Milat, Newson, & King, 2014).

Increased pressure on healthcare organisations to improve access, quality and cost of care has led to the identification of strategies to reduce the gap between research and practice (Elshaug et al., 2009). As allied health professionals generally have positive attitudes towards evidence informed decision making (Sally. Bennett et al., 2003; Harding et al., 2014; Iles & Davidson, 2006; Jette et al., 2003; Lizarondo et al., 2011; Metcalfe et al., 2001), strategies targeted at changing reactions, beliefs and knowledge may not address the needs of decision makers. Instead, the research implementation strategies described in our randomised controlled trial protocol aim to complement existing evidence informed decision-making processes in allied health. Stroke rehabilitation is one of many areas where allied health has led the implementation of research into policy and practice (Walker, Fisher, Korner-Bitensky, McCluskey, & Carey, 2012). Consensus implementation statements based on systematic review evidence (Fisher et al., 2011), and clinical champions (diffusion fellows) (Rowley, Morriss, Currie, & Schneider, 2012) have been identified as some of the best methods for implementing stroke rehabilitation evidence into practice (Menon, Korner-Bitensky, Kastner, McKibbon, & Straus, 2009; Walker et al., 2012). While our strategies (evidence based policy recommendation and knowledge brokerage) share similarities with consensus statements and clinical champions, these approaches have not yet been evaluated in a randomised controlled setting.

Conclusion

Evidence based policy recommendation documents communicate key research findings to the healthcare community in an accessible format. This comparatively low cost research implementation approach can be combined with using a knowledge broker to work collaboratively with decision makers to promote the transfer and exchange of information. The results from this study may also inform the development of a model for translating research into practice for allied health settings.

Chapter 6 – A novel counterbalanced implementation study design: methodological description and application to implementation research

Preamble to Chapter 6 methodological design study

Conventional randomised controlled study designs may be difficult to apply in implementation settings, particularly when recruiting healthcare policy makers and managers. Indeed this presented a challenge in the protocol described in Chapter 5, which partly explains why the results from this study were not available for thesis inclusion. Novel, within group repeated measures study designs might improve statistical efficiency for prospective implementation trials, requiring fewer recruited participants to achieve adequate statistical power. The following chapter presents the methodology for a novel counterbalanced study design in implementation settings, and is adapted from an article published during 2019 in Implementation Science. The article citation is: Sarkies MN, Skinner EH, Bowles K-A, Morris M, Williams C, O'Brien L, Bardoel A, Martin J, Holland AE, Carey L, White J, Haines TP. A novel counterbalanced implementation study design: methodological description and application to implementation research. *Implementation Science.* 2019;14(1):45. doi:10.1186/s13012-019-0896-0. (Mitchell. N. Sarkies et al., 2019)

Abstract

Background

Implementation research is increasingly being recognised for optimising the outcomes of clinical practice. Frequently, the benefits of new evidence are not implemented due to difficulties applying traditional research methodologies to implementation settings. Randomised controlled trials are not always practical for the implementation phase of knowledge transfer, as differences between individual and organisational readiness for change combined with small sample sizes can lead to imbalances in factors that impede or facilitate change between intervention and control groups. Within-cluster repeated measures designs could control for

variance between intervention and control groups by allowing the same clusters to receive a sequence of conditions. Although in implementation settings, they can contaminate intervention and control groups after initial exposure to interventions. We propose the novel application of counterbalanced design to implementation research where repeated measures are employed through crossover but contamination is averted by counterbalancing different health contexts in which to test the implementation strategy.

Methods

In a counterbalanced implementation study the implementation strategy (independent variable) has two or more levels evaluated across an equivalent number of health contexts (e.g. community acquired pneumonia and nutrition for critically ill patients) using the same outcome (dependent variable). This design limits each cluster to one distinct strategy related on one specific context, and therefore does not overburden any cluster to more than one focussed implementation strategy for a particular outcome, and provides a ready-made control comparison, holding fixed. The different levels of the independent variable can be delivered concurrently because each level uses a different health context within each cluster to avoid the effect of treatment contamination from exposure to the intervention or control condition.

Results

An example application of the counterbalanced implementation design is presented in a hypothetical study to demonstrate the comparison of 'video-based' and 'written-based' evidence summary research implementation strategies for changing clinical practice in community acquired pneumonia and nutrition in critically ill patient health contexts.

Conclusion

A counterbalanced implementation study design provides a promising model for concurrently investigating the success of research implementation strategies across multiple health context areas such as community acquired pneumonia and nutrition for critically ill patients.

Background

The movement to translate research evidence into healthcare policy and practice is well established (Martin P. Eccles & Mittman, 2006; Russell E. Glasgow et al., 2012; Thornicroft, Lempp, & Tansella, 2011). Delays in the uptake of research evidence can prolong the provision of ineffective, low-value, and even potentially harmful healthcare interventions (A. G. Elshaug, A. M. Watt, L. Mundy, & C. D. Willis, 2012; T. Haines et al., 2017). In response, governments, organisations, and health professionals are increasingly expected to ensure policy and practice is informed by high quality, contemporaneous research. Implementation research has been promoted as one way to facilitate the translation of research into practice (J. Grimshaw, M. Eccles, J. Lavis, S. Hill, & J. Squires, 2012). This developing field of research evaluates the success of strategies such as knowledge brokering (Sarkies et al., 2017; Mitchell N. Sarkies et al., 2018), algorithms (Elizabeth H. Skinner et al., 2018), and multifaceted approaches (McKenzie et al., 2008; Riis et al., 2016) for individual and organisational change. Health service researchers have increasingly recognised implementation research as a field of science (Bammer, 2003), although the benefits of many implementation attempts remain unclear (Bero et al., 1998; Sarkies et al., 2017).

If the translation of research into practice is to be improved, it is important to understand which implementation strategies are effective and cost-effective. One approach is to compare one group receiving a strategy against another receiving usual care control conditions. However, often there is not only interest in whether a strategy is effective, but also in whether one strategy is more or less effective than another. Some strategies with minimal success may still be efficient if they are also low-cost. Likewise, the cost of successful strategies must be considered when making implementation resource allocation decisions (Reilly et al., 2018). In addition, many healthcare interventions found to be efficacious in one health context fail to translate benefits to effective patient care outcomes when implemented across diverse contexts (Damschroder et al., 2009). Therefore, comparative effectiveness study designs that compare multiple strategies across different contexts are required.

Parallel cluster randomised controlled trials are commonly used in implementation science. These designs are amenable to evaluating studies of implementation when practice change is desired on a service level rather than an individual level (Hemming, Haines, Chilton, Girling, & Lilford, 2015). However, many potential

difficulties exist in the application of traditional research methodologies such as parallel designs to studies of implementation success. Logistical challenges in recruitment, implementation strategy delivery, and ensuring adequate statistical power in analyses have been reported in randomised controlled trials that did not reach recruitment targets (M. G. Wilson et al., 2015). In addition, some organisations and individuals are more ready for change than others due to differences in organisational culture, previous history with change, and differences in individuals' resistance to change (Backer, 1995; Ingersoll, Kirsch, Merk, & Lightfoot, 2000). When these organisational and individual differences are combined with small sample sizes, this can lead to imbalances in factors that impede or facilitate change between intervention and control groups. Performing post-hoc analysis and measuring additional factors such as 'organisational readiness for change' have historically been used to account for these issues (Bohman et al., 2008; Hagedorn & Heideman, 2010; Whitten, Holtz, Meyer, & Nazione, 2009). However, doing so creates additional data collection burden and may still not adequately control for differences between organisations, as these measures have been found to involve conceptual ambiguities, and limited evidence of reliability or validity (Bryan J Weiner, Amick, & Lee, 2008). It would be preferable to mitigate this potential source of bias and minimise data collection burden through a design-based solution (Pannucci & Wilkins, 2010).

One approach to minimise inter-group variation is to use within-cluster repeated measure designs. These differ from between-cluster designs by exposing each cluster to the strategies being evaluated and comparing the effect within clusters rather than between (Charness, Gneezy, & Kuhn, 2012). Crossover studies are a commonly used within-cluster design, which provides each cluster with a random sequence of strategies to counterbalance order effects in repeated measure designs. The limitation of crossover designs in this setting is that exposure to an implementation strategy can permanently contaminate study clusters so their characteristics are no longer comparable to what they were before they were exposed to the alternate condition. We propose a novel application of counterbalanced design to implementation science, which allows the concurrent comparison of interventions while minimising inter-group differences and the risk of contamination. In this paper, we firstly discuss the rationale and implications of using such an approach. We then describe a hypothetical example application of this approach to compare the effectiveness of two implementation strategies involving a 'video-based' evidence summary and 'written-based' evidence summary.

Methods

Common randomised study designs used in implementation research

The more traditional of the cluster randomised study designs used in implementation research is a between-cluster parallel design. As parallel designs rely on comparing different clusters response to study conditions over the same time period, there is risk of imbalance between study groups where small sample sizes are recruited. Alternatively, researchers may consider with-cluster designs, such as crossover and stepped-wedge studies. These designs randomly assign clusters to a sequence of study conditions over a series of time periods. However, there is a risk that exposure to one implementation strategy will contaminate the cluster so they are no longer comparable in these designs. Factorial designs allow clusters to experience all combinations of conditions, where there are two or more 'factors', each with different 'levels'. One of the advantages is the ability to look at interaction effects between factors. However, this design may also contaminate clusters after initial exposure to implementation strategies. In the proposed counterbalanced implementation study, units are randomised to alternative interventions; the different levels of which are applied in different contexts to reduce the risk of contamination. Figure 6.1 contrasts the counterbalanced design with other commonly used designs in implementation research.

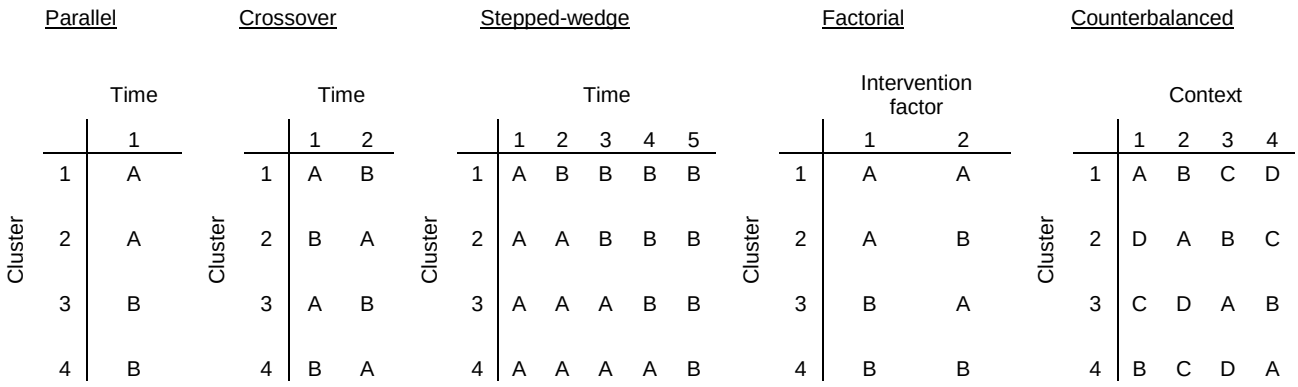


Figure 6.1. Contrast of different study designs

The counterbalanced implementation study methodological design

This design differs from conventional studies in that the implementation strategy (independent variable) can take on two or more levels which are evaluated across an equivalent number of health contexts (e.g.

inpatients, outpatients, medical, surgical), using the same outcome (dependent variable). This design limits each cluster to one distinct strategy related on one specific context, and therefore does not overburden any cluster to more than one focussed implementation strategy for a particular outcome, and provides a ready-made control comparison, holding fixed. Unlike conventional designs, the different levels of the implementation strategy (independent variable) do not need to be provided sequentially; they can be provided concurrently, thereby eliminating contamination and period effects. Each level of the implementation strategy (independent variable) being delivered uses a different health context within each individual cluster to avoid contamination. This approach is represented most simply by a study comparing two implementation strategies (i.e. one independent variable that has two levels):

R	XA1|B1	XA2|B2	O
R	XA2|B1	XA1|B2	O

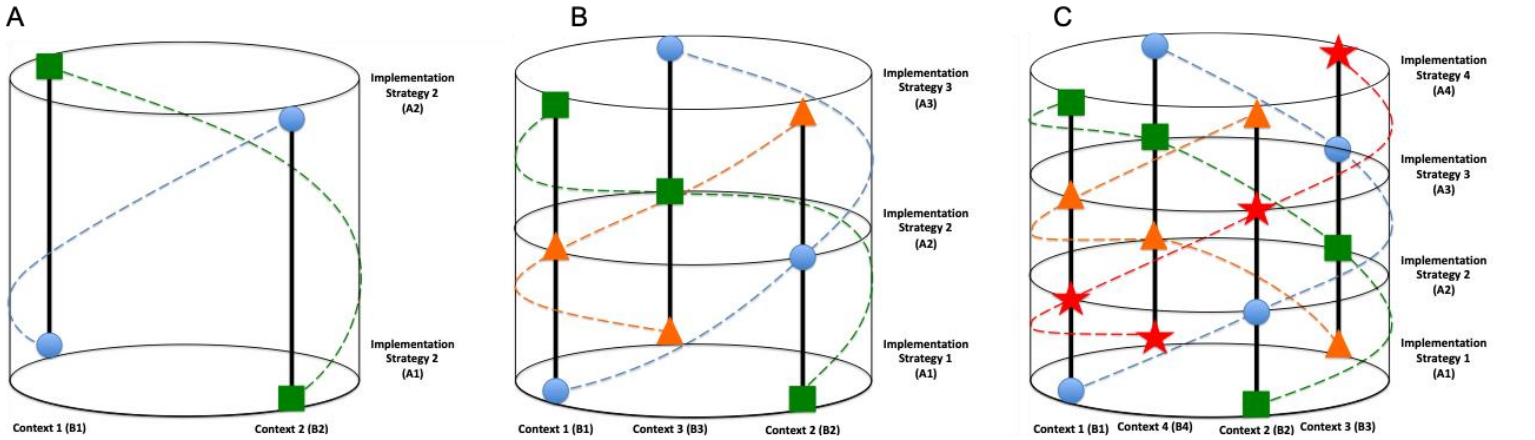
Where R indicates random assignment of units to conditions, O represents unit outcome assessment, A is implementation strategy, and B is health context.

In this model, the XA1|B1 and XA2|B2 study group receives Implementation Strategy 1 (e.g. audit and feedback) in Health Context 1 (e.g. surgical inpatients) and Strategy 2 (e.g. knowledge broker) in Context 2 (e.g. medical outpatients), whereas the XA2|B1 and XA1|B2 study group receives Implementation Strategy 2 (e.g. knowledge broker) in Health Context 1 (e.g. surgical inpatients) and Strategy 1 (e.g. audit and feedback) in Context 2 (e.g. medical outpatients), see Figure 6.2-A for three dimensional representation.

The counterbalanced approach is not limited to two-level applications. Theoretically, a factorial approach could be used for any number of implementation strategy and health context combinations. However, there may be a risk of imbalance in characteristics between clusters, particularly with low recruitment rates. Therefore, any number of implementation strategies can be examined; however, a new health context would ideally be added for each additional implementation strategy included. This process is illustrated with the 3-level helical study model:

R	XA1|B1	XA2|B2	XA3|B3	O
R	XA2|B1	XA3|B2	XA1|B3	O
R	XA3|B1	XA1|B2	XA2|B3	O

In this model, the XA1|B1 and XA2|B2 and XA3|B3 study group receives Implementation Strategy 1 in Health Context 1, Strategy 2 in Context 2, and Strategy 3 in Context 3. The XA2|B1 and XA3|B2 and XA1|B3 study group receives Implementation Strategy 2 in Health Context 1, Strategy 3 in Context 2, and Strategy 1 in Context 3, and similarly for the XA3|B1 and XA1|B2 and XA2|B3 study group. See Figure 6.2-B for a three dimensional representation. The described three-sequence trial has six potential choices of assignment. In order to reduce the potential risk of order effects for both concurrent and sequential study condition assignment, a randomly selected balanced design could be achieved by matched randomisation of the three different strategies and contexts with blocks. Figure 6.2-C illustrates three dimensionally how a four-level study model can be applied. The advantage of this model is systematic replication without contamination.



* Circle: participant group 1; Square: participant group 2; Triangle: participant group 3; Star: participant group 4

Figure 6.2. Counterbalanced implementation study model

We next illustrate a hypothetical counterbalanced implementation study example. This will demonstrate the pragmatic comparison of 'video-based' and 'written-based' evidence summary research implementation strategies for changing clinical practice in community acquired pneumonia and nutrition in critically ill patient health contexts. For simplicity a two-level counterbalanced implementation study is presented, with the effectiveness of two different implementation strategies examined in two different health contexts.

Results

Hypothetical counterbalanced implementation study example

Two potential priority health contexts for the implementation of research evidence in practice are: 'management of community acquired pneumonia', and 'nutrition in critically ill patients'. Community acquired pneumonia is the second highest cause of mortality globally (S. E. Soh, M. E. Morris, J. J. Watts, J. L. McGinley, & R. Iansek, 2016). Evidence suggests that corticosteroid therapy may reduce mortality, need for mechanical ventilation, hospital length of stay, time to clinical stability and severe complications (Anne E. Holland, 2014; Marti et al., 2015; Siemieniuk, Meade, Alonso-Coello, & et al., 2015). Despite these findings, poor adherence to guidelines for the use of corticosteroids to treat community acquired pneumonia has been reported (Adler, Weber, Gunadasa, Hughes, & Friedman, 2014; Elizabeth H. Skinner et al., 2018). A second health context where current practice does not always align with the most contemporaneous research is nutrition in critically ill patients. Despite guidelines recommending the provision of early enteral nutrition for critically ill patients (Doig, Heighes, Simpson, Sweetman, & Davies, 2009; Doig et al., 2008; Heyland, Dhaliwal, Drover, Gramlich, & Dodek, 2003; Kreymann et al., 2006; Martin et al., 2004), many do not receive adequate nutritional support (Doig et al., 2009; Doig et al., 2008; Heyland, Schroter-Noppe, et al., 2003).

Two potential strategies which could be used to implement research into practice in the management of community acquired pneumonia, and nutrition in critically ill patient health contexts are 'video-based' research evidence summaries and 'written-based' research evidence summaries. Written-based evidence summaries have been a conventional method for evidence dissemination through scientific journal articles, abstracts, books, and editorials (Bero et al., 1998; Giguère et al., 2012). There has been some examination of the effectiveness of written-based evidence summaries (Beynon et al., 2012; Maureen Dobbins, Rhonda

Cockerill, & Jan Barnsley, 2001). However, this evidence is limited and does not include comparison with a non-written evidence summary approach. Similarly, video-based evidence summaries have been examined in some areas such as falls prevention education (Hill et al., 2009). However, results may not be applicable to other health contexts.

A counterbalanced implementation study could examine the success of written (A1) versus video (A2) evidence summaries for translating research into practice for community acquired pneumonia (B1) and nutrition in critically ill patients (B2). This study model would be conducted as follows:

R	XA1|B1	XA2|B2	O
R	XA2|B1	XA1|B2	O

In this model, the XA1|B1 and XA2|B2 study group receives the written-based evidence summary implementation strategy (A1) in community-acquired pneumonia (B1), and the video-based evidence summary implementation strategy (A2) in nutrition for critically ill patient contexts (B2). The XA2|B1 and XA1B2 study group would receive the opposite, video-based evidence summary implementation strategy (A2) in the community acquired pneumonia context (B1) and the written-based evidence summary implementation strategy (A1) in the nutrition for critically ill patient context (B2), see Figure 6.3 for a three dimensional representation.

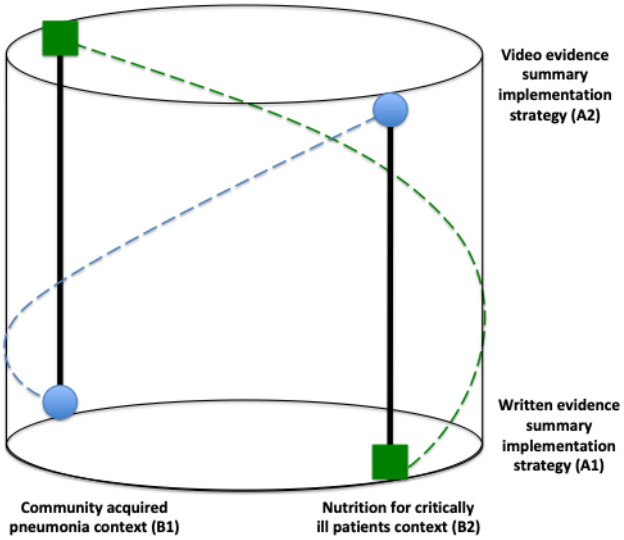


Figure 6.3. Two-level counterbalanced study model for written and video evidence summaries in community acquired pneumonia and nutrition for critically ill patients

Measuring success in a counterbalanced implementation study

How to best measure implementation success is a developing concept in this field of science (E. Proctor et al., 2011; Sarkies et al., 2017). Researchers must clearly define their aims before planning outcome measurement, as process measures may not necessarily translate to changed behaviour or improved patient outcomes, and vice versa. Potential outcomes can be conceptualised as an educational intervention measured according to the four level Kirkpatrick Model Hierarchy: (1) reaction, (2) learning, (3) behaviour, and (4) results (Kirkpatrick, 1975). In addition, a number of process measures and implementation-specific outcomes can be considered (E. Proctor et al., 2011). Arguably, results such as patient and health service outcomes should be the standard for judging the success of an implementation strategy. However, it is important to understand the mechanisms leading to those changes and the sustainability of change.

Several logistical difficulties in the measurement of patient or organisation outcomes are posed in the counterbalanced implementation study paradigm. As multiple health contexts are considered, several different context-specific outcomes may need to be measured. In the hypothetical example, time required to achieve 80% of the calculated energy intake goal may be an appropriate measure for the nutrition in critically

ill patients example (Martin et al., 2004), however, for community acquired pneumonia, pneumonia-associated complications may be an appropriate measure (Elizabeth H. Skinner et al., 2018). Data would also need to be clustered for analysis, which potentially limits statistical power if the implementation strategies were delivered at ward or hospital level. Another consideration is whether recruitment rates would reach an adequate threshold so that the number of health professionals in each cluster is not sub-therapeutic within the cluster. For example, a video or written-based evidence summary aiming to improve corticosteroid use in the management of community acquired pneumonia would need to recruit enough medical, nursing, and allied health staff on each ward to be able to change outcomes at the aggregate ward cluster level. This problem could be offset by requiring a smaller overall sample size from which to collect outcomes, as balanced within-cluster repeated measure study designs may require a relatively smaller sample size than other unbalanced designs to achieve adequate statistical power (Sibbald & Roberts, 1998).

Implementation-specific outcomes, and changes in attitudes, learning and behaviour may provide a more pragmatic, adequate measure of success in a counterbalanced implementation study, if assumptions about flow-on effects from process measures to health outcome changes are avoided, and setting-specific organisational factors are considered. Whichever level of outcome from the Kirkpatrick Hierarchy is selected to be the primary outcome in a counterbalanced trial, it is important to consider using the same outcome either within or across health contexts depending on the focus of the study, as this may allow pooling of results across implementation studies. Where a health outcome is the chosen primary outcome measure, a generic scale (such as a generic health-related quality-of-life scale) could also be applied within or across health contexts to allow comparison of success across studies. It is worth noting that generic scales can be less responsive than disease-specific scales, which may have implications for the statistical power and sample size of the study (Wiebe, Guyatt, Weaver, Matijevic, & Sidwell, 2003).

Statistical analysis considerations

Analysis of a counterbalanced implementation study for the effectiveness of implementation strategies in each context should follow intention-to-treat conventions based on paired data, given participants act as their own controls (Mills et al., 2009). Both superiority and non-inferiority analytical tests can be performed depending on the focus of the study and outcome measures of interest.

The overall effect of an implementation strategy can be derived using single mixed-effects generalised linear model (Appendix 8.1). In this statistical model, each cluster (unit of randomisation) is treated as a random effect (nesting where relevant), and each implementation strategy and (separately) context as a fixed effect (to account for the potential for differential exposure of implementation strategies to different context areas through non-permuted randomisation). Clusters are considered to be uncorrelated across health contexts. A two-level model is presented, however, multilevel approaches can be applied.

Interaction effects also may need to be considered in a counterbalanced implementation study (Appendix 8.2). This is because an implementation strategy may be more effective in one health context than another. Including an interaction effect term in the statistical model can be used to further clarify relationships between dependent and independent variables. The model presented in Appendix 8.2 includes the same statistical model described previously with the addition of an interaction effect term.

For analysis of counterbalanced designs in implementation science, consideration of whether health context is treated as a fixed or random factor is needed. An implementation study could also be designed with the health context as a random factor, providing an efficient way of producing generalisable knowledge. Mixed effects modelling with multiple crossed random effects have been used to evaluate similar designs in the social science research (Judd, Westfall, & Kenny, 2012; Quené & van den Bergh, 2008; J. Westfall, Kenny, & Judd, 2014). This research often counterbalances participant response to test items under different conditions, or treatment response for different stimuli. In this setting, both participants and condition/stimuli are considered random factors, as they have been sampled from a larger population. The inference is that researchers can generalise findings across participants and condition/stimuli.

Sample size and power calculations

For this study design, sample size estimations can be calculated in two steps. First a power analysis for a two-sampled paired-proportions test is conducted assuming two independent samples to determine the sample size required for a between-cluster study design. This calculation is then followed by an adjustment

for the relative efficiency (RE) of within-cluster designs. In order to illustrate this two stage approach, an example sample size and power calculation is presented.

For a study with three levels of context and implementation strategy, a sample size of 50 clusters (unit of randomisation) per group (150 clusters total) would provide 80% power at a 0.05 significance level with a two-sample paired-proportions test adjusted for the relative efficiency of within cluster designs examining a pairwise contrast between two levels of implementation strategy across all three contexts, under the assumption that 60% of those in an intervention group align with the desired practice change, and 40% in the control group. This process begins with a sample size of 107 clusters (unit of randomisation) across three levels of context and implementation strategy levels, generating 321 cluster-level outcome measurement observations. In this first step, a power analysis for a two-sample paired-proportions test examining a pairwise contrast between two levels of implementation strategy across all three contexts would provide 80% power at a 0.05 significance level, under the assumption that 60% of those in an intervention group align with the desired practice change, and 40% in the control group. In the second step, adjustment for the relative efficiency (RE) of repeated measures in a counterbalanced design can be performed using the formula: $RE=0.5[(1–Pc\ –p)/(1+(n–1)p)]$, where n=number of units within each cluster across periods, p=intra-class correlation coefficient (ICC) between units in the same cluster at the same time point, and Pc=the inter-period correlation (Rietbergen & Moerbeek, 2011; Rutterford, Copas, & Eldridge, 2015). One unit within each cluster across three periods, an assumed ICC of 0.001 between units and an inter-period correlation of 0.0442, leads to an estimated relative efficiency for crossover in the counterbalanced design of 0.4685. Once the between-cluster sample size is multiplied by the relative efficiency of within-cluster design (107 * 0.4685), this adjustment creates the target study sample size of 50 clusters (unit of randomisation) per group (150 total clusters total).

This analytic approach was compared against a simulation-based method where a simulated dataset with the same characteristics as that described above. Using simulation, a sample size of 50 participants per group resulted in 73% power.

Planning a counterbalanced implementation trial design

Implementation studies can be designed to change practice at the organisational level (e.g. health services), departmental level (e.g. hospital wards), health professional level (e.g. medical staff or physiotherapists), or patient level (e.g. inpatient or outpatients). Selecting the unit level of analysis is dependent on the focus of the study, and researchers also need to consider the feasibility of recruitment, implementation strategy delivery, and statistical power. Wilson and colleagues reflected on a randomised controlled trial attempt which did not reach recruitment targets, reporting that recruiting at a departmental or divisional unit of allocation, rather than at the level of individual staff members may provide more meaningful analysis of implementation success (M. G. Wilson et al., 2015). However, this approach has limitations in statistical power, which would need to be addressed.

Planning a counterbalanced implementation study involves the selection of both health contexts and implementation strategies. We recommend that researchers engage in a consultative process with potential participant organisations and individuals, which, in turn may improve recruitment rates and fidelity of interventions. This type of early engagement is important because it can help to ensure health contexts and implementation strategies are relevant to participating individuals and organisations. Consultation would identify context areas of interest to patients, clinicians, managers, policy-makers, and organisations. A prioritisation process may then provide a mechanism for selecting the specific health contexts for implementation in a counterbalanced study. Limitations could be imposed on the number of helices (strategy/context combinations) in the study, or several different studies could be run. Health contexts should involve interventions, assessments, policies, programs, or practices with good levels of evidence to support both effectiveness and cost-effectiveness prior to implementation.

We recommend the selection of implementation strategies for examination that involve the application of an evidence-based framework, model or theory (Slade et al., 2018). Evaluation of implementation strategies can be aimed at describing the process of translating research into practice, understanding different variables which influence implementation outcomes, or examining strategy success depending on the overall aims of the study (Per Nilsen, 2015). Process models such as the knowledge to action framework can specify the stages to guide the process of translating research into practice (K. M. Wilson, Brady, Lesesne, &

Translation, 2011). The i-PARIHS (integrated Promoting Action on Research Implementation in Health Service) framework (Harvey & Kitson, 2015; Alison Kitson, Gill Harvey, & Brendan McCormack, 1998), theory of diffusion (E. M. Rogers, 1995), and the COM-B (Capability, Opportunity, Motivation, and Behaviour) model (Susan Michie, Maartje M. van Stralen, & Robert West, 2011) are all examples of understanding what influences implementation outcomes; where the RE-AIM (Reach, Efficacy, Adoption, Implementation, and Maintenance) model focuses on examining implementation strategy success (Russell E Glasgow et al., 1999). Once an overall theory is established, implementation strategies can then be tailored to the trial organisation or individuals, as studies have shown tailored strategies may be more effective than generic strategies (Dobbins, Hanna, et al., 2009; R. LaRocca, J. Yost, M. Dobbins, D. Ciliska, & M. Butt, 2012).

It is worth noting the consideration of system levels when planning a counterbalanced study. By replicating a counterbalanced study across multiple systems (e.g. hospitals, healthcare organisations, public/private, primary/tertiary, states), more generalisable findings regarding implementation strategies applied in different contexts could be developed. Developing evidence in this way creates an opportunity to ensure external validity of findings, which would support scale-up of implementation strategies (C Hendricks Brown et al., 2017). Alternatively, it could be valuable to conduct a counterbalanced trial in a single system. Creating locally specific knowledge around the implementation process would re-direct the study focus to how strategies work within local organisational cultures. This would be useful for those interested in the internal validity of strategies and their applicability at a local site (Duan, Kravitz, & Schmid, 2013).

Discussion

In this manuscript, we have described a novel approach to the evaluation of different implementation strategies across multiple health contexts. The counterbalanced implementation trial compares the same subjects response to all interventions, effectively reducing the number of potential confounding covariates. This approach may improve the efficiency and precision of studies through smaller levels of variance, which can reduce the sample size required to identify a statistically significant change in outcomes (Piantadosi, 2005). In situations where implementation strategies cannot be evaluated concurrently, the potential for order effects needs to be considered. Homogeneity between implementation strategies or context areas

would have to be addressed to avoid potential carryover or 'learning' effects, where the benefits of the implementation strategy in one context are potentially carried over to the next implementation strategy in the next context. Some implementation strategies are 'health context specific', in that they may be successful in one area but not in others (Diwan et al., 1995; Watson et al., 2002). Researchers should consider whether their implementation strategy is transferrable across health contexts, or whether a counterbalanced design would be better employed to compare the strategy in the same health context across different organisations or study sites, rather than across contexts.

The applicability of traditional study designs to implementation science has been questioned (Schliep, Alonzo, & Morris, 2017). Randomised controlled trials are important for determining the efficacy of treatments in highly controlled environments to ensure internal validity (Stolberg, Norman, & Trop, 2004). However, it has been suggested that these designs may not be appropriate for the implementation phase of evaluation, due to potentially low levels of external validity (Schliep et al., 2017). Novel designs, such as the counterbalanced, stepped-wedge (T. Haines et al., 2014), and adaptive trials (Bhatt & Mehta, 2016) that incorporate the use of routinely collected health service data and incorporate consent waivers where ethically appropriate, may provide a logistically simple, low cost pathway for the effectiveness and implementation phase of clinical research. Ideally, implementation evaluations would be conducted in 'real-world' settings, be appropriately statistically powered, and designed to reduce potential confounders and risk of bias that could mislead study conclusions (Elizabeth H. Skinner et al., 2018). Implementation studies often focus on the processes to integrate evidence informed decision making in healthcare organisations, involving clinicians, managers and policy-makers (Sarkies et al., 2017). These populations are notoriously time-poor (A. M. Boström, K. N. Kajermo, G. Nordström, & L. Wallin, 2008; Cheater et al., 2005; Richard Grol & Wensing, 2004; Jette et al., 2003; Oliver et al., 2014), which can lead to difficulties in enrolling participants in an implementation study (M. G. Wilson et al., 2015). Therefore, study designs that can increase exposure to different conditions while maximising statistical power are valuable for implementation researchers. The counterbalanced implementation study design provides a pathway for progressive up scaling of successful implementation strategies in different health contexts, allowing gradual refinement of strategies for certain contexts. Upon study conclusion, all participants or participant clusters will have been provided with each

implementation strategy, which can be continued if proved effective, cost effective, and is taken up by the study organisation.

Potential limitations of a counterbalanced design

Despite the advantages to conducting a counterbalanced implementation trial presented, there are limitations to applying this study design in some circumstances. The main limitations identified and described below relate to feasibility and potential sources of bias.

Feasibility

A necessity of the counterbalanced implementation study is that recruited health services or individuals can be exposed to the target implementation strategies in each health context. Each individual participant or participating healthcare organisation would need to provide services towards each of the health contexts selected for the study. For example, if the two context areas were chosen: (1) reducing prescription of antibiotics for upper respiratory tract infections which have been shown to be overused (Schroeck et al., 2015), and (2) reducing the use of arthroscopic surgery for knee osteoarthritis which has no identified benefit for un-discriminated osteoarthritis (Laupattarakasem, Laopaiboon, Laupattarakasem, & Sumananont, 2008), participants or participating healthcare organisations would need to be involved in both prescribing antibiotics for upper respiratory tract infections and routine treatment delivery for knee osteoarthritis. This may be difficult to achieve given the different disciplines and specialties involved.

The selection of certain health contexts and implementation strategies for evaluation may be restricted by the organisation policies, individual preferences, and limitations in resources provided at the health service or study location. Identifying multiple health contexts and implementation strategies in collaboration with organisations and individuals involved in a prospective counterbalanced implementation study may address this limitation. This collaborative approach may not differ largely from conventional implementation settings, where practice change must be aligned to organisational policies, goals, and priorities. An interesting approach that could account for these issues is ‘co-production’ or ‘co-design’ in implementation strategy development (K. J. Haines, Kelly, Fitzgerald, Skinner, & Iwashyna, 2017; Heaton, Day, & Britten, 2015). This

concept involves the collaborative development of implementation strategies by both the producer and user stakeholders (Voorberg, Bekkers, & Tummers, 2015), and may assist researchers and organisations in evaluating the implementation of programs, practices, or policies.

Selection of outcomes in a counterbalanced implementation study also requires a consideration of feasibility, as specific measurements may differ between health contexts. We recommend patient or health service outcomes be used as standard measurements of implementation success where feasible. Feasibility should be determined prior to study conduct by considering the difficulty and cost of obtaining outcomes. Data such as hospital length of stay and rate of adverse events are routinely collected by health services and could therefore be considered examples of feasible outcome measures (Sarkies et al., 2016; Sarkies et al., 2015; Elizabeth H. Skinner et al., 2018). It must also be considered whether participant recruitment is likely to reach adequate thresholds as to effect outcomes within-clusters (e.g. wards, hospitals). Alternatively, changes in attitudes, knowledge, behaviour, or implementation process outcomes may be considered, where outcomes are not based on routinely collected data (e.g. patient comprehension errors), or recruitment is unlikely to alter outcomes at the cluster level.

Potential source of bias

Two potential sources of bias in a counterbalanced implementation study are outcome and participant selection bias. Outcomes should be carefully selected and interpreted from a grounded theoretical basis, and pre-specified in clinical trial registration and published protocols to avoid the selection of 'convenient' outcomes, or selective reporting in published manuscripts. Participant selection bias can occur through low response rates in recruitment for counterbalanced implementation studies. Therefore, reporting should address whether there was a low response rate in participant recruitment and approaches used to address this potential risk of bias. In addition, there should be clear reporting when there are limitations to the application of results outside of the study sample.

Future research

There are currently no reporting guidelines specific for counterbalanced randomised studies. Until consensus is established for the minimum standards for transparent reporting of counterbalanced trials, we recommend that reporting should follow the CONsolidated Standards of Reporting Trials (CONSORT) Statement 2010 (M. K. Campbell, Piaggio, Elbourne, & Altman, 2012; Mills et al., 2009). In addition, reporting of any testing (or non-testing) for carryover effects of interventions across periods, and reporting of washout periods, should be included if clusters are exposed to study conditions sequentially. Other manuscript requirements from the International Committee of Medical Journal Editors (ICMJE) should also be considered (International Committee of Medical Journal Editors (ICMJE), 2004). Future research should focus on consensus reporting guidelines and analyses of counterbalanced implementation trials to ensure quality of conduct and reporting.

Conclusion

The proposed novel counterbalanced implementation trial that provides a potentially efficient and pragmatic research implementation study design for the evaluation of different strategies across multiple contexts. This design extends conventional trials used in the evaluation of implementation strategies. In the example application, comparing video versus written based research evidence summaries in community acquired pneumonia and nutrition for critically ill patients, the counterbalanced implementation design would offer a potentially feasible and cost effective means for evaluation and tailoring of implementation strategies in a study setting. The improved study balance through repeated measures design may result in proportionally fewer participants needed for adequate statistical power compared to potentially less balanced parallel approaches, allowing a ‘two for one’ evaluation of implementation strategies for high priority implementation contexts. Further refinement and tailoring of strategies within studies may facilitate scale-up of successful implementation strategies for translating research into practice across healthcare organisations.

Chapter 7 – Effectiveness of video versus written knowledge translation strategies in nursing and allied health: a novel helix counterbalanced randomised study

Preamble to Chapter 7 helix counterbalanced randomised study

A description of the methodological considerations to make when applying a novel counterbalanced design to the implementation setting is presented in Chapter 6. The following chapter presents the novel application of a counterbalanced study design to evaluate the success of video and written knowledge translation strategies across three health contexts published in the Journal of Clinical Epidemiology, 2019. The article citation is: Sarkies MN, Maloney S, Symmons M, Haines TP. Video strategies improved health professional knowledge across different contexts: a helix counterbalanced randomised controlled study. *Journal of Clinical Epidemiology.* 2019;112:1-11. doi:10.1016/j.jclinepi.2019.04.003. (Sarkies, Maloney, Symmons, & Haines, 2019)

Abstract

Introduction

This study aimed to apply a novel helix counterbalanced randomised controlled trial design to evaluate the effectiveness of video versus written knowledge translation strategies for improving health professional knowledge of evidence provided in scientific journal articles.

Methods

A Helix counterbalanced randomised controlled trial was used to compare the impact of delivering research information via video or written modalities compared to a no-information control across three health contexts. Interventions were delivered and data collected via an online survey to nursing and allied health

professionals across five hospitals within a public health service in Melbourne, Australia. A knowledge test measuring alignment between respondent perceived benefit of the intervention and conclusions listed in the journal article was the primary outcome. Secondary outcomes included: self reported confidence in response to knowledge test, perception of whether practice should be implemented or de-implemented, and qualitative perceptions of the utility of the knowledge translation strategies provided.

Results

There were 119 participants recruited with n=13 incomplete responses. Exposure to the video increased the likelihood of a knowledge test response that was aligned with the research evidence compared to the no-information control (OR 2.61; 95% CI 1.40, 4.89; p=0.003), but this was not the case for exposure to the written modality (OR 1.39; 95% CI 0.75, 2.57; p=0.294). There was no significant difference between knowledge translation strategies for the secondary outcomes. The thematic synthesis organised 11 themes under four categories, corresponding to each of the health contexts and knowledge translation strategy modes. Overall, the video was favourably received.

Conclusion

Providing video evidence summaries to nursing and allied health professionals increases the likelihood they will understand the main findings from research articles. Use of video abstracts may be a useful adjunct to publishing research in dissemination activities. The helix counterbalanced randomised study design was a feasible means of evaluating a video knowledge translation intervention, which may inform the design of future implementation strategies and evaluation approaches.

Introduction

Health service provision does not always reflect current research evidence (Sarkies et al., 2017). This evidence-to-practice gap relates to delayed uptake of new knowledge in practice (Hanney et al., 2015), inappropriate reliance on out-dated evidence (Kelly et al., 2016), practices uninformed by evidence (Breton, Fuemmeler, & Abroms, 2011), or the continuation of potentially harmful or ineffective practices (T. P. Haines

et al., 2017). These represent substantial opportunity costs, where patient and organisational outcomes could be improved if resources were disinvested from non-evidence based practices to those with evidence of effectiveness and cost-effectiveness.

Two areas where effort is needed to reduce the evidence-to-practice gap are falls prevention and management of deep vein thrombosis (DVT). There has been a substantial amount of research published on falls prevention, which presents a difficulty for health professionals in identifying clear messages for policy and practice (Gillespie et al., 2003). Additionally, there has been a long-standing controversy regarding mobilisation versus bed rest following venous thromboembolism, potentially preventing patients from receiving evidence-based care (Ellen Hillegass et al., 2016). Levels of uncertainty and knowledge gaps have been reported in both falls prevention and DVT contexts (Arabi, 2015; Laing, Silver, York, & Phelan, 2011; Peel, Brown, Lane, Milliken, & Patel, 2008). While knowledge and beliefs do not necessarily have a causal relationship with practice change, they can present a barrier to change, as knowledge and beliefs are considered prerequisites to behaviour change (Funke J, 2017). Clinical decision-making aids at point of care can improve adherence to evidence-based guidelines across health contexts (R. B. Haynes & Wilczynski, 2010), however, if decisions are made at multiple system levels (e.g. patient, clinician, management, policy levels), it can limit the ability of individual clinicians to change practice at the bedside. Therefore, it is hypothesised that improved knowledge at multiple levels of the health system could form a prerequisite for additional implementation efforts aimed at practice change.

Nationally, Australian hospitals allocate approximately AU$590 million per year to prevent falls in hospitals (Deb Mitchell et al., 2018). Falls prevention alarms continue to account for approximately 11% (AU$909 per bed per year) of these resources (Deb Mitchell et al., 2018), despite unclear evidence of effectiveness (Sahota et al., 2014; Shorr, Chandler, Mion, & et al., 2012); and provision of falls prevention patient education materials alone without one-on-one follow-up from a health professional has demonstrated limited evidence of effectiveness (T. P. Haines et al., 2011). For the management of DVT, many people diagnosed in the hospital setting are traditionally treated with anticoagulation therapy and bed rest, which is thought to reduce the risk of pulmonary embolism (PE) (Trujillo-Santos et al., 2005). However, multiple meta-analyses have confirmed that compared with bed rest, early physical activity as an adjunct to anticoagulation

treatment for older people with acute DVT does not increase the risk of PE, may reduce the risk of extension of DVT, and can reduce pain symptoms (Kahn, Shrier, & Kearon, 2008; Liu, Tao, Chen, Fan, & Li, 2015).

There is a need to identify better approaches to enable healthcare professionals, managers and policy-makers understand and use evidence, given the benefits of research in falls prevention and DVT management may not have always been translated to improved patient and organisational outcomes in a timely manner. Historically, the scientific journal article has been one of the most common approaches to disseminate evidence (Bero et al., 1998; Giguère et al., 2012). However, key messages may be missed, as journal articles generally contain large amounts of detail sufficient to enable replication, which can take considerable time and expertise to interpret. Further, they are not typically written with the knowledge users in mind (e.g. healthcare professional, manager or policy-maker); and while they might recommend new or changed practices, there tends to be a paucity detail on how this change can be pragmatically made in 'real world' settings. Better targeted research reviews can be more palatable. After evaluating the use of research reviews specifically commissioned for healthcare policy, Campbell et al. (2011) reported that policy-makers perceived them as useful for decision making (D. Campbell et al., 2011). Similar positive perceptions regarding written evidence summaries have been reported across other studies (Chambers et al., 2012; M. Dobbins, R. Cockerill, J. Barnsley, & D. Ciliska, 2001), however, while positive perceptions may be a prerequisite for change, they do not necessarily always result in behaviour change (Bero et al., 1998; D. A. Davis, Thomson, Oxman, & Haynes, 1995; Lomas, 1991; Lomas et al., 1989; Oxman, Thomson, Davis, & Haynes, 1995; Soumerai, McLaughlin, & Avorn, 1989).

Capitalising on the popularity of video for conveying and consuming information more generally, there is a trend for communicating technical health information in this mode too (Hill et al., 2009). For example, a number of journals have begun posting video versions of research abstracts as an introduction to the full paper (Spicer, 2014). In the case of conveying practice information to healthcare professionals, the audience may not necessarily be motivated to allocate time in their ordinary workload to read and interpret a scientific journal article. This situation would seem ideal for use of video. Web-based video education has been shown to potentially build knowledge-based capacity for evidence-informed decision making (L. Chan, Mackintosh, & Dobbins, 2017). However, further evaluative research is needed, due to the paucity of evidence supporting

the effect of video based knowledge translation strategies in improving health professional understanding of research evidence.

This study aimed to apply a novel helix counterbalanced randomised controlled trial design to evaluate the effectiveness of video versus written knowledge translation strategies compared to a control condition for improving nursing and allied health professional knowledge of evidence provided in a scientific journal article across three health contexts.

Methods

The study was approved by the Monash University Human Research Ethics Committee (Ref LNR/18/MonH/155). It was also registered with the Australia New Zealand Clinical Trials Registry (ANZCTR), Trial ID: ACTRN12618000695202.

Design

This study used a controlled, 3-group helix counterbalanced randomised design (Figure 7.1). Three study groups examining the success of video and written research evidence summaries, compared with usual care control conditions were evaluated. These knowledge translation strategies aimed to align knowledge with the current research evidence for three health contexts: (1) promoting physical activity as an adjunct to anticoagulant treatment after diagnosis of deep vein thrombosis, (2) written falls prevention patient education materials only without follow up from a health professional, and (3) bedside pressure sensor alarms to prevent falls. The knowledge translation strategies were delivered and data was collected via an online survey. The evaluation was broadly based on the first two levels of the Kirkpatrick Evaluation Model Hierarchy framework: (1) reaction, and (2) learning (Kirkpatrick, 1954, 1975). In this design, the knowledge translation strategy (independent variable) takes on three levels, which are evaluated across three health contexts. Each knowledge translation strategy level uses a different health context within each participant to avoid contamination. This approach is represented below:

R XA1|B1 XA2|B2 XA3|B3 O

R XA3|B1 XA1|B2 XA2|B3 O

R XA2|B1 XA3|B2 XA1|B3 O

Where R represents random assignment of units to conditions, O indicates unit outcome assessment, A is the knowledge translation strategy, and B is the health context.

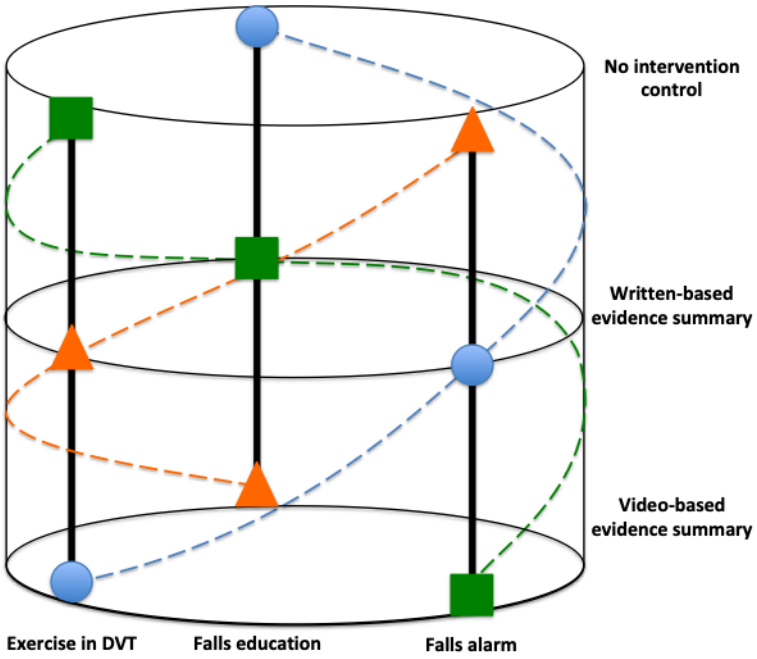


Figure 7.1. 3-level helix counterbalanced randomised study model

Setting

The study sample was drawn from a major public health service organisation in metropolitan Melbourne, Australia. This health service includes five teaching hospitals providing acute and subacute services, with more than 260,000 patient admissions each year.

Eligibility criteria

Registered nurses (RN) and enrolled nurses (EN) from all inpatient wards, as well as allied health professionals (physiotherapy, occupational therapy, speech pathology, dietetics, social work, psychology, podiatry, and exercise physiology) and allied health assistants at the study hospitals were all eligible to participate in the study. These healthcare professionals were included as they are regularly involved in delivery of interventions for the health contexts of interest in this study. Nursing staff working in aged care, outpatient, or community services, and assistant in nursing (AIN) staff working in any setting were excluded, as they were not considered to be primary clinical decision makers or delegated providers of interventions for the health contexts of interest in this study.

Interventions

Group hospital email addresses for potentially eligible nursing and allied health staff were identified by discussion with nursing unit managers for each inpatient ward and the allied health managers at the study health service. An email was then sent from one of the investigator's staff member email address to invite potential participants to take part in the study. This email provided an access link to the online survey software tool. Potential participants were provided with information on the study in the invitation email and at the beginning of the online survey. Completion of the online survey constituted implied consent. Participants were randomised to one of three groups determining the sequence of knowledge translation strategy to health context exposure on commencement of the survey using an inbuilt randomisation feature within the online survey software tool. The knowledge translation strategies were delivered simultaneously at point of randomisation via two embedded links in the survey. Participants may select the order they access the interventions and time occurred between. Group allocation was concealed to investigators and participants using the online survey's inbuilt randomisation feature, as neither was actively involved in the process. However, participants were not blinded due to the nature of the interventions.

The three research knowledge translation strategy conditions in this study were a video evidence summary, written journal article, and a no-information control condition. A summary of the study group conditions is described according to the Template for Intervention Description and Replication (TIDieR) guidelines in

Table 7.1 (Tammy C Hoffmann et al., 2014). In each health context, a full-text scientific journal article constituted the written evidence journal article, from which the video evidence summary was developed. Videos were standardised based on format (animation), captioning (subtitled with no audio), duration (3min), and software. An independent expert in rehabilitation confirmed the content in relation to the main messages contained within the video (based on the selected journal article). Scientific journal articles were chosen on the basis that they included recommendations for professional practice on the basis of findings. Those recommendations related to physical activity as an adjunct to anticoagulant treatment after diagnosis of deep vein thrombosis, provision of falls prevention education materials to patients without one-on-one follow-up from a health professional, and use of bedside pressure sensor alarms to prevent falls. Participants from across locations and professions were randomly allocated to one of three groups described in Table 7.2.

Table 0.1. Study group condition according to the Template for Intervention Description and Replication TIDieR guidelines

TIDieR criteria	(a)	(b)	(c)
Item 1. Brief name	Video evidence summary	Written evidence summary	No-intervention control
Item 2. Why	Video knowledge translation strategy approaches have emerged as a new way for journal publishers to communicate study results by providing video abstracts (Spicer, 2014). A recent study reported increased knowledge as a result of a web based video education series that aimed to build capacity for evidence informed decision making (L. Chan et al., 2017).	Providing written evidence summaries is one of the most common traditional dissemination approaches for the translation of research into practice (Bero et al., 1998; Giguère et al., 2012). This approach has demonstrated some success but has not been compared with other implementation strategy modes, such as providing video evidence summaries (Giguère et al., 2012).	No-intervention control serves as a pragmatic reference standard for implementation science.
Item 3. What (materials)	A video summary of available research evidence in the relevant health context area was provided. This video was an animation format with subtitles.	A written summary of available research evidence in the relevant health context area was provided in the form of a published full text research article.	There was no material provided to the control group during the study period.
Item 4. What (procedures)	The video evidence summary was provided to participants at time of random group allocation. The investigative team developed the video based on the same evidence provided in the written summary implementation strategy.	The written evidence summary was provided to participants at time of random group allocation.	No intervention was provided at time of random group allocation.
Item 5. Who	A team of tertiary qualified academics and clinicians, from healthcare backgrounds in Victoria, Australia produced the video evidence summary.	A team of tertiary qualified academics and clinicians, from healthcare backgrounds in Victoria, Australia selected the written evidence summary based on their judgement of the highest quality research currently available in the relevant health context areas. An independent expert in the field of rehabilitation confirmed this selection.	No intervention was provided by any persons.
Item 6. How	An electronic version of the video evidence summary was provided via an online survey software tool.	An electronic version of the written evidence summary was provided via an online survey software tool.	No intervention was provided by any mode.
Item 7. Where	Recruitment occurred online via staff	Recruitment occurred online via staff email	No intervention was

	email address. While these can be accessed by staff offsite, it was anticipated that the majority of participants would access the interventions at their place of work, in the study hospital.	address. While these can be accessed by staff offsite, it was anticipated that the majority of participants would access the interventions at their place of work, in the study hospital.	provided at any location.
Item 8. When and how Much	One 3-minute video evidence summary was provided to participants at time of random group allocation.	One written evidence summary in the form of a published full text research article was provided to participants at time of random group allocation.	No intervention was provided.
Item 9. Tailoring	There was no adaptation planned for the video evidence summary during the study period.	There was no adaptation planned for the written evidence summary during the study period.	No intervention was provided or adapted during the study period.
Item 10. Modifications	No modifications were made.	No modifications were made.	No modifications were made.
Item 11. How well (planned)	The duration of time taken to complete the online survey provides a proxy measure to whether the video and written intervention were watched and read respectively. Participants whose survey duration time was less than 3-minutes were considered not to have adhered to the interventions.	The duration of time taken to complete the online survey provides a proxy measure to whether the video and written intervention were watched and read respectively. Participants whose survey duration time was less than 3-minutes were considered not to have adhered to the interventions.	As no intervention is provided, adherence or fidelity was not assessed for this control intervention during the study period.
Item 12. How well (actual)	Nineteen participants completed the survey in less than 3-minutes, indicating it is unlikely they watched the full video intervention.	Nineteen participants completed the survey in less than 3-minutes, indicating it is unlikely they read the written intervention.	Participants had no way to access the video or written intervention for the control health context. Therefore adherence to the control condition is assumed.

Table 0.2. Group allocation to dissemination strategy and health context sequence

Group	Description
1	Received the video evidence summary education strategy for promotion of physical activity as an adjunct to anticoagulant treatment after diagnosis of deep vein thrombosis, followed by the written journal article education strategy for the provision of falls prevention education materials to patients without one-on-one follow-up from a health professional, and then a no-intervention control in bedside pressure sensor alarms to prevent falls.
2	Received the video evidence summary education strategy in bedside pressure sensor alarms to prevent falls, followed by the written journal article education strategy for promotion of physical activity as an adjunct to anticoagulant treatment after diagnosis of deep vein thrombosis, and then a no intervention control for the provision of falls prevention education materials to patients without one-on-one follow-up from a health professional.
3	Received the video evidence summary education strategy for the provision of falls prevention education materials to patients without one-on-one follow-up from a health professional, the written journal article education strategy in bedside pressure sensor alarms to prevent falls, and the no intervention control for promotion of physical activity as an adjunct to anticoagulant treatment after diagnosis of deep vein thrombosis.

Participant outcomes of interest

Data collection occurred using an online survey software tool. The recruitment, intervention delivery, and data collection all occurred within one period (online survey); therefore, each participant determined time to completion. The video and written interventions were delivered for each health context in a single block prior

to being presented with the survey questions. Participants were prompted to answer the survey questions immediately after the intervention block delivery. Questions are presented in Table 7.3, and were developed specifically for the purposed of this study to test alignment of knowledge with the research evidence contained in the materials presented.

Table 0.3. Survey description

Outcome	Survey questions
Primary outcome: alignment between respondent perceived benefit of treatment in each health context and conclusions listed in each journal article	"How beneficial do you think written patient educational materials are for preventing falls in hospital?", and "How beneficial do you think exercise is as an adjunct treatment for deep vein thrombosis (DVT)?". Participants were able to choose the options of "beneficial", "not beneficial but not harmful", or "harmful".
Secondary outcome 1: self reported confidence of judgement in response to knowledge test	*Participants were asked: "*How certain are you that this judgement of benefit is correct?" and were able to choose the options of "very certain", "somewhat certain", and "uncertain".
Secondary outcome 2: self reported perception of whether practice should be implemented or de-implemented	Participants were asked: "Do you think this strategy should be used to prevent falls in hospital?" and were able to choose the options of "yes", "no", or "unsure".
Secondary outcome 3: qualitative perceptions of the utility of the implementation strategies provided	Each survey question provided an open text box for comments and an open-ended question at the end of the survey asked: 'Do you have any comments regarding the video or written evidence summaries provided?'.

Sample size

A sample size of 49 participants in each group (147 total participants) would provide 80% power at a 0.05 significance level for the primary outcome, under the assumption that 70% of knowledge test responses in an intervention group align with the presented research evidence, and 40% in the control group (approximately 30% difference or an odds ratio of 3.5). Adjustment for the relative efficiency (RE) of within-group repeated measures designs (constructed specifically for this research design) was performed using the formula: RE=0.5[(1–Pc – p)/(1+(n–1)p)], where n=number of units within each cluster across time periods, p=intra-class correlation coefficient (ICC) between units in the same cluster at the same time point, and Pc=the inter-period correlation (Rutterford et al., 2015). An ICC of 0.001 between units was used based on interim analysis data conducted once n=53 participants had been recruited. We conservatively estimated a similar inter-period correlation of 0.001, estimating a relative efficiency for the within-group repeated

measures design of 0.5. This adjustment creates a sample size of 25 participants per group (74 participants in total). We aimed to recruit 30 participants per group (90 total participants) to allow for approximately 20% withdrawal rate or loss to follow up.

An interim analysis was performed once a sample size of n=53 participants were recruited from one of the study hospitals. The original target sample size calculation was based on calculations for continuous data, leading to statistically underpowered results from our initial sample at one hospital site from the study health service. The target sample size was amended using appropriate methods for estimating sample size needed to achieve adequate statistical power for cluster within-group repeated measures designs (Rutterford et al., 2015). Four additional hospital sites were required within the study health service in order to achieve adequate sample size recruitment.

Analysis

All quantitative data were analysed using intention to treat principles. Descriptive statistics summarised demographic data. Continuous data is presented as mean and standard deviation (SD). Categorical data are presented as median and interquartile range (IQR), and nominal data as percentage. Statistical significance was set at $p<0.05$.

Mixed-effects, general linear model analysis were used to determine differences between knowledge translation strategies (video versus written) for the proportion of participants whose knowledge test response aligns with the research evidence for each health context. The investigators, based on their review of the evidence base and confirmed by an independent expert in rehabilitation, classified responses of “not beneficial but not harmful” for the bed alarms for falls prevention and falls prevention education materials alone contexts as being correct, and “beneficial” for the exercise for deep vein thrombosis prevention context as being correct. The knowledge translation strategy was entered into this model as a fixed effect, along with the intervention context (bed alarms for falls prevention, falls prevention education materials alone, exercise for deep vein thrombosis). We also included an knowledge translation strategy*intervention context

interaction effect. Individual participant identifiers were entered as a random effect. A Bernouli family and logit link function was employed.

We examined participant responses to the rating of their certainty in their knowledge test response separately for participant responses whose knowledge test response aligned and did not align with the research evidence. For those who aligned, we compared the level of certainty in their judgment using ordered logit regression with data clustered by participant. We included main effects for each knowledge translation strategy and intervention context along with a knowledge translation strategy*intervention context interaction effect. We conducted similar analyses separately for those whose knowledge test responses did not align with the current research evidence.

We examined participant responses to whether a particular intervention should be used, separately for each health context (bed alarms for falls prevention, falls prevention education materials alone, exercise for deep vein thrombosis prevention) as the evidence of benefit differs between these contexts. We used ordered logit regression with data clustered by participant to examine difference between the effects of each knowledge translation strategy on this outcome.

Qualitative data obtained from open ended survey questions were analysed thematically by one investigator in order to allow the interpretation of qualitative data within a single immersed individual, acting as a facilitator of data curation (E. H. Bradley et al., 2007; Janesick, 2003; Sarkies et al., 2017). In contrast to quantitative analysis, level of consensus between analysts is not the primary method for achieving interpretative rigor (Kitto, Chesters, & Grbich, 2008). Open-ended comment responses were reviewed line-by-line and coded by the lead investigator (MS). Codes were developed using an inductive approach, which were then collated into themes (Pope, Ziebland, & Mays, 2000). Data analysis occurred during the coding process, allowing constant comparison of new codes to ensure methodological rigor. Codes were considered finalised when no new concepts emerged (theoretical saturation).

Results

Invitation emails were sent on the 8th of May 2018, and the survey was closed on the 31st July 2018, once the recruitment target had been reached. Response rate was unable to be determined, as email distribution from the allied health and nursing managers was unable to be accessed. Of the potentially eligible participants, 119 respondents commenced the online survey and were randomly assigned to Group 1 (n=44) Group 2 (n=37), or Group 3 (n=38) sequence of knowledge translation strategy and health context. There were 13 participants (n=7 from Group 1, n=3 from Group 2, and n=3 from Group 3) who did not complete all 26 questions, leaving a dropout rate of 11% (Figure 7.2). The median time to survey completion was approximately 7.27 minutes (IQR 10.28 minutes). Table 7.4 describes the baseline participant characteristics between each knowledge translation strategy and health context group sequence.

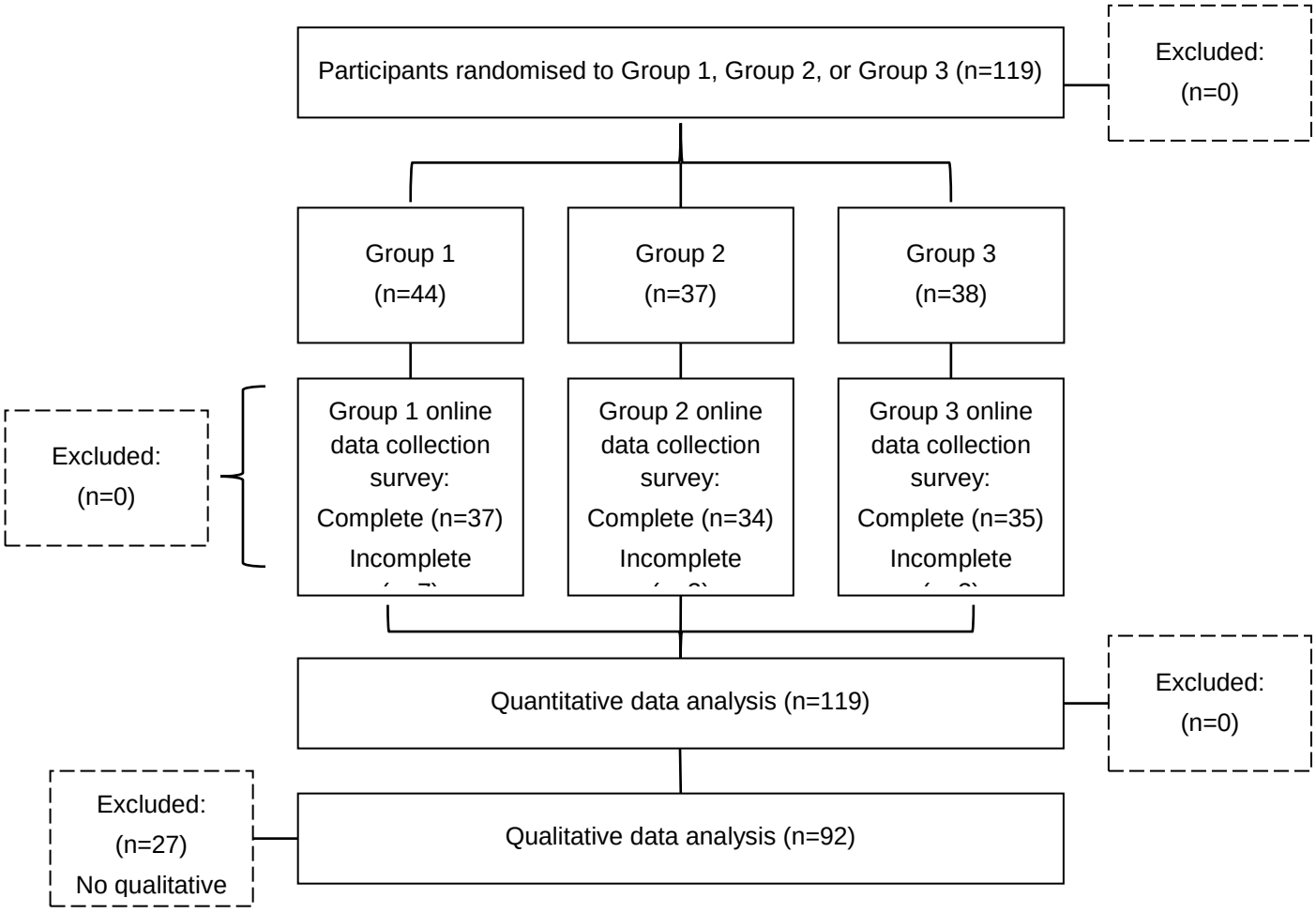


Figure 7.2. Study flow chart

Table 0.4. Baseline participant characteristics

Characteristic	Group 1 (n=44)	Group 2 (n=37)	Group 3 (n=38)
Profession:			
Registered nurse	17 (39%)	14 (38%)	18 (47%)
Enrolled nurse	2 (5%)	1 (3%)	0 (0%)
Physiotherapist	6 (14%)	13 (35%)	6 (16%)
Occupational therapist	2 (5%)	3 (8%)	3 (8%)
Speech pathologist	3 (7%)	0 (%)	0 (%)
Dietitian	1 (2%)	2 (5%)	1 (3%)
Social work	2 (5%)	1 (3%)	1 (3%)
Allied health assistant	4 (9%)	0 (%)	2 (5%)
Podiatry	0 (0%)	0 (%)	2 (5%)
Clinical psychology	0 (0%)	0 (0%)	1 (3%)
Neuropsychologist	0 (0%)	0 (0%)	1 (3%)
Unknown	7 (16%)	3 (8%)	3 (8%)
Highest level of formal qualification:			
Certificate 1-4	4 (9%)	1 (3%)	4 (11%)
Diploma	5 (11%)	0 (%)	2 (5%)
Bachelor's degree	17 (39%)	18 (49%)	17 (45%)
Bachelor's degree (honours)	3 (7%)	6 (16%)	5 (13%)
Post graduate certificate	1 (2%)	1 (3%)	0 (%)
Post graduate diploma	0 (0%)	0 (0%)	1 (3%)
Master's degree (coursework)	6 (14%)	6 (16%)	5 (13%)
Master's degree (research)	1 (2%)	1 (3%)	0 (0%)
Doctoral degree (research)	0 (0%)	1 (3%)	0 (0%)
Doctoral degree (coursework and research)	0 (0%)	0 (0%)	1 (3%)
Unknown	7 (16%)	3 (8%)	3 (8%)
Years' experience:			
Less than 1 year	5 (11%)	5 (14%)	1 (3%)
Between 1 and 2 years	1 (2%)	4 (11%)	5 (13%)
Between 2 and 5 years	8 (18%)	7 (19%)	9 (24%)
Between 5 and 10 years	10 (23%)	9 (24%)	8 (21%)
Greater than 10 years	13 (30%)	9 (24%)	12 (32%)
Unknown	7 (16%)	3 (8%)	3 (8%)

* Per cent (%) values subject to rounding error

Quantitative outcomes

Main results for the primary outcome: alignment between respondent knowledge test result for each health context and conclusions listed in each journal article are presented in Table 7.5. Participant knowledge test responses more frequently aligned with the research evidence when exposed to the video compared to no-

information in either falls prevention health context. Similarly, participants more frequently correctly rated the treatment benefit of promoting physical activity after diagnosis of deep vein thrombosis, regardless of which knowledge translation strategy was provided.

Table 0.5. Summative results for the primary outcome (alignment between knowledge test response and current research evidence

Health Context	Knowledge translation Strategy		
	Control	Written	Video
Context 1: Bedside pressure sensor alarms to prevent falls	6/44 (14%)	8/38 (21%)	15/37 (39%)
Context 2: falls prevention education materials alone without follow up from a health professional	10/37 (27%)	14/44 (32%)	18/38 (47%)
Context 3: physical activity as an adjunct treatment after diagnosis of deep vein thrombosis	26/38 (68%)	27/37 (73%)	31/44 (70%)

* Data presented as n=correct/incorrect (percentage correct). Per cent (%) values subject to rounding error

The effect of knowledge translation strategy across contexts is presented in Table 7.6. For the primary outcome, exposure to the video increased the likelihood of a knowledge test response that was aligned with the research evidence compared to no-information (OR 2.61; 95% CI 1.40, 4.89; p=0.003), but this was not the case for exposure to the written modality (OR 1.39; 95% CI 0.75, 2.57; p=0.294). There was no significant difference between the video and written modality when compared to the no-information control for the secondary outcomes: self reported confidence of judgement in response to knowledge test, and self reported perception of whether practice should be implemented or de-implemented. Participants were significantly less likely to report self confidence in their knowledge test response for the promotion of physical activity after diagnosis of deep vein thrombosis (OR 0.60; 95% CI 0.39, 0.92; p=0.021) compared to the bedside pressure sensor alarms to prevent falls health context. For participant's self confidence in their knowledge test response, there was a significant interaction effect identified between the written modality and falls prevention education materials without one-on-one follow up (OR 0.29; 95% CI 0.09, 0.95; p=0.041). This indicates that the difference in reported self-confidence in knowledge test response for the written modality intervention compared to the control was smaller in the falls prevention education materials without one-on-one follow up context compared to the other two contexts.

Table 0.6. Main results for the primary and secondary outcomes of each knowledge translation strategy across contexts

Item	Item Wording	Knowledge translation Strategy OR (95% CI)			Health Context OR (95% CI)	
		Control versus written	Control versus video	Written versus video	Pressure sensor falls prevention alarms vs falls prevention education materials alone without health professional follow up	Pressure sensor falls prevention alarms vs physical activity as an adjunct treatment for DVT
1	How beneficial do you think bed/chair alarms are for preventing falls in hospital?' How beneficial do you think written patient educational materials are for preventing falls in hospital? How beneficial do you think exercise is as an adjunct treatment for deep vein thrombosis (DVT)?	1.39 (0.75, 2.57); p=0.294	2.61 (1.40, 4.89); p=0.003	1.88 (1.02, 3.46(; p=0.044	1.73 (0.96, 3.12); p=0.070	10.79 (5.30, 21.97); p<0.001
2	How certain are you that this judgement of benefit is correct?	1.34 (0.82, 2.20); p=0.245	1.46 (0.94, 2.28); p=0.095	1.10 (0.71, 1.70); p=0.676)	1.13 (0.71, 1.78); p=0.604	0.60 (0.39, 0.92); p=0.021
3	Do you think this strategy should be used to prevent falls in hospital? Do you think this strategy should be used as an adjunct treatment for deep vein thrombosis (DVT) in hospital?	0.77 (0.44, 1.36); p=0.370	0.63 (0.36, 1.11); p=0.112	0.81 (0.49, 1.34); p=0.423	1.06 (0.63, 1.80); p=0.823	1.25 (0.73, 2.13); p=0.417

*OR=odds ratio; CI=confidence interval

Qualitative outcomes

A thematic synthesis was performed using open text responses provided at the end of question sets for each health context, and at the end of the survey. This synthesis explored perceptions of the value of the dissemination mode, and of the evidence surrounding each health context. Themes were organised under four categories, corresponding to each of the health contexts and implementation strategy modes (video and written) in Table 7.7. The thematic synthesis process generated 11 themes from 58 individual codes. Across categories, 203 open text responses of varying lengths (words, sentences, paragraphs) were coded to one or more of the 58 codes. Example participant quotes are provided in Table 7.8 and referenced throughout the text.

Table 0.7. Summary of themes for each category

Dissemination mode	Bed/chair falls alarm	Falls education material only	Exercise adjunct treatment for DVT
• Videos perceived positively • Provision of evidence is useful	• Disagreement with evidence • Rationalising • Explanations for ineffectiveness	• Adaptations to treatments can make them effective • Explanations for ineffectiveness	• Agreement with evidence • Reference to research • Risk avoidance • Desire for more information

Dissemination mode

Overall, provision of information via video was positively received. Participants specifically praised the clear and concise nature of the video presentation (Participant 36). Video was also preferred over the written summary, with participants referring to difficulties in consuming the large amount of information provided in the written implementation strategy (Participant 20). In contrast, some participants stated the video evidence summary did not provide enough information. One of the participants asked directly for the written summary to be provided alongside the video to confirm information in the video was a good representation of the original text (Participant 78). Generally, participants indicated support for being provided with evidence in any mode as information for reference and to justify treatment in the health context (Participant 47 and Participant 15).

Bed/chair falls alarm

Many participants tended to disagree with the evidence presented in either video or written format for this health context. Some did not believe there was enough evidence presented to justify practice change, while others preferred to make decisions based on anecdotal evidence (Participant 25, and Participant 67). Other participants focussed on describing why practice should not be changed. It was suggested that while bed/chair falls alarms may not have been effective in the study, there are some circumstances where they could be effective (Participant 30). Further, explanations were provided to explain why bed/chair falls alarms do not work in some circumstances (Participant 1).

Falls education materials for patients only (without follow up)

Similar to the other falls prevention health context, participants provided explanation around why written falls prevention education materials alone without follow up from a health professional are not effective in some circumstances (Participant 23). Suggestions for how an alternative approach could improve effectiveness were also provided, suggesting participants understood the evidence of ineffectiveness, could identify why this approach may be ineffective, and thought about modifications to current practice (Participant 48).

Exercise as an adjunct treatment for deep vein thrombosis

In contrast to the two falls prevention health contexts, many participants agreed with the evidence presented in both the video and written format (Participant 59 and Participant 61). Interestingly, participants also made regular reference to the evidence presented or other evidence they were aware of (Participant 14). Perhaps due to the nature of the health context, statements around risk avoidance were more present in this health context (Participant 16).

Table 0.8. Example quotes from participant open text responses

Participant 36	'Concise video with clearly presented information'
Participant 20	'The video format held my attention and was an aid to remembering the information in comparison to the large amounts of written information.'
Participant 78	'It would be nice to see the paper article used for the falls video for further information as to whether what was presented in the video was a good representation'
Participant 47	'Great information for reference'
Participant 15	'Informative, good article to have a justification for early mobilisation'
Participant 25	'Given the evidence presented it is difficult to make an informed judgement. I would also say the recommendation to prevent falls needs to be more personalised. As one answers doesn't fit all patients.'
Participant 67	'I have observed time and time again the falls alarms have prevented falls from happening in hospital. Impulsive, cognitive impaired patients who are not compliant with assistance or supervision for mobilising are having the falls alarms notify staffing to them before harm can occur. Also it is a visual reminder for clinicians when you walk into a room and see the floor alarm that the patient has been identified as a high falls risk.'
Participant 30	'The bed/chair alarms can be useful in a particular cohort of patients as they can alert the staff when a patient engages in unsafe behaviour. These definitely prevent patients from doing their regular mobility tasks and can lead to associated deconditioning. At this time there isn't enough evidence to support or refute the use of bed alarms and the associated cultural change with it'
Participant 1	'Alarms are helpful in some situations but some patients are so fast the lag time of the alarm does not help prevent a fall in that first instance where a lot of falls occur'
Participant 23	'Patients are given a lot of written material in hospital - not sure how much they read, and if

	they do read it how much they retain'
Participant 48	'Word of mouth is more educational because the different nationality and book a interpreter to help because eye sight language barrier family being their lot more beneficial because paper work get lost and you need to print out in different language.'
Participant 59	'Confident due to systematic review (video) that showed it was more beneficial than bed rest and did not increase the likelihood of PEs'
Participant 61	'Early mobilisation has so many proven benefits to help prevent secondary pulmonary complications from bed rest and sedentary behaviour and it is shown in the article to not increase risk of developing pulmonary embolism so it should be routine practice for early mobilisation of these patients.'
Participant 14	'High quality evidence has shown nil negative effects from early mobilisation and there is a lot of gold standard practice regarding early mobilisation in hospital for reducing pulmonary complications and avoiding deconditioning. Educating medical staff to feel comfortable with this input would be the main barrier to implementation'
Participant 16	'Exercise could cause the DVT to travel within the vein and become a PE. I would use exercise with caution and request direction from the involved medical team.'

Discussion

This study is the first to apply a helix counterbalanced randomised controlled trial design to evaluate the effectiveness of knowledge translation strategies. The video modality increased the proportion of participant's knowledge test alignment with the research evidence across the three health contexts when compared to those who did not receive any information (control). Comparatively, the written journal article was not more effective in improving participant knowledge than providing no-information. Neither of the knowledge translation strategies improved participant's certainty of judgement of response to the knowledge test, or perception of whether practice should be implemented or de-implemented. Quantitative findings for the primary outcome were consistent with the qualitative study results, as participants generally provided positive feedback regarding the video modality. Applying this knowledge in clinical practice would require further implementation efforts involving human factor engineering and clinical decision-making support before broad improvements in patient outcomes can be achieved.

These study findings were somewhat concordant with previous research examining video and written evidence summaries. While there is little evidence comparing video and written strategies for knowledge translation in the nursing and allied health professions, some research has been identified in other settings. For example, one study has examined the use of multimedia approaches using voice-over and visual reinforcement to recruit potential study participants, which has been shown to potentially improve knowledge informing consent more than text alone (Kraft et al., 2017). The videos provided in our study did not include a

voice-over component, as many computers based in the study hospital wards do not have adequate sound compatibility. Instead, captioning/subtitles were used, Health professionals are increasingly favouring continuous professional development in computer-based format online. A recent survey of the American Public Health Association members reported more than 50% of respondents preferred online courses (Neuberger, Montes, Woodhouse, Nazir, & Ferebee, 2014), which intuitively seems reasonable, given changes in other forms of education provision catering to the next generation of 'digital natives' who have been immersed in technology all their lives (Sue. Bennett, Maton, & Kervin, 2008). However, this does not necessarily follow that online course are more effective or cost effective than face to face interventions to improve knowledge. Hence the importance of performing high level experimental studies using randomised controlled designs to compare approaches.

Journal publishers can consider the results from this study when deciding whether to adopt video to accompany written abstracts for online articles. Future randomised controlled trials and cost benefit analyses may be needed to identify whether videos can drive journal article traffic (e.g. reads, downloads, and citations) that warrant the cost (real and opportunity) of producing them. Improvements in public engagement, information dissemination, and journal impact might be achievable if information can be provided to health professionals in their preferred format. Scientific journals and authors of articles could potentially identify papers with direct and rigorous practice related recommendations (e.g. systematic reviews) and produce videos for the purpose of professional development. We have demonstrated that a helix counterbalanced design is feasible to use, provided relative efficiency in statistical power, and allowed the simultaneous comparison of two different knowledge translation strategies across three health contexts. Researchers may consider the applicability of this research design for prospective studies, where questions around the applicability of multiple knowledge translation strategies in different health contexts arise. This design-based solution potentially retains external validity by evaluating strategies across multiple contexts and ensures internal validity through controlled randomisation. Future studies may consider the benefits of applying a helix counterbalanced design when conducting large cluster randomised controlled trials, where health organisations are randomised to study groups. The improved 'balance' achieved through within-group repeated measures design may improve the relative efficiency of statistical power and reduce risk of an

imbalance of factors impeding or facilitating change between knowledge translation strategy and control groups.

Limitations

Generally there was a low level of correct responses to the knowledge test for each health context. The percentage correct and knowledge improvements were concordant with previous studies exploring health professional falls prevention knowledge (Laing et al., 2011; Pascoe et al., 2013; Peel et al., 2008), however, there was little previous literature for comparison regarding DVT care. Knowledge test responses for the benefit of physical activity promotion as an adjunct to anticoagulant treatment post diagnosis of deep vein thrombosis more often aligned with the research evidence, regardless of which implementation strategy was provided. Participants were also more confident of this judgement. Context is a practical issue for any implementation study (Green & Seifert, 2005), as it is a potential confounder representing the normal conditions in which knowledge translation strategies must be integrated if they are to be useful in practice (May, Johnson, & Finch, 2016). The evidence provided in the DVT context had been published earlier (2008) than the evidence in either falls prevention context, and was based on a systematic review of studies rather than a single study. It is possible that nursing and allied health staff were already aware of this evidence, or more receptive as it was based on a higher level of evidence according to the National Health and Medical Research Council (NHMRC) evidence hierarchy (National Health and Medical Research Council, 2000, 2008).

The qualitative analysis was performed by a single investigator, which may be considered a limitation, as a second independent investigator could not provide a check for consistency. This study examined the effect of two different knowledge translation strategies on knowledge, confidence and intention outcomes. These outcomes precede behaviour change and eventual health outcome changes, which are the end goal of implementation efforts. Changes in knowledge do not necessarily lead to behaviour and health outcome changes (Kimberly Corace & Gary Garber, 2014); therefore assumptions regarding flow-on effects from improved knowledge to practice change are avoided. The majority of participants completed the study survey in sufficient time to have watched the video and read the written journal article. However, out of 119 participants, 19 completed the survey in less than three minutes. These participants were assumed not to

have watched the video or read the written knowledge translation strategy prior to answering the survey questions, as they would not have had enough time. The online survey software did not enable control of time to completion to encourage engagement with the interventions. Ideally, it would be preferable for all participants to have full engagement with each knowledge translation strategy but this is not always possible in practice. Engagement rates reported in this trial are similar to those reported in other implementation studies where up to 30% of participants may not engage fully with provided strategies (Dobbins, Hanna, et al., 2009), given these strategies must overcome considerable barriers to research implementation (Sarkies et al., 2017).

Conclusion

Providing video evidence summaries to nursing and allied health professionals increases the likelihood they will understand the main findings from research papers. Use of video abstracts may be a useful adjunct to publishing research in dissemination activities. The helix counterbalanced randomised design provided a feasible approach to evaluating the effect of multiple knowledge translation strategies across different health contexts. Further research is needed to determine whether improved knowledge from digital approaches to knowledge translation can contribute as a component of more complex, multifaceted research implementation strategies to improve evidence uptake in healthcare policy and practice..

Chapter 8 – Discussion of main findings and thesis summary

Introduction

This program of research broadly focussed on how to evaluate research implementation efforts in healthcare policy and practice. While this might seem a simple aim, this pathway of enquiry has uncovered the depth of complexity in the field of implementation science. Two pathways of enquiry were explored; the first focussed on applying a conventional implementation study design and the second focussed on the novel application of methodological approaches to implementation enquiry.

The use of conventional methodological approaches for implementing evidence informed policy and management healthcare resource allocation decisions was explored in the Chapter 4 systematic review and Chapter 5 protocol. The policy and management health context focussed on weekend allied health service provision to acute general medical and surgical, and subacute rehabilitation hospital wards. A systematic review was used to determine the effectiveness of additional weekend allied health services to the relevant hospital wards in Chapter 4. Once evidence was synthesised and evidence based recommendations for weekend allied health service provision were endorsed, a cluster randomised controlled trial protocol was presented in Chapter 5 to implement recommendations.

Following the conventional approach, a novel methodological study design for implementing evidence informed clinician level healthcare resource allocation decisions was then explored in Chapters 6 and 7. The clinician level health contexts for evidence implementation involved nursing and allied health interventions in falls prevention and deep vein thrombosis. A counterbalanced study design was described in Chapter 6, and applied in Chapter 7 to evaluate the effectiveness of video and written modality evidence summaries for implementing evidence informed falls prevention and deep vein thrombosis care by nursing and allied health professionals.

This chapter summarises key findings from this program of research, and integrates the strengths, limitations and future directions.

Main findings and implications

Previous implementation literature

A systematic review was conducted to evaluate the effectiveness of research implementation strategies for promoting evidence informed policy and management decisions in healthcare (Chapter 2). Three experimental studies were identified; finding workshops, ongoing technical assistance, and distribution of instructional digital materials may improve knowledge and skills. Policy briefs including expert opinion might affect intended actions and intentions leading to actions, and tailored targeted messages were more effective for behaviour change compared to the same messages with additional access to a knowledge broker. The secondary aim was to describe factors perceived to be associated with effective research implementation strategies and their interrelationship. A thematic synthesis identified a hierarchal flow from (1) establishing an imperative for practice change, (2) building trust between implementation stakeholders and (3) developing a shared vision, to (4) actioning change mechanisms. This was underpinned by (5) employment of effective communication strategies and (6) provision of resources to support change.

However, this thematic synthesis was based on low levels (III and IV) of evidence according to the National Health and Medical Research Council (NHMRC) designations of 'levels of evidence' (National Health and Medical Research Council, 2000, 2008). Although, previous reviews have identified consistent themes, they were based on similar levels of evidence (Oliver et al., 2014; Tricco et al., 2016). A previous systematic review on the barriers to and facilitators of evidence use in policy by Oliver et al. (2014) reported most identified studies focussed on perceptions of respondents' experiences, rather than empirical evidence of research use. Relationships, organisation resources, and researcher characteristics were considered important factors influencing use of evidence by policy makers. Similar results were also reported in a scoping review by Tricco et al. (2016), which emphasised the importance of tailoring key messages to the relevant audience and partnerships between researchers, policy makers and healthcare managers in their uptake of systematic reviews by policy makers and healthcare managers. Consistency between reported results could indicate valid and reliable evidence were produced, and that despite being based on low levels of evidence findings, may hold adequate external validity. Implementation practitioners can therefore

consider the factors reported in the Chapter 2 systematic review when designing strategies targeting evidence informed decision making by healthcare managers and policy makers. Similarly, researchers may use these factors as a foundation for development and evaluation of strategies in prospective implementation studies.

It is worth noting the paucity of experimental evidence identified in the Chapter 2 systematic review. Only two randomised controlled trials and one non-randomised study evaluated the effectiveness of implementation strategies, limiting the ability to achieve the primary aims of the review. Two hypotheses were posited to explain the low number of studies identified in this setting. One related to the relative novelty of implementation science as a field of research. The last decade has seen a substantial growth in interest and research output within implementation science, including the production of a specialty journal (Implementation Science), scientific conferences (Global Implementation Conference), academic programs (Specialist Certificate in Implementation Science at the University of Melbourne), and professional societies (Global Implementation Society)(Norton, Lungeanu, Chambers, & Contractor, 2017). More time and development is likely needed within the field before additional randomised controlled trials can be conducted on research implementation strategies for policy and management decisions in healthcare. An alternative hypothesis was that the relatively low number of identified studies related to the complexity and difficulty of using traditional study designs to evaluate implementation success. It may be difficult to recruit healthcare managers and policy makers as participants when conducting implementation studies for policy and management resource allocation settings, particularly when using traditional randomised controlled trial designs. For example, a recent attempt to perform a parallel randomised controlled trial evaluating an evidence service for health system policy makers reported a recruitment rate of only 15%, leading to termination of the study (M. G. Wilson et al., 2015). Factors influencing participation included concerns regarding the time commitment and political considerations, as participants were representatives of a health ministry.

Another interesting finding from this review was that none of the identified studies measured implementation success using endpoint health or organisation outcomes. While previous research has conceded that the ultimate goal of evidence informed treatments and implementation is socially significant improvements in

people's well-being (Ogden & Fixsen, 2015), many studies have focussed on 'implementation outcomes', which are conceptually and empirically different to patient and organisation outcomes (E. K. Proctor et al., 2011). Lewis and Proctor, have been influential in leading improved empiricism for outcome measurement in implementation science (Lewis et al., 2015; E. K. Proctor et al., 2011). The former developed the concept of implementation outcomes and the latter focussed on the measurement of these outcomes. Implementation outcomes are defined as the effects of deliberative and purposive actions to implement new treatments, practice, and services (E. K. Proctor et al., 2011). Implementation outcomes are purported to serve as an indicator of implementation success, a proximal indicator of implementation processes, and as key intermediate outcomes (E. K. Proctor et al., 2011; Rosen & Proctor, 1981). The assumption is that changes in proximal and intermediate outcomes such as attitudes, knowledge and behaviour are necessary preconditions for changes in health and organisational outcomes (E. K. Proctor et al., 2011). This assumption is not necessarily evidence based, as previous studies have consistently reported changes in intermediate outcomes did not result in changes in meaningful endpoint outcomes (Bergström, Hagströmer, Hagberg, & Elinder, 2013; Kimberly. Corace & Gary. Garber, 2014; McCluskey & Lovarini, 2005). The business sector has also been unable to confirm hierarchical relationships in educational outcomes within the Kirkpatrick Model (Alliger & Janak, 1989; Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997). In other words, changes in perceptions and knowledge have not always lead to changed behaviour and benefits to endpoint results. Understanding of the processes or change mechanisms that lead to successful implementation is needed (Ogden & Fixsen, 2015), however, this does not substitute the need to measure whether improvements in people's well-being has occurred.

The systematic review in Chapter 4 and study protocol in Chapter 5 aimed to address the lack of studies examining research implementation for policy and management healthcare resource allocation decisions. The policy and management health resource allocation decision of interest was how to distribute weekend allied health service provision between acute and subacute hospital wards. A key ingredient in research implementation study proposals is that the healthcare service needs to be ready for implementation or de-implementation. Implementation readiness can be demonstrated by high levels of empirical evidence of efficacy, effectiveness, and cost effectiveness and delayed uptake in policy and practice (Proctor et al., 2012). It has been suggested that researchers can establish readiness for implementation by conducting a

systematic review and meta-analyses of randomised controlled trials in the health context area of interest (Proctor et al., 2012). As outlined in Chapter 4, a systematic review synthesised the evidence of effectiveness for additional weekend allied health service provision to hospital wards to establish readiness for service implementation or de-implementation. It was identified that providing additional weekend allied health to subacute rehabilitation wards reduces hospital length of stay, where disinvestment in acute general medical and surgical wards is unlikely to affect length of stay.

Conventional cluster randomised implementation study

In order to evaluate the implementation of evidence based weekend service recommendations for allied health managers, a traditional parallel cluster randomised controlled trial protocol was developed and presented in Chapter 5. This study will be completed postdoctoral conferral. The two strategies of interest were provision of an evidence based weekend allied health policy recommendation document and the provision of the same document with additional access to a knowledge broker. Knowledge brokers have been explored previously in the macro-level resource allocation decision setting, however, their effectiveness is unclear (Dobbins, Hanna, et al., 2009; Ward & Hamer, 2009). Previous authors have suggested that interactive, multicomponent mixed strategies may be more effective than passive, single component strategies (Boaz, Baeza, & Fraser, 2011; J. M. Grimshaw et al., 2012). Intuitively, knowledge brokering meets these requirements for a successful strategy. Roles such as 'knowledge manager', 'linkage agent', and 'capacity builder' are considered theoretically grounded core functions of a knowledge brokers that complement each other (Bornbaum et al., 2015; Dagenais, Laurendeau, et al., 2015), but in reality, there may be tensions between them (Currie, Finn, & Martin, 2007; Kislov, Hodgson, & Boaden, 2015; Kislov, Wilson, & Boaden, 2017). Previous work by Kislov et al. (2017) has suggested a move from individual 'brokers' towards collective 'brokering'. This would recognise knowledge brokering as 'core business', potentially re-framing engagement with a knowledge broker from 'one more thing' in a healthcare managers already time pressured day, to a part of daily routines as an 'in-between' role (Chew, Armstrong, & Martin, 2013). The approach taken in the Chapter 5 cluster randomised controlled trial protocol followed previous conventions of evaluating an individual knowledge broker. This intervention was tailored according to the factors perceived to be associated with successful strategies identified in Chapter 2. While behaviour change is the primary outcome for this study, process measures and health outcomes will also be measured.

Counterbalanced implementation study

Chapters 6 and 7 of this thesis aimed to address the difficulty in performing implementation studies, by describing and applying a novel design for evaluating strategies in clinician level healthcare resource allocation decision making. Challenges in conducting implementation studies have been described by Ogden and Fixsen (2015), including: methodological, measurement of outcomes, large units of analysis (e.g. organisations, communities), and long time periods (e.g. 5–10 years). Due to the relative novelty of implementation science as a discipline, individual implementation stages/components have not yet been formally operationalised. In addition, measures of implementation remain inconsistent. Implementation efforts often involve going beyond the individual healthcare practitioner towards organisational and systems level changes, and changes at these levels can take a number of years. This can lead to the need for large units of analysis and long study durations, such as entire health services over multi-year periods. Recruiting large organisations to take part in implementation studies can be difficult and may limit the ability to reach recruitment targets. For example, if 100 health services are required for adequate statistical power at the cluster level, and a country only has 80 health service organisations, achieving this target may be impossible. In order to address these issues when conducting randomised controlled implementation trials, Russell. E. Glasgow, Magid, Beck, Ritzwoller, and Estabrooks (2005) and Speroff and O'Connor (2004) have recommended using within-cluster designs. When using these designs, clusters can be at the unit of individual health professionals, organisations, or even states and nations, potentially addressing issues around selecting units of analysis. In addition, the statistical efficiency obtained through repeated measures within-cluster designs requires fewer units of randomisation, the corollary being that recruitment targets can be more easily achieved by requiring less recruitment (Russell. E. Glasgow et al., 2005; Speroff & O'Connor, 2004). Using a pairwise contrast, the relative efficiency of within-cluster repeated measures designs was determined to be approximately 0.5 effectively doubling the statistical power compared to a parallel design. Therefore, a within-cluster counterbalanced design was described and applied as a proof of concept around the use of randomised controlled trial methodology to evaluate strategies for clinician level healthcare resource allocation decisions in Chapters 6 and 7.

As described in Chapter 7, when video modalities of evidence delivery were compared with written based summaries, it was found that video improved nursing and allied health professionals understanding of research findings. The use of a counterbalanced implementation study design allowed a relatively small sample of health professionals to be recruited, providing adequate statistical power over three different implementation strategy and health context conditions. The effect of video modality knowledge translation strategies on improved knowledge may be applicable to some health contexts outside those investigated in the Chapter 9 study. Dissemination of video based evidence for psychological treatments in post-traumatic stress disorder appear to show some promise (Karlin et al., 2010). Where active disseminating of the Ottawa Ankle Rules using one hour educational sessions that included a 13 minute instructional videos had minimal impact on behaviour change and clinical practice (Cameron & Naylor, 1999). Despite the success of the video modality knowledge translation strategy in the examined health contexts, detailed written evidence should not necessarily be abandoned as a dissemination mode. Some study participants commented that the video did not provide enough information, and one specifically asked for the written evidence summary to be provided alongside the video. Future research could be conducted to test whether evidence summaries using video modalities could complement detailed written evidence.

Investigators were well positioned to leverage their prior experience in clinical practice and research to determine the readiness for evidence implementation and de-implementation in falls prevention and deep vein thrombosis care. This was a different approach to that taken in Chapter 4, where a systematic review and meta-analysis was used to determine readiness for implementation. Both approaches are considered appropriate in the field of implementation science (Proctor et al., 2012). In addition, the selection and development of implementation strategies for the first counterbalanced implementation study was not informed by any specific formalised theory, model or framework. Instead, alternative forms of explicit rationale were relied upon, including information from previous research evidence. Choosing a formalised theory for a study that includes both strategies for implementation and de-implementation is problematic, as most theories do not distinguish between approaches by which behaviour increases and decreases in frequency (Patey, Hurt, Grimshaw, & Francis, 2018). Additionally, it has been argued there is little empirical evidence that formal theories, frameworks or models improve implementation strategy effectiveness (Bhattacharyya et al., 2006; Per. Nilsen, 2015; Oxman et al., 2005). Bhattacharyya et al. (2006) has outlined

limitations of theoretically driven research implementation, including the lack of reproducible processes for applying predictor variables from quantitative theory based descriptive studies to implementation strategy components, unreliability in theoretical predictions of outcome both within theorised groups and when extrapolated to other groups, and difficulty selecting the most appropriate theory from the large number available. Theory can certainly lead to greater understanding of change mechanisms, but the complexity of 'wicked problems' that implementation science is often aiming to address limits the predictive power of theories and could be considered a reductive approach to problem solving. Until there is empirical evidence that behaviour change interventions designed using theories are more effective than those not designed using theory, the choice should remain subjective (Bhattacharyya et al., 2006).

Strengths and limitations

The combination of methodology used in this program of doctoral research increased the range, scope, and complexity of inquiry, which cannot be adequately captured using a single research approach. A detailed outline of the strengths and limitations of each approach is discussed as follows.

Strengths

One of the key strengths for this program of research is using novel approaches to evaluate implementation strategy success. Chapter 6 and Chapter 7 presented the development and application of a counterbalanced design to implementation settings. Use of this design has not been identified in previous implementation studies, and previous methodological explorations have focussed on social science settings without consideration of implementation science. This approach allows the simultaneous evaluation of multiple research implementation strategies across different health contexts using randomised controlled methodology. Increased statistical efficiency was demonstrated by requiring fewer participants for adequate statistical power within cluster measures, reducing the burden of participant recruitment and risk of wasted resources towards underpowered studies or those that are unable to reach recruitment targets.

Another key strength of this program of research was the use of rigorous methodology in the process of implementation evaluation. In Chapter 4, a systematic review and meta-analysis was used to determine the

effectiveness of additional weekend allied health services to acute general medical and surgical wards, and subacute rehabilitation wards prior to implementation of recommendations. This represents the highest level of evidence (Level I) according to the National Health and Medical Research Council (NHMRC) designations of 'levels of evidence' (National Health and Medical Research Council, 2000, 2008). The protocol to implement evidence based weekend service recommendations for allied health managers (Chapter 5) described a cluster randomised controlled trial methodology (Level II evidence), with strategies informed by the systematic review presented in Chapter 2. Finally evidence supporting the use of video modality evidence summaries to implement evidence informed falls prevention and DVT care by nursing and allied health professionals (Chapter 7) was based on randomised controlled methodologies (Level II evidence).

The impact of this program of research is also acknowledged. The systematic review and meta-analysis described in Chapter 4 presents the first clear evidence that additional weekend allied health services reduce hospital length of stay in the subacute rehabilitation setting. In addition, it is the first known meta-analysis of stepped wedge randomised controlled trials. The cluster randomised controlled trial protocol for the implementation of evidence based weekend service recommendations describes what will arguably be the largest research implementation study in the allied health professions to date. At the time of thesis submission, 186 individual allied health managers across 67 hospitals within 39 health services in Australia and New Zealand had been recruited according to the Australian and New Zealand Clinical Trials Registry (ANZCTRN: 12618000029291).

Limitations

While the substantial strengths and methodological advancements of this research have been discussed, there were inherent limitations identified. Behaviour change and health outcomes were not measured in the counterbalanced implementation study presented in Chapter 7. Given the novelty of applying a counterbalanced implementation study design, this RCT was considered a proof of concept study that did not have available resources to measure behaviour and health outcome changes. Therefore, it is unknown whether changes in knowledge as a result of the video evidence summary led to behavioural and eventual health outcomes changes.

While the video knowledge translation strategy presented in Chapter 7 appeared to be successful in improving knowledge, this was only observed for the health context areas examined. It is possible that the same strategy applied to different health contexts could lead to different results; or if the evidence provided in the three health contexts was based on more complex designs, the video strategy may have not been as effective. The external validity of these study results may remain unclear until replication is performed. This limitation is also present for the cluster randomised controlled trial protocol presented in Chapter 5. If the knowledge broker strategy is successful (or not) in the single applied context, assurances regarding success in different contexts cannot be made. Additionally, the results of this study were not available upon thesis completion.

Future directions

This program of research has generated a number of enquires that require further exploration. The use of health outcomes as primary measures in future research implementation studies has been advocated throughout this program of research. However, they were not always able to be feasibly collected. Hybrid implementation effectiveness designs that evaluate treatment effect and implementation success using the same population sample might provide an opportunity to improve methodological rigor in evaluation using health outcomes. Estimates of treatment effect and implementation success derived from the same population sample would be more likely to involve fewer imbalances in potential confounders between groups.

Novel methodological designs are needed, given the challenges encountered in implementation research. For example, the use of within-cluster counterbalanced designs in prospective randomised controlled implementation studies can improve statistical efficiency, requiring fewer clusters to provide evidence of effectiveness (or ineffectiveness). Indeed, this was demonstrated through the counterbalanced randomised implementation study in Chapter 7. Alternative novel design applications such as Stepped-wedge (T. P. Haines & Hemming, 2018), Crossover (Mills et al., 2009), Latin Square (J. V. Bradley, 1958), Multiple-Baseline (Hawkins, Sanson-Fisher, Shakeshaft, D'Este, & Green, 2007), Alternating Treatments (Barlow &

Hayes, 1979), and Simultaneous Treatment (Kazdin & Hartmann, 1978) studies also require further consideration in implementation settings. These all provide within-cluster design solutions to improving statistical efficiently in prospective implementation RCTs. Some of which could be applied across different systems levels, including n=1 trials, where a single cluster receives a series of conditions rather than groups of clusters (Lillie et al., 2011). Researchers will not have to rely on approaches with low levels of methodological rigor if these designs can address issues surrounding outcome measurement, requirements for large cluster level units of analysis and associated recruitment difficulties, and account for multilevel and multistage influences/confounders. Investigation of different statistical approaches and direct comparison with alternatives is needed to confirm whether these designs provide more statistical efficiency for implementation studies. For example, would it be better to perform three parallel studies or one counterbalanced study with three strategies and three health contexts?

The acceptance of experimental methods in implementation science has not been universally received (Berwick, 2008). One potential future direction of research could be to explore why experimental methods are not as readily accepted in implementation science when compared to other fields of research. Is it due to feasibility or difficulty applying methodological designs? Is it a permanent structural perception or a transient viewpoint that will evolve as higher standards of evidence are eventually made available? Regardless of methodological approach, further comparative research is needed in implementation science. Questions surrounding the success of one implementation strategy against a control are important, but there is also value to knowing whether strategies are more effective than alternatives. Therefore, studies that compare two or more research implementation strategies with a control deserve consideration for future research. Knowledge translation via video modality showed promise compared with written evidence dissemination in Chapter 7, however, it is not known whether this led to behaviour change and improved health outcomes. Strategies such as video evidence summaries that require minimal time commitment and can be incorporated into daily schedules warrant further investigation.

One research implementation strategy that may meet minimal time requirements and incorporation into daily schedules is knowledge brokering. The cluster randomised controlled trial comparing an evidence based weekend allied health recommendation document and the same document with additional access to a

knowledge broker presented in Chapter 5 is anticipated for completion in 2020. While the outcomes of this study cannot necessarily be pre-empted, some consideration for future directions can be proposed. Studies evaluating knowledge brokering may have limited external validity, as different individuals performing the knowledge broker role could produce different results. The knowledge broker role is highly complex, and involves development of relationships with stakeholders, synthesising and delivering evidence, and supporting communication (Bornbaum et al., 2015). It is difficult to expect one knowledge broker in one health setting to always produce similar outcomes to another knowledge broker in another setting. Further development of nuanced approaches to standardise components of knowledge broker interventions, while still allowing for appropriate tailoring might be possible. Rather than defining and standardising intervention components, the key functions of the interventions or steps in the change process could be standardised, allowing appropriate tailoring and rigorous evaluation (Hawe, Shiell, & Riley, 2004). Fractional factorial designs are one approach that could be considered to identify effective components of a knowledge broker strategy without the burden of running a full factorial design.

As the field of implementation science develops, answers to questions surrounding what works in which setting will eventually become apparent. Few strategies have been trialled to date, and with the advent of technological advancement, there will likely be an increased scope of implementation strategies in the future. Health professionals, managers and policy makers can consider applying one of the many available theoretical approaches to identify barriers (Damschroder et al., 2009; Kitson et al., 2008; Sarkies et al., 2017) and guide development of strategies to facilitate desired changes in policy and practice (May et al., 2007; Susan. Michie et al., 2011; Bryan. J. Weiner, 2009). Strategies should be consciously designed to address specific barriers and would ideally avoid generic or inappropriate application of strategies. This approach has been trialled in the intensive care unit setting, where health professionals elicited barriers to implementing mobilisation of mechanically ventilated patients for the purpose of designing appropriate strategies to facilitate practice change (Holdsworth et al., 2015). One example of potentially inappropriate strategy application would be the use of an education workshop to address barriers around normative beliefs and attitudes; instead, strategies using peer influence such as team building or social networking may be more successful in this setting.

Conclusion

The field of implementation science is gradually developing in relation to methodological design and evidence for effectiveness. A number of approaches have been explored in this program of research to address these fundamental issues. However, ongoing critical appraisal is needed through the peer review process to further refine and apply ideas. Socially meaningful health and organisational outcomes should be the focus of implementation efforts, and therefore must be conceptualised and measured in future implementation research. As the field develops, implementation specific methodological designs are also needed to facilitate high-level evidence derived from randomised allocation to exposures of interest. The application of a randomised counterbalanced implementation study in Chapter 7 provided proof of concept that implementation strategies can be evaluated across multiple health contexts, using within-cluster approaches that demonstrate efficiency in statistical power.

Providing evidence via video modalities to nursing and allied health professionals in the hospital setting may align knowledge with evidence. Comparatively, evidence dissemination using traditional written modalities appeared to have no effect on knowledge in the three health contexts of interest. Future research may confirm if improved knowledge from video knowledge translation strategies translates to health professional behaviour change and eventual health outcome improvements. The systematic review on the effectiveness of weekend allied health service provision in acute general medical and surgical wards, and subacute rehabilitation wards presents a clear direction for how weekend allied health resources can be reallocated to improve patient outcomes. It is hoped that the protocol for a cluster randomised controlled implementation trial can lead to socially meaningful improvements in patient and organisational outcomes by implementing these findings into healthcare policy and practice within Australia and internationally.

References

Ada, L., Dorsch, S., & Canning, C. G. (2006). Strengthening interventions increase strength and improve activity after stroke: a systematic review. *Aust J Physiother, 52*(4), 241-248. doi:10.1016/S0004-9514(06)70003-4

Adler, N. R., Weber, H. M., Gunadasa, I., Hughes, A. J., & Friedman, N. D. (2014). Adherence to therapeutic guidelines for patients with community-acquired pneumonia in Australian hospitals. *Clinical Medicine Insights. Circulatory, Respiratory and Pulmonary Medicine, 8*, 17-20. doi:10.4137/CCRPM.S17978

Alliger, G. M., & Janak, E. A. (1989). Kirkpatrick's levels of training criteria: thirty years later. *Personnel Psychology, 42*(2), 331-342. doi:doi:10.1111/j.1744-6570.1989.tb00661.x

Alliger, G. M., Tannenbaum, S. I., Bennett, W., Traver, H., & Shotland, A. (1997). A meta-analysis of the relations among training criteria. *Personnel Psychology, 50*(2), 341-358. doi:doi:10.1111/j.1744-6570.1997.tb00911.x

Althabe, F., Bergel, E., Cafferata, M. L., Gibbons, L., Ciapponi, A., Aleman, A., . . . Palacios, A. R. (2008). Strategies for improving the quality of health care in maternal and child health in low- and middle-income countries: an overview of systematic reviews. *Paediatric and Perinatal Epidemiology, 22 Suppl 1*, 42-60. doi:10.1111/j.1365-3016.2007.00912.x

Anderson, R., & Shemilt, I. (2010). The role of economic perspectives and evidence in systematic review. *Evidence-based Decisions and Economics: Health Care, Social Welfare, Education and Criminal Justice*. doi:10.1002/9781444320398.ch3

Arabi, Y. M. (2015). Toward evidence-based approach to deep venous thrombosis. *Annals of thoracic medicine, 10*(1), 1-2. doi:10.4103/1817-1737.146845

Armstrong, R. (2011). *Evidence-informed public health decision-making in local government.* (PhD thesis), University of Melbourne, Australia. Retrieved from http://hdl.handle.net/11343/35974

Armstrong, R., Waters, E., Dobbins, M., Lavis, J. N., Petticrew, M., & Christensen, R. (2011). Knowledge translation strategies for facilitating evidence-informed public health decision making among managers and policy-makers. *Cochrane Database of Systematic Reviews*(6). doi:10.1002/14651858.CD009181

Assareh, H., Chen, J., Ou, L., Hillman, K., & Flabouris, A. (2016). Incidences and variations of hospital acquired venous thromboembolism in Australian hospitals: a population-based study. *BMC Health Services Research, 16*(1), 511. doi:10.1186/s12913-016-1766-y

Australian Institute of Health and Welfare. (2018). *Hospital resources 2016–17: Australian hospital statistics.* Health services series no. 86. Cat. no. HSE 205. Canberra: Australian Istitute of Health and Welfare. Canberra: Australian Institute of Health and Welfare.

Babu, A. S., Noone, M. S., Haneef, M., & Samuel, P. (2010). The effects of 'on-call/out of hours' physical therapy in acute exacerbations of chronic obstructive pulmonary disease: a randomized controlled trial. *Clin Rehabil, 24*(9), 802-809. doi:10.1177/0269215510367558

Backer, T. E. (1995). Assessing and enhancing readiness for change: Implications for technology transfer. *NIDA research monograph, 155*, 21-41.

Balas, A. E., & Boren, S. A. (2000). Managing clinical knowledge for health care improvement. *Yearbook of Medical Informatics, 2000*(2000), 65-70.

Bammer, G. (2003). Integration and implementation sciences: building a new specialization. *Ecol. Soc, 10*(2), 95-107.

Barlow, D. H., & Hayes, S. C. (1979). Alternating treatments design: One strategy for comparing the effects of two treatments in a single subject. *Journal of Applied Behavior Analysis, 12*(2), 199-210. doi:10.1901/jaba.1979.12-199

Beder, J. (2008). Evaluation research on social work interventions: a study on the impact of social worker staffing. *Social Work in Health Care, 47*(1), 1-13. doi:1080/00981380801970590

Bennett, J. B., Lehman, W. E., & Forst, J. K. (1999). Change, transfer climate, and customer orientation a contextual model and analysis of change-driven training. *Group & Organization Management, 24*(2), 188-216. doi:10.1177/1059601199242004

Bennett, S., Maton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology, 39*(5), 775-786. doi:10.1111/j.1467-8535.2007.00793.x

Bennett, S., Tooth, L., McKenna, K., Rodger, S., Strong, J., Ziviani, J., . . . Gibson, L. (2003). Perceptions of evidence-based practice: A survey of Australian occupational therapists. *Australian Occupational Therapy Journal, 50*(1), 13-22. doi:10.1046/j.1440-1630.2003.00341.x

Bergström, H., Hagströmer, M., Hagberg, J., & Elinder, L. S. (2013). A multi-component universal intervention to improve diet and physical activity among adults with intellectual disabilities in community residences: A cluster randomised controlled trial. *Research in Developmental Disabilities, 34*(11), 3847-3857. doi:10.1016/j.ridd.2013.07.019

Bero, L. A., Grilli, R., Grimshaw, J. M., Harvey, E., Oxman, A. D., & Thomson, M. A. (1998). Closing the gap between research and practice: an overview of systematic reviews of interventions to promote the implementation of research findings. *BMJ : British Medical Journal, 317*(7156), 465-468.

Berwick, D. M. (2008). The science of improvement. *Jama, 299*(10), 1182-1184. doi:10.1001/jama.299.10.1182

Beynon, P., Chapoy, C., Gaarder, M., & Masset, E. (2012). *What difference does a policy brief make?* : Institute of Development Studies and 3ie.

Bhatt, D. L., & Mehta, C. (2016). Adaptive Designs for Clinical Trials. *New England journal of medicine, 375*(1), 65-74. doi:10.1056/NEJMra1510061

Bhattacharyya, O., Reeves, S., Garfinkel, S., & Zwarenstein, M. (2006). Designing theoretically-informed implementation interventions: Fine in theory, but evidence of effectiveness in practice is needed. *Implementation Science, 1*(1), 5. doi:10.1186/1748-5908-1-5

Birch, S. (1997). As a matter of fact: evidence-based decision-making unplugged. *Health Economics, 6*(6), 547-559. doi:10.1002/(SICI)1099-1050(199711)6:6<547::AID-HEC307>3.0.CO;2-P

Birch, S., & Gafni, A. (2004). 4 Evidence-based health economics. *Routledge International Studies in Health Economics*, 50.

Birken, S. A., Powell, B. J., Shea, C. M., Haines, E. R., Alexis, K. M., Leeman, J., . . . Presseau, J. (2017). Criteria for selecting implementation science theories and frameworks: results from an international survey. *Implementation Science : IS, 12*, 124. doi:10.1186/s13012-017-0656-y

Blackwood, B. (2006). Methodological issues in evaluating complex healthcare interventions. *Journal of advanced nursing, 54*(5), 612-622. doi:10.1111/j.1365-2648.2006.03869.x

Bluedorn, A. C., & Evered, R. (1980). Middle range theory and the strategies of theory construction *Middle range theory and the study of organizations* (pp. 19-32): Springer.

Boaz, A., Baeza, J., & Fraser, A. (2011). Effective implementation of research into practice: an overview of systematic reviews of health literature. *BMC Research Notes, 4*, 212. doi:10.1186/1756-0500-4-212

Bohman, T. M., Kulkarni, S., Waters, V., Spence, R. T., Murphy-Smith, M., & McQueen, K. (2008). Assessing health care organizations' ability to implement screening, brief intervention, and referral to treatment. *Journal of addiction medicine, 2*(3), 151-157.

Borkowski, D., McKinstry, C., Cotchett, M., Williams, C., & Haines, T. (2016). Research culture in allied health: a systematic review. *Australian Journal of Primary Health, 22*(4), 294-303. doi:10.1071/PY15122

Bornbaum, C. C., Kornas, K., Peirson, L., & Rosella, L. C. (2015). Exploring the function and effectiveness of knowledge brokers as facilitators of knowledge translation in health-related settings: a systematic review and thematic analysis. *Implementation Science, 10*(1), 1-12. doi:10.1186/s13012-015-0351-9

Boström, A.-M., Kajermo, K. N., Nordström, G., & Wallin, L. (2008). Barriers to research utilization and research use among registered nurses working in the care of older people: Does the BARRIERS Scale discriminate between research users and non-research users on perceptions of barriers? *Implementation Science, 3*, 24. doi:10.1186/1748-5908-3-24

Boström, A. M., Kajermo, K. N., Nordström, G., & Wallin, L. (2008). Barriers to research utilization and research use among registered nurses working in the care of older people: Does the BARRIERS Scale discriminate between research users and non-research users on perceptions of barriers? *Implement Sci, 3*, 24. doi:10.1186/1748-5908-3-24

Bowen, S., Erickson, T., Martens, P. J., & Crockett, S. (2009). More than "using research": the real challenges in promoting evidence-informed decision-making. *Healthcare Policy, 4*(3), 87.

Bowen, S., & Zwi, A. B. (2005). Pathways to “evidence-informed” policy and practice: a framework for action. *PLoS medicine, 2*(7), e166. doi:10.1371/journal.pmed.0020166

Boxall, A.-m., Sayers, A., & Caplan, G. A. (2004). A cohort study of 7 day a week physiotherapy on an acute orthopaedic ward. *Journal of Orthopaedic Nursing, 8*(2), 96-102. doi:10.1016/j.joon.2004.03.004

Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative data analysis for health services research: developing taxonomy, themes, and theory. *Health services research, 42*(4), 1758-1772. doi:10.1111/j.1475-6773.2006.00684.x

Bradley, J. V. (1958). Complete counterbalancing of immediate sequential effects in a Latin square design. *Journal of the American Statistical Association, 53*(282), 525-528. doi:10.1080/01621459.1958.10501456

Brasel, K. J., Lim, H. J., Nirula, R., & Weigelt, J. A. (2007). Length of stay: an appropriate quality measure? *Archives of Surgery, 142*(5), 461-466. doi:10.1001/archsurg.142.5.461

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. doi:10.1191/1478088706qp063oa

Breton, E. R., Fuemmeler, B. F., & Abroms, L. C. (2011). Weight loss—there is an app for that! But does it adhere to evidence-informed practices? *Translational Behavioral Medicine, 1*(4), 523-529. doi:10.1007/s13142-011-0076-5

Brijlal, V., Gilson, L., Makan, B., & McIntyre, D. (1997). District financing in support of equity: Tender Contract to provide technical assistance to provinces with obtaining equity in district financing. *Report submitted to the national Department of Health. Johannesburg: Centre for Health Policy, University of the Witwatersrand and Health Economics Unit, University of Cape Town*.

Brown, C. H., Curran, G., Palinkas, L. A., Aarons, G. A., Wells, K. B., Jones, L., . . . Wallace, A. (2017). An overview of research and evaluation designs for dissemination and implementation. *Annual review of public health, 38*, 1-22.

Brown, C. H., Curran, G., Palinkas, L. A., Aarons, G. A., Wells, K. B., Jones, L., . . . Cruden, G. (2017). An Overview of Research and Evaluation Designs for Dissemination and Implementation. *Annual Review of Public Health, 38*, 1-22. doi:10.1146/annurev-publhealth-031816-044215

Brownson, R. C., Ballew, P., Brown, K. L., Elliott, M. B., Haire-Joshu, D., Heath, G. W., & Kreuter, M. W. (2007). The effect of disseminating evidence-based interventions that promote physical activity to health departments. *American journal of public health, 97*(10), 1900-1907. doi:10.2105/AJPH.2006.090399

Brownson, R. C., Fielding, J. E., & Maylahn, C. M. (2009). Evidence-based public health: a fundamental concept for public health practice. *Annual Review of Public Health, 30*, 175-201. doi:10.1146/annurev.pu.30.031709.100001

Brusco, N. K., Shields, N., Taylor, N. F., & Paratz, J. (2007). A Saturday physiotherapy service may decrease length of stay in patients undergoing rehabilitation in hospital: a randomised controlled trial. *Australian Journal of Physiotherapy, 53*(2), 75-81. doi:10.1016/S0004-9514(07)70039-9

Brusco, N. K., Watts, J. J., Shields, N., Chan, S.-P., & Taylor, N. F. (2014). Does additional acute phase inpatient rehabilitation help people return to work? A subgroup analysis from a randomized controlled trial. *Clinical Rehabililation, 28*(8), 754-761. doi:10.1177/0269215514520774

Brusco, N. K., Watts, J. J., Shields, N., & Taylor, N. F. (2014). Are weekend inpatient rehabilitation services value for money? An economic evaluation alongside a randomized controlled trial with a 30 day follow up. *BMC medicine, 12*, 89. doi:10.1186/1741-7015-12-89

Brusco, N. K., Watts, J. J., Shields, N., & Taylor, N. F. (2015). Is cost effectiveness sustained after weekend inpatient rehabilitation? 12 month follow up from a randomized controlled trial. *BMC Health Services Research, 15*(1), 1. doi:10.1186/s12913-015-0822-3

Bucknall, T., & Fossum, M. (2015). It Is Not That Simple nor Compelling!: Comment on" Translating Evidence Into Healthcare Policy and Practice: Single Versus Multi-faceted Implementation Strategies–Is There a Simple Answer to a Complex Question?". *International Journal of Health Policy and Management, 4*(11), 787. doi:10.15171/IJHPM.2015.142

Budescu, D. V., Erev, I., & Wallsten, T. S. (1997). On the importance of random error in the study of probability judgment. Part I: New theoretical developments. *Journal of Behavioral Decision Making, 10*(3), 157-171. doi:10.1002/(SICI)1099-0771(199709)10:3<157::AID-BDM260>3.0.CO;2-#

Budescu, D. V., Wallsten, T. S., & Au, W. T. (1997). On the importance of random error in the study of probability judgment. Part II: Applying the stochastic judgment model to detect systematic trends. *Journal of Behavioral Decision Making, 10*(3), 173-188. doi:10.1002/(SICI)1099-0771(199709)10:3<173::AID-BDM261>3.0.CO;2-6

Bullock, A., Morris, Z. S., & Atwell, C. (2013). Exchanging knowledge through healthcare manager placements in research teams. *The Service Industries Journal, 33*(13-14), 1363-1380. doi:10.1080/02642069.2013.815739

Burns, P. B., Rohrich, R. J., & Chung, K. C. (2011). The Levels of Evidence and their role in Evidence-Based Medicine. *Plastic and Reconstructive Surgery, 128*(1), 305-310. doi:10.1097/PRS.0b013e318219c171

Button, K. S., Ioannidis, J. P., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S., & Munafò, M. R. (2013). Power failure: why small sample size undermines the reliability of neuroscience. *Nature Reviews Neuroscience, 14*(5), 365. doi:10.1038/nrn3475

Cairney, P. (2011). *Understanding public policy: theories and issues*: Palgrave Macmillan.

Cameron, C., & Naylor, D. C. (1999). No impact from active dissemination of the Ottawa Ankle Rules: further evidence of the need for local implementation of practice guidelines. *Canadian Medical Association Journal, 160*(8), 1165-1168.

Campbell, D., Donald, B., Moore, G., & Frew, D. (2011). Evidence check: knowledge brokering to commission research reviews for policy. *Evid Policy, 7*. doi:10.1332/174426411x553034

Campbell, L., Bunston, R., Colangelo, S., Kim, D., Nargi, J., Hill, K., & Brooks, D. (2010). The provision of weekend physiotherapy services in tertiary-care hospitals in Canada. *Physiother Can, 62*(4), 347-354. doi:10.3138/physio.62.4.347

Campbell, M., Fitzpatrick, R., Haines, A., Kinmonth, A. L., Sandercock, P., Spiegelhalter, D., & Tyrer, P. (2000). Framework for design and evaluation of complex interventions to improve health. *BMJ, 321*(7262), 694-696.

Campbell, M. K., Piaggio, G., Elbourne, D. R., & Altman, D. G. (2012). Consort 2010 statement: extension to cluster randomised trials. *BMJ : British Medical Journal, 345*. doi:10.1136/bmj.e5661

Campbell, N. C., Murray, E., Darbyshire, J., Emery, J., Farmer, A., Griffiths, F., . . . Kinmonth, A. L. (2007). Designing and evaluating complex interventions to improve health care. *BMJ: British Medical Journal, 334*(7591), 455.

Carey, L., Macdonell, R., & Matyas, T. A. (2011). SENSe: Study of the Effectiveness of Neurorehabilitation on Sensation: A Randomized Controlled Trial. *Neurorehabilitation and Neural Repair, 25*(4), 304-313. doi:10.1177/1545968310397705

Caruana, E. L., Kuys, S. S., & Brauer, S. G. (2018). Allied health weekend service provision in Australian rehabilitation units. *Australas J Ageing, 37*(2), E42-e48. doi:10.1111/ajag.12500

Caruana, E. L., Kuys, S. S., Clarke, J., & Bauer, S. G. (2016). A pragmatic implementation of a 6-day physiotherapy service in a mixed inpatient rehabilitation unit. *Disabil Rehabil*, 1-6. doi:10.1080/09638288.2016.1211181

Chalmers, I. (2003). Trying to do more Good than Harm in Policy and Practice: The Role of Rigorous, Transparent, Up-to-Date Evaluations. *The ANNALS of the American Academy of Political and Social Science, 589*(1), 22-40. doi:10.1177/0002716203254762

Chalmers, I. (2005). If evidence-informed policy works in practice, does it matter if it doesn't work in theory? *Evid Policy, 1*. doi:10.1332/1744264053730806

Chambers, D., Grant, R., Warren, E., Pearson, S.-A., & Wilson, P. (2012). Use of evidence from systematic reviews to inform commissioning decisions: a case study. *Evidence & Policy: A Journal of Research, Debate and Practice, 8*(2), 141-148.

Chambers, D., Wilson, P. M., Thompson, C. A., Hanbury, A., Farley, K., & Light, K. (2011). Maximizing the Impact of Systematic Reviews in Health Care Decision Making: A Systematic Scoping Review of Knowledge-Translation Resources. *Milbank quarterly, 89*(1), 131-156.

Champagne, F., Lemieux-Charles, L., Duranceau, M.-F., MacKean, G., & Reay, T. (2014). Organizational impact of evidence-informed decision making training initiatives: a case study comparison of two approaches. *Implementation Science, 9*(1), 53.

Chan, A.-W., Tetzlaff, J. M., Gøtzsche, P. C., Altman, D. G., Mann, H., Berlin, J. A., . . . Moher, D. (2013). SPIRIT 2013 explanation and elaboration: guidance for protocols of clinical trials. *BMJ : British Medical Journal, 346*. doi:10.1136/bmj.e7586

Chan, L., Mackintosh, J., & Dobbins, M. (2017). How the "Understanding Research Evidence" Web-Based Video Series From the National Collaborating Centre for Methods and Tools Contributes to Public Health Capacity to Practice Evidence-Informed Decision Making: Mixed-Methods Evaluation. *Journal of Medical Internet Research, 19*(9), e286. doi:10.2196/jmir.6958

Charness, G., Gneezy, U., & Kuhn, M. A. (2012). Experimental methods: Between-subject and within-subject design. *Journal of Economic Behavior & Organization, 81*(1), 1-8.

Cheater, F., Baker, R., Gillies, C., Hearnshaw, H., Flottorp, S., Robertson, N., . . . Oxman, A. D. (2005). Tailored interventions to overcome identified barriers to change: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*(3). doi:10.1002/14651858.CD005470

Chew, S., Armstrong, N., & Martin, G. (2013). Institutionalising knowledge brokering as a sustainable knowledge translation solution in healthcare: how can it work in practice? *Evid Policy, 9*. doi:10.1332/174426413x662734

Chow, K. M., & Szeto, C. C. (2005). Impact of enforcing the Labour Ordinance, with 1-in-7-day off for hospital doctors, on weekend hospital discharge rate. *Journal of public health, 27*(2), 189-191.

Cifu, D. X., Kreutzer, J. S., Kolakowsky-Hayner, S. A., Marwitz, J. H., & Englander, J. The relationship between therapy intensity and rehabilitative outcomes after traumatic brain injury: a multicenter analysis. *Archives of physical medicine and rehabilitation, 84*(10), 1441-1448. doi:10.1016/S0003-9993(03)00272-7

Ciliska, D., Dobbins, M., & Thomas, H. (2008). Using systematic reviews in health services. *Reviewing research evidence for nursing practice: Systematic reviews*, 243-253. doi:10.1002/9780470692127.ch16

Ciliska, D., Thomas, H., & Buffett, C. (2008). A compendium of critical appraisal tools for public health practice. *National Collaborating Centre for*

Methods and Tools.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (Vol. 2). United States of America Lawrence Earlbaum Associates.

Corace, K., & Garber, G. (2014). When knowledge is not enough: Changing behavior to change vaccination results. *Human vaccines & immunotherapeutics, 10*(9), 2623-2624.

Corace, K., & Garber, G. (2014). When knowledge is not enough: changing behavior to change vaccination results. *Human Vaccines and Immunotherapeutics, 10*(9), 2623-2624. doi:10.4161/21645515.2014.970076

Courtney, K. O., Joe, G. W., Rowan-Szal, G. A., & Simpson, D. D. (2007). Using organizational assessment as a tool for program change. *Journal of Substance Abuse Treatment, 33*(2), 131-137. doi:10.1016/j.jsat.2006.12.024

Covidence. (2018). Retrieved from https://www.covidence.org/

Critical Appraisals Skills Programme (CASP). (2017). NHS Critical Appraisal Skills Programme (CASP): appraisal tools. Retrieved from http://www.casp-uk.net/casp-tools-checklists

Curran, G. M., Bauer, M., Mittman, B., Pyne, J. M., & Stetler, C. (2012). Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. *Med Care, 50*(3), 217-226. doi:10.1097/MLR.0b013e3182408812

Currie, G., Finn, R., & Martin, G. (2007). Spanning boundaries in pursuit of effective knowledge sharing within networks in the NHS. *Journal of Health Organization and Management, 21*(4/5), 406-417. doi:10.1108/14777260710778934

Dagenais, C., Laurendeau, M.-C., & Briand-Lamarche, M. (2015). Knowledge brokering in public health: A critical analysis of the results of a qualitative evaluation. *Evaluation and Program Planning, 53*, 10-17. doi:https://doi.org/10.1016/j.evalprogplan.2015.07.003

Dagenais, C., Somé, T. D., Boileau-Falardeau, M., McSween-Cadieux, E., & Ridde, V. (2015). Collaborative development and implementation of a knowledge brokering program to promote research use in Burkina Faso, West Africa. *Global health action, 8*. doi:10.3402/gha.v8.26004

Damschroder, L. J., Aron, D. C., Keith, R. E., Kirsh, S. R., Alexander, J. A., & Lowery, J. C. (2009). Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation Science, 4*(1), 50. doi:10.1186/1748-5908-4-50

David, C., Price, N., Price, T., Sheeran, T., & Mulherin, D. (2003). Impact of weekend physiotherapy delivery on the throughput of rheumatology inpatients: Feasibility study. *Physiotherapy, 89*(1), 25-29. doi:http://doi.org/10.1016/S0031-9406(05)60666-9

Davidson, I., Hillier, V. F., Waters, K., Walton, T., & Booth, J. (2005). A study to assess the effect of nursing interventions at the weekend for people with stroke. *Clin Rehabil, 19*(2), 126-137. doi:10.1191/0269215505cr841oa

Davies, P. (2012). The state of evidence-based policy evaluation and its role in policy formation. *National Institute Economic Review, 219*(1), R41-R52. doi:10.1177/002795011221900105

Davis, D., Davis, M. E., Jadad, A., Perrier, L., Rath, D., Ryan, D., . . . Zwarenstein, M. (2003). The case for knowledge translation: shortening the journey from evidence to effect. *BMJ, 327*(7405), 33-35. doi:10.1136/bmj.327.7405.33

Davis, D. A., Thomson, M. A., Oxman, A. D., & Haynes, B. R. (1995). Changing physician performance: a systematic review of the effect of continuing medical education strategies. *Jama, 274*(9), 700-705.

Department of Health and Human Services. (2016). *Allied Health Staffing Levels for Health Service Inpatients in Victoria: Phase 1 - Macro Staffing Analysis*. Victoria, Australia Retrieved from https://www2.health.vic.gov.au/health-workforce/allied-health-workforce/resources-for-managers.

Di Noia, J., Schwinn, T. M., Dastur, Z. A., & Schinke, S. P. (2003). The relative efficacy of pamphlets, CD-ROM, and the Internet for disseminating adolescent drug abuse prevention programs: an exploratory study. *Prev Med, 37*(6 Pt 1), 646-653. doi:10.1016/j.ypmed.2003.09.009

DiSotto-Monastero, M., Chen, X., Fisch, S., Donaghy, S., & Gomez, M. (2012). Efficacy of 7 days per week inpatient admissions and rehabilitation therapy. *Archives of physical medicine and rehabilitation, 93*(12), 2165-2169. doi:10.1016/j.apmr.2012.07.003

Diwan, V. K., Wahlstrom, R., Tomson, G., Beermann, B., Sterky, G., & Eriksson, B. (1995). Effects of "group detailing" on the prescribing of lipid-lowering drugs: a randomized controlled trial in Swedish primary care. *J Clin Epidemiol, 48*(5), 705-711.

Dobbins, M., Cockerill, R., & Barnsley, J. (2001). Factors affecting the utilization of systematic reviews: A study of public health decision makers. *International Journal of Technology Assessment in Health Care, 17*(2), 203-214.

Dobbins, M., Cockerill, R., & Barnsley, J. (2001). Factors affecting the utilization systematic reviews: A study of public health decision-makers. *International Journal of Technological Assessment in Health Care, 17*(2), 203-2014. doi:10.1017/S0266462300105069

Dobbins, M., Cockerill, R., Barnsley, J., & Ciliska, D. (2001). Factors of the innovation, organization, environment, and individual that predict the influence five systematic reviews had on public health decisions. *Int J Technol Assess Health Care, 17*.

Dobbins, M., Cockerill, R., Barnsley, J., & Ciliska, D. (2001). Factors of the innovation, organization, environment, and individual that predict the influence five systematic reviews had on public health decisions. *International Journal of Technological Assessment in Health Care, 17*(4), 467-478.

Dobbins, M., Hanna, S. E., Ciliska, D., Manske, S., Cameron, R., Mercer, S. L., . . . Robeson, P. (2009). A randomized controlled trial evaluating the impact of knowledge translation and exchange strategies. *Implementation Science, 4*(1), 1-16. doi:10.1186/1748-5908-4-61

Dobbins, M., Robeson, P., Ciliska, D., Hanna, S., Cameron, R., & O'Mara, L. (2009). A description of a knowledge broker role implemented as part of a randomized controlled trial evaluating three knowledge translation strategies. *Implement Sci, 4*. doi:10.1186/1748-5908-4-23

Dobbins, M., Rosenbaum, P., Plews, N., Law, M., & Fysh, A. (2007). Information transfer: What do decision makers want and need from researchers? *Implementation Science, 2*, 20. doi:10.1186/1748-5908-2-20

Doig, G. S., Heighes, P. T., Simpson, F., Sweetman, E. A., & Davies, A. R. (2009). Early enteral nutrition, provided within 24 h of injury or intensive care unit admission, significantly reduces mortality in critically ill patients: a meta-analysis of randomised controlled trials. *Intensive Care Med, 35*(12), 2018-2027. doi:10.1007/s00134-009-1664-4

Doig, G. S., Simpson, F., Finfer, S., Delaney, A., Davies, A. R., Mitchell, I., & Dobb, G. (2008). Effect of evidence-based feeding guidelines on mortality of critically ill adults: a cluster randomized controlled trial. *JAMA, 300*(23), 2731-2741. doi:10.1001/jama.2008.826

Donner, A. (1998). Some aspects of the design and analysis of cluster randomization trials. *Journal of the Royal Statistical Society: Series C (Applied Statistics), 47*(1), 95-113. doi:doi:10.1111/1467-9876.00100

Döpp, C. M., Graff, M. J., Rikkert, M. G. M. O., van der Sanden, M. W. N., & Vernooij-Dassen, M. J. (2013). Determinants for the effectiveness of implementing an occupational therapy intervention in routine dementia care. *Implementation Science, 8*(1), 131. doi:10.1186/1748-5908-8-131

Dorning, H., & Bardsley, M. (2014). Focus on: Allied health professionals. *Can we measure quality of care*. doi:10.1108/09534810610676662

Downs, A., Besson, D., Louart, P., Durant, R., Taylor-Bianco, A., & Schermerhorn Jr, J. (2006). Self-regulation, strategic leadership and paradox in organizational change. *Journal of Organizational Change Management, 19*(4), 457-470.

Duan, N., Kravitz, R. L., & Schmid, C. H. (2013). Single-patient (n-of-1) trials: a pragmatic clinical decision methodology for patient-centered comparative effectiveness research. *Journal of Clinical Epidemiology, 66*(8, Supplement), S21-S28. doi:https://doi.org/10.1016/j.jclinepi.2013.04.006

Duckett, S. J., Breadon, P., Weidmann, B., & Nicola, I. (2014). Controlling costly care: a billion dollar hospital opportunity. *Melbourne: Grattan Institute*.

Duncan, C., Hudson, M., & Heck, C. (2015). The impact of increased weekend physiotherapy service provision in critical care: a mixed methods study. *Physiotherapy theory and practice, 31*(8), 547-555. doi:10.3109/09593985.2015.1060657

Eccles, M. P., Grimshaw, J., Walker, A., Johnston, M., & Pitts, N. (2005). Changing the behavior of healthcare professionals: the use of theory in promoting the uptake of research findings. *J Clin Epidemiol, 58*(2), 107-112. doi:10.1016/j.jclinepi.2004.09.002

Eccles, M. P., & Mittman, B. S. (2006). Welcome to Implementation Science. *Implementation Science, 1*, 1-1. doi:10.1186/1748-5908-1-1

Eddy, D. M. (1984). Variations in physician practice: the role of uncertainty. *Health affairs, 3*(2), 74-89. doi:10.1377/hlthaff.3.2.74

Ellen, M. E., Léon, G., Bouchard, G., Ouimet, M., Grimshaw, J. M., & Lavis, J. N. (2014). Barriers, facilitators and views about next steps to implementing supports for evidence-informed decision-making in health systems: a qualitative study. *Implementation Science, 9*(1), 179. doi:10.1186/s13012-014-0179-8

Elshaug, A. G., Moss, J. R., Littlejohns, P., Karnon, J., Merlin, T. L., & Hiller, J. E. (2009). Identifying existing health care services that do not provide value for money. *Medical Journal of Australia, 190*(5), 269-273.

Elshaug, A. G., Watt, A. M., Mundy, L., & Willis, C. D. (2012). Over 150 potentially low-value health care practices: an Australian study. *Medical Journal of Australia, 197*(10), 556-560. doi:10.5694/mja12.11083

Elshaug, A. G., Watt, A. M., Mundy, L., & Willis, C. D. (2012). Over 150 potentially low-value health care practices: an Australian study. *Med J Aust, 197*(10), 556-560.

English, C., Bernhardt, J., Crotty, M., Esterman, A., Segal, L., & Hillier, S. (2015). Circuit class therapy or seven-day week therapy for increasing rehabilitation intensity of therapy after stroke (CIRCIT): a randomized controlled trial. *International Journal of Stroke, 10*(4), 594-602. doi:10.1111/ijs.12470

English, C., Bernhardt, J., & Hillier, S. (2014). Circuit class therapy and 7-day-week therapy increase physiotherapy time, but not patient activity: early results from the CIRCIT trial. *Stroke, 45*(10), 3002-3007. doi:10.1161/strokeaha.114.006038

Fisher, R. J., Gaynor, C., Kerr, M., Langhorne, P., Anderson, C., Bautz-Holter, E., . . . Walker, M. F. (2011). A consensus on stroke: early supported discharge. *Stroke, 42*(5), 1392-1397. doi:10.1161/strokeaha.110.606285

Flanders, S. A., Kaufman, S. R., Saint, S., & Parekh, V. I. (2009). Hospitalists as emerging leaders in patient safety: lessons learned and future directions. *Journal of patient safety, 5*(1), 3-8. doi:10.1097/PTS.0b013e31819751f2

Foy, R., Ovretveit, J., Shekelle, P. G., Pronovost, P. J., Taylor, S. L., Dy, S., . . . Wachter, R. M. (2011). The role of theory in research to develop and evaluate the implementation of patient safety practices. *BMJ Quality and Safety, 20*(5), 453-459. doi:10.1136/bmjqs.2010.047993

Frankfort-Nachmias, C., & Nachmias, D. (2007). *Study guide for research methods in the social sciences*: Macmillan.

Funke J. (2017). How Much Knowledge Is Necessary for Action? In W. B. Meusburger P., Suarsana L., (Ed.), *Knowledge and Action. Knowledge and Space* (Vol. 9): Springer, Cham.

Gagliardi, A. R., Fraser, N., Wright, F. C., Lemieux-Charles, L., & Davis, D. (2008). Fostering knowledge exchange between researchers and decision-makers: exploring the effectiveness of a mixed-methods approach. *Health Policy, 86*(1), 53-63. doi:10.1016/j.healthpol.2007.09.002

Gan, H. W., Wong, D. J. N., Dean, B. J. F., & Hall, A. S. (2017). Do expanded seven-day NHS services improve clinical outcomes? Analysis of comparative institutional performance from the "NHS Services, Seven Days a Week" project 2013-2016. *BMC Health Services Research, 17*(1), 552. doi:10.1186/s12913-017-2505-8

Giguère, A., Légaré, F., Grimshaw, J., Turcotte, S., Fiander, M., Grudniewicz, A., . . . Gagnon, M.-P. (2012). Printed educational materials: effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*(10). doi:10.1002/14651858.CD004398.pub3

Gilfillan, C., Newnham, E., Nagappan, R., Evans, J., & Compton, J. (2016). A 7-day team-based model of care in general medicine: implementation and outcomes at 12 months. *Intern Med J, 46*(1), 79-85. doi:10.1111/imj.12913

Gillespie, L. D., Gillespie, W. J., Robertson, M. C., Lamb, S. E., Cumming, R. G., & Rowe, B. H. (2003). Interventions for preventing falls in elderly people. *Cochrane database of systematic reviews*(4).

Glasgow, R. E., Magid, D. J., Beck, A., Ritzwoller, D., & Estabrooks, P. A. (2005). Practical clinical trials for translating research to practice: design and measurement recommendations. *Med Care, 43*(6), 551-557.

Glasgow, R. E., Vinson, C., Chambers, D., Khoury, M. J., Kaplan, R. M., & Hunter, C. (2012). National Institutes of Health Approaches to Dissemination and Implementation Science: Current and Future Directions. *American journal of public health, 102*(7), 1274-1281. doi:10.2105/ajph.2012.300755

Glasgow, R. E., Vogt, T. M., & Boles, S. M. (1999). Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *American journal of public health, 89*(9), 1322-1327.

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? *Journal of Continuing Education in the Health Professions, 26*(1), 13-24. doi:10.1002/chp.47

Grant, J., Green, L., & Mason, B. (2003). Basic research and health: a reassessment of the scientific basis for the support of biomedical science. *Research Evaluation, 12*(3), 217-224. doi:10.3152/147154403781776618

Green, L. A., & Seifert, C. M. (2005). Translation of research into practice: why we can't "just do it". *The Journal of the American Board of Family Practice, 18*(6), 541-545. doi:10.3122/jabfm.18.6.541

Greening, N. J., Williams, J. E., Hussain, S. F., Harvey-Dunstan, T. C., Bankart, J. M., Chaplin, E. J., . . . Singh, S. J. (2014). An early rehabilitation intervention to enhance recovery during hospital admission for an exacerbation of chronic respiratory disease: randomised controlled trial. *BMJ, 349*, g4315. doi:10.1136/bmj.g4315

Grimshaw, J., Eccles, M., Lavis, J., Hill, S., & Squires, J. (2012). Knowledge translation of research findings. *Implement Sci, 7*.

Grimshaw, J. M., Eccles, M., Thomas, R., MacLennan, G., Ramsay, C., Fraser, C., & Vale, L. (2006). Toward evidence-based quality improvement. *J Gen Intern Med, 21*(S2), S14-S20. doi:10.1111/j.1525-1497.2006.00357.x

Grimshaw, J. M., Eccles, M. P., Lavis, J. N., Hill, S. J., & Squires, J. E. (2012). Knowledge translation of research findings. *Implementation Science, 7*, 50. doi:10.1186/1748-5908-7-50

Grimshaw, J. M., Shirran, L., Thomas, R., Mowatt, G., Fraser, C., Bero, L., . . . O'Brien, M. A. (2001). Changing provider behavior: an overview of systematic reviews of interventions. *Med Care, 39*(8 Suppl 2), Ii2-45.

Grimshaw, J. M., Thomas, R. E., MacLennan, G., Fraser, C., Ramsay, C. R., Vale, L., . . . Donaldson, C. (2004). Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technology Assessment, 8*(6), iii-iv, 1-72.

Grol, R. (2001). Successes and failures in the implementation of evidence-based guidelines for clinical practice. *Med Care, 39*(8), II-46-II-54.

Grol, R., & Grimshaw, J. (2003). From best evidence to best practice: effective implementation of change in patients' care. *The Lancet, 362*(9391), 1225-1230. doi:10.1016/S0140-6736(03)14546-1

Grol, R., & Wensing, M. (2004). What drives change? Barriers to and incentives for achieving evidence-based practice. *Medical Journal of Australia, 180*(6 Suppl), S57.

Groves, T., & Godlee, F. (2008). Innovations in publishing BMJ research. *BMJ, 337*. doi:10.1136/bmj.a3123

Haas, R., O'Brien, L., Bowles, K.-A., & Haines, T. (2018). Effectiveness of a weekend physiotherapy service on short-term outcomes following hip and knee joint replacement surgery: a quasi-experimental study. *Clin Rehabil, 32*(11), 1493-1508. doi:10.1177/0269215518779647

Haas, R., Sarkies, M., Bowles, K.-A., O'Brien, L., & Haines, T. (2016). Early commencement of physical therapy in the acute phase following elective lower limb arthroplasty produces favorable outcomes: a systematic review and meta-analysis examining allied health service models. *Osteoarthritis and Cartilage, 24*(10), 1667-1681. doi:10.1016/j.joca.2016.05.005

Hagedorn, H. J., & Heideman, P. W. (2010). The relationship between baseline Organizational Readiness to Change Assessment subscale scores and implementation of hepatitis prevention services in substance use disorders treatment clinics: a case study. *Implementation Science, 5*(1), 46. doi:10.1186/1748-5908-5-46

Haines, K. J., Kelly, P., Fitzgerald, P., Skinner, E. H., & Iwashyna, T. J. (2017). The Untapped Potential of Patient and Family Engagement in the Organization of Critical Care. *Crit Care Med, 45*(5), 899-906. doi:10.1097/ccm.0000000000002282

Haines, T., Bowles, K., Mitchell, D., O'Brien, L., Markham, D., Plumb, S., . . . Sarkies, M. (2017). Impact of disinvestment from weekend allied health services across acute medical and surgical wards: 2 stepped-wedge cluster randomised controlled trials. *PLoS medicine, 14*(10), e1002412.

Haines, T., O'Brien, L., McDermott, F., Markham, D., Mitchell, D., Watterson, D., & Skinner, E. (2014). A novel research design can aid disinvestment from existing health technologies with uncertain effectiveness, cost-effectiveness, and/or safety. *Journal of Clinical Epidemiology, 67*(2), 144-151. doi:http://dx.doi.org/10.1016/j.jclinepi.2013.08.014

Haines, T. P., Bowles, K.-A., Mitchell, D., O'Brien, L., Markham, D., Plumb, S., . . . Skinner, E. H. (2017). Impact of disinvestment from weekend allied health services across acute medical and surgical wards: 2 stepped-wedge cluster randomised controlled trials. *PLoS medicine, 14*(10), e1002412.

Haines, T. P., Foster, M. M., Cornwell, P., Fleming, J., Tweedy, S., Hart, A., & Mitchell, G. (2010). Impact of Enhanced Primary Care on equitable access to and economic efficiency of allied health services: a qualitative investigation. *Australian Health Review, 34*(1), 30-35. doi:10.1071/AH09732

Haines, T. P., & Hemming, K. (2018). Stepped-wedge cluster-randomised trials: level of evidence, feasibility and reporting. *J Physiother, 64*(1), 63-66. doi:10.1016/j.jphys.2017.11.008

Haines, T. P., Hill, A.-M., Hill, K. D., McPhail, S., Oliver, D., Brauer, S., . . . Beer, C. (2011). Patient education to prevent falls among older hospital inpatients: a randomized controlled trial. *Arch Intern Med, 171*(6), 516-524. doi:10.1001/archinternmed.2010.444

Haines, T. P., Hill, A. M., Hill, K. D., McPhail, S., Oliver, D., Brauer, S., . . . Beer, C. (2011). Patient education to prevent falls among older hospital inpatients: a randomized controlled trial. *Arch Intern Med, 171*(6), 516-524. doi:10.1001/archinternmed.2010.444

Haines, T. P., O'Brien, L., McDermott, F., Markham, D., Mitchell, D., Watterson, D., & Skinner, E. (2014). A novel research design can aid disinvestment from existing health technologies with uncertain effectiveness, cost-effectiveness, and/or safety. *Journal of Clinical Epidemiology, 67*(2), 144-151. doi:http://dx.doi.org/10.1016/j.jclinepi.2013.08.014

Haines, T. P., O'Brien, L., Mitchell, D., Bowles, K.-A., Haas, R., Markham, D., . . . Skinner, E. H. (2015). Study protocol for two randomized controlled trials examining the effectiveness and safety of current weekend allied health services and a new stakeholder-driven model for acute medical/surgical patients versus no weekend allied health services. *Trials, 16*(1), 1. doi:10.1186/s13063-015-0619-z

Hakkennes, S., Lindner, C., & Reid, J. (2015). Implementing an inpatient rehabilitation Saturday service is associated with improved patient outcomes and facilitates patient flow across the health care continuum. *Disabil Rehabil, 37*(8), 721-727. doi:10.3109/09638288.2014.939772

Hanney, S. R., Castle-Clarke, S., Grant, J., Guthrie, S., Henshall, C., Mestre-Ferrandiz, J., . . . Wooding, S. (2015). How long does biomedical research take? Studying the time taken between biomedical and health research and its translation into products, policy, and practice. *Health research policy and systems, 13*(1), 1. doi:10.1186/1478-4505-13-1

Harding, K. E., Porter, J., Horne-Thompson, A., Donley, E., & Taylor, N. F. (2014). Not enough time or a low priority? Barriers to evidence-based practice for allied health clinicians. *Journal of Continuing Education in the Health Professions, 34*(4), 224-231. doi:10.1002/chp.21255

Harris, J. E., & Eng, J. J. (2010). Strength training improves upper-limb function in individuals with stroke: a meta-analysis. *Stroke, 41*(1), 136-140. doi:10.1161/strokeaha.109.567438

Harvey, G., & Kitson, A. (2015). PARIHS revisited: from heuristic to integrated framework for the successful implementation of knowledge into practice. *Implementation Science, 11*(1), 33. doi:10.1186/s13012-016-0398-2

Hasson, H. (2010). Systematic evaluation of implementation fidelity of complex interventions in health and social care. *Implementation Science, 5*(1), 67. doi:10.1186/1748-5908-5-67

Hawe, P., Shiell, A., & Riley, T. (2004). Complex interventions: how "out of control" can a randomised controlled trial be? *BMJ, 328*(7455), 1561-1563. doi:10.1136/bmj.328.7455.1561

Hawkins, N. G., Sanson-Fisher, R. W., Shakeshaft, A., D'Este, C., & Green, L. W. (2007). The multiple baseline design for evaluating population-based research. *Am J Prev Med, 33*(2), 162-168. doi:10.1016/j.amepre.2007.03.020

Haynes, B., & Haines, A. (1998). Barriers and bridges to evidence-based clinical practice. *BMJ, 317*(7153), 273-276. doi:10.1136/bmj.317.7153.273

Haynes, R. B., & Wilczynski, N. L. (2010). Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: methods of a decision-maker-researcher partnership systematic review. *Implement Sci, 5*, 12. doi:10.1186/1748-5908-5-12

Head, B. W. (2016). Toward more "evidence-informed" policy making? *Public Administration Review, 76*(3), 472-484. doi:10.1111/puar.12475

Health Economics Research Group Office of Health Economics RAND Europe. (2008). *Medical Research: What's it worth? Estimating the economic benefits from medical research in the UK*. Retrieved from https://www.mrc.ac.uk/publications/browse/medical-research-whats-it-worth/

Health, N. S. W. (2001). A Framework for Building Capacity to Improve Health.

Heaton, J., Day, J., & Britten, N. (2015). Collaborative research and the co-production of knowledge for practice: an illustrative case study. *Implementation Science, 11*(1), 20. doi:10.1186/s13012-016-0383-9

Hemming, K., Haines, T. P., Chilton, P. J., Girling, A. J., & Lilford, R. J. (2015). The stepped wedge cluster randomised trial: rationale, design, analysis, and reporting. *BMJ : British Medical Journal, 350*. doi:10.1136/bmj.h391

Heyland, D. K., Dhaliwal, R., Drover, J. W., Gramlich, L., & Dodek, P. (2003). Canadian clinical practice guidelines for nutrition support in mechanically ventilated, critically ill adult patients. *Journal of Parenteral and Enteral Nutrition, 27*(5), 355-373. doi:10.1177/0148607103027005355

Heyland, D. K., Schroter-Noppe, D., Drover, J. W., Jain, M., Keefe, L., Dhaliwal, R., & Day, A. (2003). Nutrition support in the critical care setting: current practice in canadian ICUs--opportunities for improvement? *JPEN J Parenter Enteral Nutr, 27*(1), 74-83. doi:10.1177/014860710302700174

Higgins, J. P., Altman, D. G., Gøtzsche, P. C., Jüni, P., Moher, D., Oxman, A. D., . . . Sterne, J. A. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ, 343*, d5928. doi:10.1136/bmj.d5928

Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ, 327*(7414), 557-560. doi:10.1136/bmj.327.7414.557

Hill, A. M., McPhail, S., Hoffmann, T., Hill, K., Oliver, D., Beer, C., . . . Haines, T. P. (2009). A randomized trial comparing digital video disc with written delivery of falls prevention education for older patients in hospital. *J Am Geriatr Soc, 57*(8), 1458-1463. doi:10.1111/j.1532-5415.2009.02346.x

Hillegass, E., Puthoff, M., Frese, E. M., Thigpen, M., Sobush, D. C., & Auten, B. (2016). Role of physical therapists in the management of individuals at risk for or diagnosed with venous thromboembolism: evidence-based clinical practice guideline. *Physical therapy, 96*(2), 143-166. doi:10.2522/ptj.20150264

Hillegass, E., Puthoff, M., Frese, E. M., Thigpen, M., Sobush, D. C., Auten, B., & for the Guideline Development, G. (2016). Role of Physical Therapists in the Management of Individuals at Risk for or Diagnosed With Venous Thromboembolism: Evidence-Based Clinical Practice Guideline. *Physical Therapy, 96*(2), 143-166. doi:10.2522/ptj.20150264

Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., . . . Michie, S. (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ, 348*. doi:10.1136/bmj.g1687

Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., . . . Michie, S. (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ : British Medical Journal, 348*. doi:10.1136/bmj.g1687

Holdsworth, C., Haines, K. J., Francis, J. J., Marshall, A., O'Connor, D., & Skinner, E. H. (2015). Mobilization of ventilated patients in the intensive care unit: An elicitation study using the theory of planned behavior. *Journal of Critical Care, 30*(6), 1243-1250. doi:10.1016/j.jcrc.2015.08.010

Holland, A. E. (2014). Physiotherapy management of acute exacerbations of chronic obstructive pulmonary disease. *J Physiother, 60*(4), 181-188. doi:https://doi.org/10.1016/j.jphys.2014.08.018

Holland, A. E., Mahal, A., Hill, C. J., Lee, A. L., Burge, A. T., Cox, N. S., . . . McDonald, C. F. (2016). Home-based rehabilitation for COPD using minimal resources: a randomised, controlled equivalence trial. *Thorax*. doi:10.1136/thoraxjnl-2016-208514

Hyder, A. A., Bloom, G., Leach, M., Syed, S. B., & Peters, D. H. (2007). Exploring health systems research and its influence on policy processes in low income countries. *BMC Public Health, 7*, 309-309. doi:10.1186/1471-2458-7-309

Iles, R., & Davidson, M. (2006). Evidence based practice: a survey of physiotherapists' current practice. *Physiotherapy Research International, 11*(2), 93-103. doi:10.1002/pri.328

Implementation Science. (2018). About Implementation Science. Retrieved from http://implementationscience.biomedcentral.com/about

Ingersoll, G. L., Kirsch, J. C., Merk, S. E., & Lightfoot, J. (2000). Relationship of organizational culture and readiness for change to employee commitment to the organization. *Journal of Nursing Administration, 30*(1), 11-20.

Innvær, S., Vist, G., Trommald, M., & Oxman, A. (2002). Health policy-makers' perceptions of their use of evidence: a systematic review. *Journal of Health Services Research and Policy, 7*(4), 239-244. doi:10.1258/135581902320432778

International Committee of Medical Journal Editors (ICMJE). (2004). International Committee of Medical Journal Editors (ICMJE): uniform requirements for manuscripts submitted to biomedical journals: writing and editing for biomedical publication. *Haematologica, 89*(3), 264.

Janesick, V. (2003). The Choreography of Qualitative Research: Minuets, Improvisations, and Crystallization. In N. Denzin & Y. Lincoln (Eds.), *Strategies of Qualitative Inquiry* (2nd ed. ed., pp. 46-79). Thousand Oaks, CA: Sage Publications.

Jansons, P., Robins, L., O'Brien, L., & Haines, T. (2017). Gym-based exercise and home-based exercise with telephone support have similar outcomes when used as maintenance programs in adults with chronic health conditions: a randomised trial. *J Physiother, 63*(3), 154-160. doi:10.1016/j.jphys.2017.05.018

Jernberg, T., Johanson, P., Held, C., Svennblad, B., Lindback, J., & Wallentin, L. (2011). Association between adoption of evidence-based treatment and survival for patients with ST-elevation myocardial infarction. *Jama, 305*. doi:10.1001/jama.2011.522

Jette, D. U., Bacon, K., Batty, C., Carlson, M., Ferland, A., Hemingway, R. D., . . . Volk, D. (2003). Evidence-based practice: beliefs, attitudes, knowledge, and behaviors of physical therapists. *Physical therapy, 83*(9), 786-805.

Jones, H., Jones, N., Walker, D., & Walsh, C. (2009). Strengthening science–policy dialogue in developing countries: a priority for climate change adaptation. *Background Note. London: ODI*.

Jones, N., & Walsh, C. (2008). *Policy briefs as a communication tool for development research*: Overseas development institute (ODI).

Judd, C. M., Westfall, J., & Kenny, D. A. (2012). Treating stimuli as a random factor in social psychology: A new and comprehensive solution to a pervasive but largely ignored problem. *Journal of personality and social psychology, 103*(1), 54.

Kahn, S. R., Shrier, I., & Kearon, C. (2008). Physical activity in patients with deep venous thrombosis: a systematic review. *Thromb Res, 122*(6), 763-773. doi:10.1016/j.thromres.2007.10.011

Karlin, B. E., Ruzek, J. I., Chard, K. M., Eftekhari, A., Monson, C. M., Hembree, E. A., . . . Foa, E. B. (2010). Dissemination of evidence-based psychological treatments for posttraumatic stress disorder in the Veterans Health Administration. *Journal of traumatic stress, 23*(6), 663-673. doi:10.1002/jts.20588

Kazdin, A. E., & Hartmann, D. P. (1978). The simultaneous-treatment design. *Behavior Therapy, 9*(5), 912-922.

Keenan, S. P., Sinuff, T., Burns, K. E., Muscedere, J., Kutsogiannis, J., Mehta, S., . . . Hand, L. (2011). Clinical practice guidelines for the use of noninvasive positive-pressure ventilation and noninvasive continuous positive airway pressure in the acute care setting. *Canadian Medical Association Journal, 183*(3), E195-E214. doi:10.1503/cmaj.100071

Kelly, P., Baker, G., McAdam, C., Milton, K., Richards, J., Foster, C., . . . Mutrie, N. (2016). Critique of 'The physical activity myth' paper: discussion of flawed logic and inappropriate use of evidence. *British Journal of Sports Medicine, 50*(20), 1230-1231. doi:10.1136/bjsports-2015-095120

Kemm, J. (2006). The limitations of 'evidence-based' public health. *J Eval Clin Pract, 12*(3), 319-324. doi:10.1111/j.1365-2753.2006.00600.x

Kinoshita, S., Momosaki, R., Kakuda, W., Okamoto, T., & Abo, M. (2017). Association between 7 days per week rehabilitation and functional recovery of patients with acute stroke: a retrospective cohort study based on the Japan rehabilitation database. *Archives of physical medicine and rehabilitation, 98*(4), 701-706. doi:10.1016/j.apmr.2016.11.004

Kirkpatrick, D. L. (1954). *Evaluating human relations programs for industrial foremen and supervisors*: University of Wisconsin--Madison.

Kirkpatrick, D. L. (1975). *Evaluating training programs: A collection of articles from the Journal of the American Society for Training and Development*: American Society for Training and Development.

Kislov, R., Hodgson, D., & Boaden, R. (2015). Professionals as knowledge brokers: The limits of authority in healthcare collaboration. *Public Administration, 94*(2), 472-489. doi:10.1111/padm.12227

Kislov, R., Wilson, P., & Boaden, R. (2017). The 'dark side' of knowledge brokering. *Journal of Health Services Research and Policy, 22*(2), 107-112. doi:10.1177/1355819616653981

Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: a conceptual framework. *BMJ Quality & Safety, 7*(3), 149-158.

Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: a conceptual framework. *BMJ Quality and Safety, 7*(3), 149-158.

Kitson, A., Rycroft-Malone, J., Harvey, G., McCormack, B., Seers, K., & Titchen, A. (2008). Evaluating the successful implementation of evidence into practice using the PARiHS framework: Theoretical and practical challenges. *Implementation Science, 3*. doi:10.1186/1748-5908-3-1

Kitson, A., Silverston, H., Wiechula, R., Zeitz, K., Marcoionni, D., & Page, T. (2011). Clinical nursing leaders', team members' and service managers' experiences of implementing evidence at a local level. *J Nurs Manag, 19*(4), 542-555. doi:10.1111/j.1365-2834.2011.01258.x

Kitto, S. C., Chesters, J., & Grbich, C. (2008). Quality in qualitative research. *Med J Aust, 188*(4), 243-246.

Klein, R. (2003). Evidence and policy: interpreting the Delphic oracle. *Journal of the Royal Society of Medicine, 96*(9), 429-431. doi:10.1177/014107680309600903

Kotter, J. R. (2007). Leading change-Why transformation efforts fail. *Harvard business review, 85*(1).

Kraft, S. A., Constantine, M., Magnus, D., Porter, K. M., Lee, S. S., Green, M., . . . Cho, M. K. (2017). A randomized study of multimedia informational aids for research on medical practices: Implications for informed consent. *Clin Trials, 14*(1), 94-102. doi:10.1177/1740774516669352

Kreymann, K. G., Berger, M. M., Deutz, N. E., Hiesmayr, M., Jolliet, P., Kazandjiev, G., . . . Spies, C. (2006). ESPEN Guidelines on Enteral Nutrition: Intensive care. *Clin Nutr, 25*(2), 210-223. doi:10.1016/j.clnu.2006.01.021

Kunz, R., Vist, G., & Oxman, A. D. (2007). Randomisation to protect against selection bias in healthcare trials. *Cochrane Database of Systematic Reviews*(2). doi:10.1002/14651858.MR000012.pub2

Kwakkel, G., van Peppen, R., Wagenaar, R. C., Dauphinee, S. W., Richards, C., Ashburn, A., . . . Wellwood, I. (2004). Effects of augmented exercise therapy time after stroke a meta-analysis. *Stroke, 35*(11), 2529-2539. doi:10.1161/01.STR.0000143153.76460.7d

Labonté, R. (2010). Health Systems Governance for health equity: critical reflections. *Revista de salud pública, 12*(1), 62-76.

Ladher, N., & Jarvies, D. (2013). Video abstracts: British Medical Journal Publishing Group.

Laing, S. S., Silver, I. F., York, S., & Phelan, E. A. (2011). Fall prevention knowledge, attitude, and practices of community stakeholders and older adults. *Journal of aging research, 2011*, 395357-395357. doi:10.4061/2011/395357

Landsverk, J., Brown, C. H., Reutz, J. R., Palinkas, L., & Horwitz, S. M. (2011). Design elements in implementation research: a structured review of child welfare and child mental health studies. *Administration and policy in mental health, 38*(1), 54-63. doi:10.1007/s10488-010-0315-y

Lane, H., Sarkies, M., Martin, J., & Haines, T. (2016). Equity in healthcare resource allocation decision making: A systematic review. *Social Science and Medicine, 175*, 11-27. doi:10.1016/j.socscimed.2016.12.012

LaRocca, R., Yost, J., Dobbins, M., Ciliska, D., & Butt, M. (2012). The effectiveness of knowledge translation strategies used in public health: a systematic review. *BMC Public Health, 12*.

LaRocca, R., Yost, J., Dobbins, M., Ciliska, D., & Butt, M. (2012). The effectiveness of knowledge translation strategies used in public health: a systematic review. *BMC Public Health, 12*, 751. doi:10.1186/1471-2458-12-751

Laupattarakasem, W., Laopaiboon, M., Laupattarakasem, P., & Sumananont, C. (2008). Arthroscopic debridement for knee osteoarthritis. *Cochrane Database of Systematic Reviews*(1). doi:10.1002/14651858.CD005118

Lavis, J. N. (2006). Research, public policymaking, and knowledge-translation processes: Canadian efforts to build bridges. *Journal of Continuing Education in the Health Professions, 26*(1), 37-45. doi:10.1002/chp.49

Lavis, J. N. (2009). How can we support the use of systematic reviews in policymaking? *PLoS medicine, 6*(11), e1000141. doi:10.1371/journal.pmed.1000141

Lavis, J. N., Ross, S. E., & Hurley, J. E. (2002). Examining the role of health services research in public policymaking. *Milbank quarterly, 80*(1), 125-154. doi:10.1111/1468-0009.00005

Levit, L., & Patlak, M. (2009). *Ensuring quality cancer care through the oncology workforce: sustaining care in the 21st century: workshop summary*: National Academies Press.

Levy, R. I. (1982). The National Heart, Lung, and Blood Institute. Overview 1980. The Director's Report to the NHLBI Advisory Council. *Circulation, 65*(2), 217-225.

Lewis, C. C., Fischer, S., Weiner, B. J., Stanick, C., Kim, M., & Martinez, R. G. (2015). Outcomes for implementation science: an enhanced systematic review of instruments using evidence-based rating criteria. *Implementation Science, 10*(1), 155. doi:10.1186/s13012-015-0342-x

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., . . . Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Annals of internal medicine, 151*(4), W-65-W-94. doi:10.1371/journal.pmed.1000100

Lillie, E. O., Patay, B., Diamant, J., Issell, B., Topol, E. J., & Schork, N. J. (2011). The n-of-1 clinical trial: the ultimate strategy for individualizing medicine? *Personalized medicine, 8*(2), 161-173. doi:10.2217/pme.11.7

Liu, Z., Tao, X., Chen, Y., Fan, Z., & Li, Y. (2015). Bed Rest versus Early Ambulation with Standard Anticoagulation in The Management of Deep Vein Thrombosis: A Meta-Analysis. *PLoS One, 10*(4), e0121388. doi:10.1371/journal.pone.0121388

Lizarondo, L., Grimmer-Somers, K., & Kumar, S. (2011). A systematic review of the individual determinants of research evidence use in allied health. *Journal of Multidisciplinary Healthcare, 4*, 261-272. doi:10.2147/JMDH.S23144

Lokker, C., McKibbon, K. A., Wilczynski, N. L., Haynes, R. B., Ciliska, D., Dobbins, M., . . . Straus, S. E. (2010). Finding knowledge translation articles in CINAHL. *Stud Health Technol Inform, 160*(Pt 2), 1179-1183. doi:10.3233/978-1-60750-588-4-1179

Lomas, J. (1991). Words without action? The production, dissemination, and impact of consensus recommendations. *Annual Review of Public Health, 12*(1), 41-65. doi:10.1146/annurev.pu.12.050191.000353

Lomas, J., Anderson, G. M., Domnick-Pierre, K., Vayda, E., Enkin, M. W., & Hannah, W. J. (1989). Do practice guidelines guide practice? *New England Journal of Medicine, 321*(19), 1306-1311. doi:10.1056/NEJM198911093211906

Lyons, R., Warner, G., Langille, L., & Phillips, S. J. (2006). Evidence in action, acting on evidence: A casebook of health services and policy research knowledge translation stories. *Canadian Institutes of Health Research, 5*(3), 267-279. doi:10.1332/174426409X463811

Macintyre, S., & Petticrew, M. (2000). Good intentions and received wisdom are not enough. *Journal of epidemiology and Community Health, 54*(11), 802-803. doi:10.1136/jech.54.11.802

Madon, T., Hofman, K., Kupfer, L., & Glass, R. (2007). Public health: implementation science. *Science, 318*(5857), 1728-1729. doi:10.1126/science.1150009

Maidment, Z. L., Hordacre, B. G., & Barr, C. J. (2014). Effect of weekend physiotherapy provision on physiotherapy and hospital length of stay after total knee and total hip replacement. *Australian Health Review, 38*(3), 265-270. doi:10.1071/ah13232

Mansouri, M., & Lockyer, J. (2007). A meta-analysis of continuing medical education effectiveness. *Journal of Continuing Education in the Health Professions, 27*(1), 6-15. doi:10.1002/chp.88

Marinopoulos, S. S., Dorman, T., Ratanawongsa, N., Wilson, L. M., Ashar, B. H., Magaziner, J. L., . . . Bass, E. B. (2007). Effectiveness of continuing medical education. *Evidence Report Technology Assessment (Full Report)*(149), 1-69.

Marks, G. (2013). Monitoring pulmonary rehabilitation and long-term oxygen therapy for people with chronic obstructive pulmonary disease (COPD).

Marti, C., Grosgurin, O., Harbarth, S., Combescure, C., Abbas, M., Rutschmann, O., . . . Garin, N. (2015). Adjunctive corticotherapy for community acquired pneumonia: a systematic review and meta-analysis. *PLoS One, 10*(12), e0144032.

Martin, C. M., Doig, G. S., Heyland, D. K., Morrison, T., Sibbald, W. J., & Network, f. T. S. O. C. C. R. (2004). Multicentre, cluster-randomized clinical trial of algorithms for critical-care enteral and parenteral therapy (ACCEPT). *Canadian Medical Association Journal, 170*(2), 197-204.

May, C. R., Finch, T., Mair, F., Ballini, L., Dowrick, C., Eccles, M., . . . Heaven, B. (2007). Understanding the implementation of complex interventions in health care: the normalization process model. *BMC Health Services Research, 7*(1), 148. doi:10.1186/1472-6963-7-148

May, C. R., Johnson, M., & Finch, T. (2016). Implementation, context and complexity. *Implementation Science, 11*(1), 141. doi:10.1186/s13012-016-0506-3

McCarthy, M. (2016). Falls are leading cause of injury deaths among older people, US study finds. *BMJ, 354*. doi:10.1136/bmj.i5190

McCluskey, A., & Lovarini, M. (2005). Providing education on evidence-based practice improved knowledge but did not change behaviour: a before and after study. *BMC medical education, 5*(1), 40. doi:10.1186/1472-6920-5-40

McKee, M., Britton, A., Black, N., McPherson, K., Sanderson, C., & Bain, C. (1999). Interpreting the evidence: choosing between randomised and non-randomised studies. *BMJ, 319*(7205), 312-315. doi:10.1136/bmj.319.7205.312

McKenzie, J. E., French, S. D., O'Connor, D. A., Grimshaw, J. M., Mortimer, D., Michie, S., . . . Green, S. E. (2008). IMPLEmenting a clinical practice guideline for acute low back pain evidence-based manageMENT in general practice (IMPLEMENT): cluster randomised controlled trial study protocol. *Implement Sci, 3*, 11. doi:10.1186/1748-5908-3-11

McKibbon, K. A., Lokker, C., Wilczynski, N. L., Ciliska, D., Dobbins, M., Davis, D. A., . . . Straus, S. E. (2010). A cross-sectional study of the number and frequency of terms used to refer to knowledge translation in a body of health literature in 2006: a Tower of Babel? *Implementation Science, 5*, 16. doi:10.1186/1748-5908-5-16

McKibbon, K. A., Lokker, C., Wilczynski, N. L., Haynes, R. B., Ciliska, D., Dobbins, M., . . . Straus, S. E. (2012). Search filters can find some but not all knowledge translation articles in MEDLINE: an analytic survey. *J ournal of Clinical Epidemiology, 65*(6), 651-659. doi:10.1016/j.jclinepi.2011.10.014

Menon, A., Korner-Bitensky, N., Kastner, M., McKibbon, K. A., & Straus, S. (2009). Strategies for rehabilitation professionals to move evidence-based knowledge into practice: a systematic review. *J Rehabil Med, 41*(13), 1024-1032. doi:10.2340/16501977-0451

Merlin, T., Weston, A., & Tooher, R. (2009). Extending an evidence hierarchy to include topics other than treatment: revising the Australian 'levels of evidence'. *BMC Med Res Methodol, 9*, 34. doi:10.1186/1471-2288-9-34

Metcalfe, C., Lewin, R., Wisher, S., Perry, S., Bannigan, K., & Moffett, J. K. (2001). Barriers to implementing the evidence base in four NHS therapies: dietitians, occupational therapists, physiotherapists, speech and language therapists. *Physiotherapy, 87*(8), 433-441. doi:10.1016/S0031-9406(05)65462-4

Michie, S., Johnston, M., Abraham, C., Lawton, R., Parker, D., & Walker, A. (2005). Making psychological theory useful for implementing evidence based practice: a consensus approach. *Quality and Safety in Health Care, 14*(1), 26-33. doi:10.1136/qshc.2004.011155

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science : IS, 6*, 42-42. doi:10.1186/1748-5908-6-42

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science, 6*, 42-42. doi:10.1186/1748-5908-6-42

Milat, A. J., Bauman, A., & Redman, S. (2015). Narrative review of models and success factors for scaling up public health interventions. *Implementation Science, 10*(1), 1-11. doi:10.1186/s13012-015-0301-6

Milat, A. J., & Li, B. (2017). Narrative review of frameworks for translating research evidence into policy and practice. *Public Health Research and Practice, 27*(1), 1-13. doi:10.17061/phrp2711704

Milat, A. J., Newson, R., & King, L. (2014). Increasing the scale of population health interventions: a guide. *Health research policy and systems, 12*, 18. doi:10.1186/1478-4505-12-18

Mills, E., Hume, V., & Stiller, K. (2017). Increased allied health services to general and acute medical units decreases length of stay: comparison with a historical cohort. *Australian Health Review, 42*(3), 327-333. doi:10.1071/AH16220

Mills, E., Hume, V., & Stiller, K. (2017). Increased allied health services to general and acute medical units decreases length of stay: comparison with a historical cohort*. *Australian Health Review*, -. doi:https://doi.org/10.1071/AH16220

Mills, E. J., Chan, A.-W., Wu, P., Vail, A., Guyatt, G. H., & Altman, D. G. (2009). Design, analysis, and presentation of crossover trials. *Trials, 10*(1), 27.

Mitchell, D., O'Brien, L., Bardoel, A., & Haines, T. (2017). Challenges, uncertainties and perceived benefits of providing weekend allied health services—a managers' perspective. *BMC Health Services Research, 17*, 118. doi:10.1186/s12913-017-2035-4

Mitchell, D., Raymond, M., Jellett, J., Webb-St Mart, M., Boyd, L., Botti, M., . . . Haines, T. (2018). Where are falls prevention resources allocated by hospitals and what do they cost? A cross sectional survey using semi-structured interviews of key informants at six Australian health services. *Int J Nurs Stud, 86*, 52-59. doi:https://doi.org/10.1016/j.ijnurstu.2018.06.002

Mitton, C., Adair, C. E., McKenzie, E., Patten, S. B., & Perry, B. W. (2007). Knowledge transfer and exchange: review and synthesis of the literature. *Milbank quarterly, 85*(4), 729-768. doi:10.1111/j.1468-0009.2007.00506.x

Moat, K. A., Lavis, J. N., Clancy, S. J., El-Jardali, F., & Pantoja, T. (2014). Evidence briefs and deliberative dialogues: perceptions and intentions to act on what was learnt. *Bulletin of the World Health Organization, 92*(1), 20-28. doi:10.2471/BLT.12.116806

Moher, D., Schulz, K. F., & Altman, D. G. (2001). The CONSORT statement: revised recommendations for improving the quality of reports of parallel group randomized trials. *BMC Med Res Methodol, 1*(1), 2. doi:10.1186/1471-2288-1-2

Monroe, P. A. (2011). Evidence-based policymaking: Insights from policy-minded researchers and research-minded policymakers. *Journal of Marriage and Family*. doi:10.1111/j.1741-3737.2011.00831.x

Morgan, M., & Beech, R. (1990). Variations in lengths of stay and rates of day case surgery: implications for the efficiency of surgical management. *Journal of Epidemiology & Community Health, 44*(2), 90-105. doi:10.1136/jech.44.2.90

Morris, M. E., Murphy, A. T., Watts, J. J., Jolley, D., Campbell, D., Soh, S.-E., . . . Iansek, R. (2015). The Health Profile of People Living with Parkinsonâ s Disease Managed in a Comprehensive Care Setting. *Journal of Aging Science, 3*(2), 1-7. doi:10.4172/2329-8847.1000135

Morris, S. L., Dodd, K. J., & Morris, M. E. (2004). Outcomes of progressive resistance strength training following stroke: a systematic review. *Clin Rehabil, 18*(1), 27-39. doi:10.1191/0269215504cr699oa

Morris, Z. S., Wooding, S., & Grant, J. (2011). The answer is 17 years, what is the question: understanding time lags in translational research. *Journal of the Royal Society of Medicine, 104*(12), 510-520. doi:10.1258/jrsm.2011.110180

Morse, J. M. (2015). Critical analysis of strategies for determining rigor in qualitative inquiry. *Qualitative health research, 25*(9), 1212-1222. doi:10.1177/1049732315588501

Mosadeghrad, A. M. (2014). Factors influencing healthcare service quality. *International Journal of Health Policy and Management, 3*(2), 77-89. doi:10.15171/ijhpm.2014.65

Moullin, J. C., Sabater-Hernández, D., Fernandez-Llimos, F., & Benrimoj, S. I. (2015). A systematic review of implementation frameworks of innovations in healthcare and resulting generic implementation framework. *Health research policy and systems, 13*, 16. doi:10.1186/s12961-015-0005-z

Murray, G. R., Cameron, I. D., & Cumming, R. G. (2007). The consequences of falls in acute and subacute hospitals in Australia that cause proximal femoral fractures. *Journal of the American Geriatrics Society, 55*(4), 577-582. doi:10.1111/j.1532-5415.2007.01102.x

Murthy, L., Shepperd, S., Clarke, M. J., Garner, S. E., Lavis, J. N., Perrier, L., . . . Straus, S. E. (2012). Interventions to improve the use of systematic reviews in decision-making by health system managers, policy makers and clinicians. *Cochrane Database of Systematic Reviews*(9), Cd009401. doi:10.1002/14651858.CD009401.pub2

National Health and Medical Research Council. (2000). Guide to the Development, Implementation and Evaluation of Clinical Practice Guidelines. *Canberra: National Health and Medical Research Council, 88*.

National Health and Medical Research Council. (2008). NHMRC additional levels of evidence and grades for recommendations for developers of guidelines: Stage 2 consultation, National Health and Medical Research Council.

National Health Hospitals Reform Commission. (2009). *A Healthier Future for All Australians: Final Report June 2009*: Department of Health and Ageing.

National Heart, L., and Blood Institute,. (2014). Background: Development and use of study quality assessment tools. US department of Health and Human Services. Retrieved from https://www.nhlbi.nih.gov/node/80102

National Institute of Clinical Excellence (NICE). Improving health and social care through evidence-based guidance. Retrieved from https://www.nice.org.uk/

Neuberger, J. S., Montes, J. H., Woodhouse, C. L., Nazir, N., & Ferebee, A. (2014). Continuing educational needs of APHA members within the professional public health workforce. *J Public Health Manag Pract, 20*(5), 530-533. doi:10.1097/PHH.0b013e3182a9c0f5

Nilsen, P. (2015). Making sense of implementation theories, models and frameworks. *Implementation Science, 10*(1), 53. doi:10.1186/s13012-015-0242-0

Nilsen, P. (2015). Making sense of implementation theories, models and frameworks. *Implementation Science : IS, 10*, 53. doi:10.1186/s13012-015-0242-0

Norton, W. E., Lungeanu, A., Chambers, D. A., & Contractor, N. (2017). Mapping the Growing Discipline of Dissemination and Implementation Science in Health. *Scientometrics, 112*(3), 1367-1390. doi:10.1007/s11192-017-2455-2

Nutley, S. M., Davies, H. T., & Smith, P. C. (2000). *What works?: Evidence-based policy and practice in public services*: MIT Press.

Nutley, S. M., Walter, I., & Davies, H. T. (2007). *Using evidence: How research can inform public services*: Policy press.

O'Brien, L., Mitchell, D., Skinner, E. H., Haas, R., Ghaly, M., McDermott, F., . . . Haines, T. (2017). What makes weekend allied health services effective and cost-effective (or not) in acute medical and

surgical wards? Perceptions of medical, nursing, and allied health workers. *BMC Health Services Research, 17*(1), 345. doi:10.1186/s12913-017-2279-z

Oakley, A., Strange, V., Bonell, C., Allen, E., & Stephenson, J. (2006). Process evaluation in randomised controlled trials of complex interventions. *BMJ, 332*(7538), 413-416. doi:10.1136/bmj.332.7538.413

Ogden, T., & Fixsen, D. L. (2015). Implementation science: a brief overview and a look ahead. *Zeitschrift für Psychologie*(222), 4-11. doi:10.1027/2151-2604/a000160

Oliver, K., Innvar, S., Lorenc, T., Woodman, J., & Thomas, J. (2014). A systematic review of barriers to and facilitators of the use of evidence by policymakers. *BMC Health Services Research, 14*(1), 1-12. doi:10.1186/1472-6963-14-2

Orton, L., Lloyd-Williams, F., Taylor-Robinson, D., O'Flaherty, M., & Capewell, S. (2011). The use of research evidence in public health decision making processes: systematic review. *PLoS One, 6*(7), e21704. doi:10.1371/journal.pone.0021704

Oxman, A. D., Fretheim, A., & Flottorp, S. (2005). The OFF theory of research utilization. *Journal of Clinical Epidemiology, 58*(2), 113-116. doi:10.1016/j.jclinepi.2004.10.002

Oxman, A. D., Thomson, M. A., Davis, D. A., & Haynes, R. B. (1995). No magic bullets: a systematic review of 102 trials of interventions to improve professional practice. *CMAJ: Canadian Medical Association Journal, 153*(10), 1423-1431.

Palese., A., Tomietto., M., Suhonen., R., Efstathiou., G., Tsangari., H., Merkouris., A., . . . Papastavrou., E. (2011). Surgical patient satisfaction as an outcome of nurses' caring behaviors: a descriptive and correlational study in six European countries. *Journal of Nursing Scholarship, 43*(4), 341-350. doi:doi:10.1111/j.1547-5069.2011.01413.x

Pannucci, C. J., & Wilkins, E. G. (2010). Identifying and Avoiding Bias in Research. *Plastic and reconstructive surgery, 126*(2), 619-625. doi:10.1097/PRS.0b013e3181de24bc

Paramonczyk, A. (2005). Barriers to implementing research in clinical practice. *Can Nurse, 101*(3), 12-15.

Pascoe, D., Sturnieks, D., Close, J., Tiedemann, A., Lord, S., Twomey, D., & Finch, C. (2013). Knowledge outcomes and retention of a university-based falls prevention education program (UniFPEP). *Focus on Health Professional Education: A Multi-disciplinary Journal, 15*(2), 55.

Patey, A. M., Hurt, C. S., Grimshaw, J. M., & Francis, J. J. (2018). Changing behaviour 'more or less'—do theories of behaviour inform strategies for implementation and de-implementation? A critical interpretive synthesis. *Implementation Science, 13*(1), 134. doi:10.1186/s13012-018-0826-6

Peel, C., Brown, C. J., Lane, A., Milliken, E., & Patel, K. (2008). A survey of fall prevention knowledge and practice patterns in home health physical therapists. *Journal of geriatric physical therapy, 31*(2), 64-70.

Peiris, C. L., Shields, N., Brusco, N. K., Watts, J. J., & Taylor, N. F. (2013). Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial. *BMC medicine, 11*(1), 1. doi:10.1186/1741-7015-11-198

Peiris, C. L., Taylor, N. F., & Shields, N. (2012a). Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial. *Archives of physical medicine and rehabilitation, 93*(8), 1365-1370. doi:10.1016/j.apmr.2012.03.004

Peiris, C. L., Taylor, N. F., & Shields, N. (2012b). Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. *Archives of physical medicine and rehabilitation, 92*(9), 1490-1500. doi:10.1016/j.apmr.2011.04.005

Peiris, C. L., Taylor, N. F., & Shields, N. (2012c). Patients value patient-therapist interactions more than the amount or content of therapy during inpatient rehabilitation: a qualitative study. *J Physiother, 58*(4), 261-268. doi:10.1016/s1836-9553(12)70128-5

Pengas, I. P., Khan, W. S., Bennett, C. A., & Rankin, K. S. (2015). Impact of weekend physiotherapy service on the cost effectiveness of elective orthopaedic hip and knee arthroplasty. *Open Orthop J, 9*, 515-519. doi:10.2174/1874325001509010515

Perrier, L., Mrklas, K., Lavis, J. N., & Straus, S. E. (2011). Interventions encouraging the use of systematic reviews by health policymakers and managers: a systematic review. *Implementation Science, 6*, 43. doi:10.1186/1748-5908-6-43

Peters, D. H., Adam, T., Alonge, O., Agyepong, I. A., & Tran, N. (2013). *Implementation research: what it is and how to do it* (Vol. 347).

Petrou, S., & Wolstenholme, J. (2000). A review of alternative approaches to healthcare resource allocation. *Pharmacoeconomics, 18*(1), 33-43. doi:10.2165/00019053-200018010-00004

Phelan, T. (1999). National Statement on Ethical Conduct in Research Involving Humans. *Chisholm Health Ethics Bulletin, 5*(1), 1.

Philip, K. (2015). Allied health: untapped potential in the Australian health system. *Australian Health Review, 39*(3), 244-247. doi:10.1071/AH14194

Phillips, S. J. (2008). Piloting knowledge brokers to promote integrated stroke care in Canada. *Evidence in action, acting on evidence*, 57.

Piantadosi, S. (2005). Crossover designs. *Clinical Trials: A Methodologic Perspective, Second Edition*, 515-527.

Pope, C., Ziebland, S., & Mays, N. (2000). Analysing qualitative data. *BMJ : British Medical Journal, 320*(7227), 114-116.

Poulos, C. J., & Eagar, K. (2007). Determining appropriateness for rehabilitation or other subacute care: is there a role for utilisation review? *Australia and New Zealand Health Policy, 4*(1), 3. doi:10.1186/1743-8462-4-3

Proctor, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., . . . Hensley, M. (2011). Outcomes for Implementation Research: Conceptual Distinctions, Measurement Challenges, and Research Agenda. *Administration and Policy in Mental Health, 38*(2), 65-76. doi:10.1007/s10488-010-0319-7

Proctor, E. K., Powell, B. J., Baumann, A. A., Hamilton, A. M., & Santens, R. L. (2012). Writing implementation research grant proposals: ten key ingredients. *Implementation Science, 7*, 96. doi:10.1186/1748-5908-7-96

Proctor, E. K., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., . . . Hensley, M. (2011). Outcomes for Implementation Research: Conceptual Distinctions, Measurement Challenges, and Research Agenda. *Administration and policy in mental health, 38*(2), 65-76. doi:10.1007/s10488-010-0319-7

Pua, Y.-H. H., Ong, P.-H., Chong, H.-C., & Lo, N.-N. (2011). Sunday physiotherapy reduces inpatient stay in knee arthroplasty: a retrospective cohort study. *Archives of physical medicine and rehabilitation, 92*(6), 880-885. doi:10.1016/j.apmr.2011.01.009

Puhan, M. A., Scharplatz, M., Troosters, T., & Steurer, J. (2005). Respiratory rehabilitation after acute exacerbation of COPD may reduce risk for readmission and mortality–a systematic review. *Respiratory research, 6*(1), 54. doi:10.1186/1465-9921-6-54

Quené, H., & van den Bergh, H. (2008). Examples of mixed-effects modeling with crossed random effects and with binomial data. *Journal of Memory and Language, 59*(4), 413-425. doi:https://doi.org/10.1016/j.jml.2008.02.002

Ram, F. S., & Wellington, S. R. (2002). General practitioners use of the Cochrane Library in London. *Primary Care Respiratory Journal, 11*(4), 123-125. doi:10.1038/pcrj.2002.104

Redman, S., Turner, T., Davies, H., Williamson, A., Haynes, A., Brennan, S., . . . Green, S. (2015). The SPIRIT Action Framework: a structured approach to selecting and testing strategies to increase the use of research in policy. *Social Science and Medicine, 136-137*, 147-155. doi:10.1016/j.socscimed.2015.05.009

Reilly, K. L., Reeves, P., Deeming, S., Yoong, S. L., Wolfenden, L., Nathan, N., & Wiggers, J. (2018). Economic analysis of three interventions of different intensity in improving school implementation of a government healthy canteen policy in Australia: costs, incremental and relative cost effectiveness. *BMC Public Health, 18*(1), 378. doi:10.1186/s12889-018-5315-y

Rhodes, K. V., Bisgaier, J., Lawson, C. C., Soglin, D., Krug, S., & Van Haitsma, M. (2013). “Patients who can't get an appointment go to the ER”: access to specialty care for publicly insured children. *Annals of emergency medicine, 61*(4), 394-403. doi:10.1016/j.annemergmed.2012.10.030

Rietbergen, C., & Moerbeek, M. (2011). The design of cluster randomized crossover trials. *Journal of Educational and Behavioral Statistics, 36*(4), 472-490.

Riis, A., Jensen, C. E., Bro, F., Maindal, H. T., Petersen, K. D., Bendtsen, M. D., & Jensen, M. B. (2016). A multifaceted implementation strategy versus passive implementation of low back pain guidelines in

general practice: a cluster randomised controlled trial. *Implementation Science, 11*(1), 143. doi:10.1186/s13012-016-0509-0

Rogers, E. M. (1995). *Diffusion of innovations*. New York: The Free Press.

Rogers, E. M. (2010). *Diffusion of innovations: fourth addition*. New York: Simon and Schuster.

Rose, J. H., O'Toole, E. E., Dawson, N. V., Thomas, C., Connors, A. F., Wenger, N. S., . . . Lynn, J. (2000). Age Differences in Care Practices and Outcomes for Hospitalised Patients with Cancer. *Journal of the American Geriatrics Society, 48*(S1), S25-S32. doi:doi:10.1111/j.1532-5415.2000.tb03137.x

Rosen, A., & Proctor, E. K. (1981). Distinctions between treatment outcomes and their implications for treatment evaluation. *Journal of Consulting and Clinical Psychology, 49*(3), 418. doi:10.1037/0022-006X.49.3.418

Rowley, E., Morriss, R., Currie, G., & Schneider, J. (2012). Research into practice: Collaboration for Leadership in Applied Health Research and Care (CLAHRC) for Nottinghamshire, Derbyshire, Lincolnshire (NDL). *Implementation Science, 7*, 40. doi:10.1186/1748-5908-7-40

Runciman, W. B., Hunt, T. D., Hannaford, N. A., Hibbert, P. D., Westbrook, J. I., Coiera, E. W., . . . Braithwaite, J. (2012). CareTrack: assessing the appropriateness of health care delivery in Australia. *Medical Journal of Australia, 197*(10), 549. doi: 10.5694/mja12.10510

Rutterford, C., Copas, A., & Eldridge, S. (2015). Methods for sample size determination in cluster randomized trials. *International Journal of Epidemiology, 44*(3), 1051-1067. doi:10.1093/ije/dyv113

Rycroft-Malone, J., Seers, K., Titchen, A., Harvey, G., Kitson, A., & McCormack, B. (2004). What counts as evidence in evidence-based practice? *Journal of advanced nursing, 47*(1), 81-90.

Sackett, D. L. (1997). *Evidence-based medicine.* Paper presented at the Seminars in perinatology.

Sackett, D. L., Rosenberg, W. M. C., Gray, J. A. M., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: what it is and what it isn't. *BMJ, 312*(7023), 71-72. doi:10.1136/bmj.312.7023.71

Sahota, O., Drummond, A., Kendrick, D., Grainge, M. J., Vass, C., Sach, T., . . . Avis, M. (2014). REFINE (REducing Falls in In-patieNt Elderly) using bed and bedside chair pressure sensors linked to radio-pagers in acute hospital care: a randomised controlled trial. *Age and Ageing, 43*(2), 247-253. doi:10.1093/ageing/aft155

Said, C. M., Morris, M. E., Woodward, M., Churilov, L., & Bernhardt, J. (2012). Enhancing physical activity in older adults receiving hospital based rehabilitation: a phase II feasibility study. *BMC Geriatr, 12*, 26. doi:10.1186/1471-2318-12-26

Sales, A., Smith, J., Curran, G., & Kochevar, L. (2006). Models, strategies, and tools. Theory in implementing evidence-based findings into health care practice. *J Gen Intern Med, 21 Suppl 2*, S43-49. doi:10.1111/j.1525-1497.2006.00362.x

Salls, J., Dolhi, C., Silverman, L., & Hansen, M. (2009). The use of evidence-based practice by occupational therapists. *Occupational therapy in health care, 23*(2), 134-145. doi:10.1080/07380570902773305

Sarkies, M. N., Bowles, K.-A., Skinner, E. H., Haas, R., Lane, H., & Haines, T. P. (2017). The effectiveness of research implementation strategies for promoting evidence-informed policy and management decisions in healthcare: a systematic review. *Implementation Science, 12*(1), 132. doi:10.1186/s13012-017-0662-0

Sarkies, M. N., Bowles, K.-A., Skinner, E. H., Haas, R., Mitchell, D., O'Brien, L., . . . Haines, T. P. (2016). Do daily ward interviews improve measurement of hospital quality and safety indicators? A prospective observational study. *J Eval Clin Pract*(5), 792-798. doi:10.1111/jep.12543

Sarkies, M. N., Bowles, K.-A., Skinner, E. H., Mitchell, D., Haas, R., Ho, M., . . . O'Brien, L. (2015). Data collection methods in health services research: Hospital length of stay and discharge destination. *Applied clinical informatics, 6*(1), 96. doi:10.4338/ACI-2014-10-RA-0097

Sarkies, M. N., Maloney, S., Symmons, M., & Haines, T. P. (2019). Video strategies improved health professional knowledge across different contexts: a helix counterbalanced randomised controlled study. *Journal of Clinical Epidemiology, 112*, 1-11. doi:10.1016/j.jclinepi.2019.04.003

Sarkies, M. N., Skinner, E. H., Bowles, K.-A., Morris, M., Williams, C., O'Brien, L., . . . Haines, T. P. (2019). A novel counterbalanced implementation study design: methodological description and application to implementation research. *Implementation Science, 14*(1), 45. doi:10.1186/s13012-019-0896-0

Sarkies, M. N., White, J., Henderson, K., Haas, R., Bowles, J., & Evidence Translation in Allied Health (EviTAH) Group. (2018). Additional weekend allied health services reduce length of stay in subacute rehabilitation wards but their effectiveness and cost-effectiveness are unclear in acute general

medical and surgical hospital wards: a systematic review. *J Physiother, 64*(3), 142-158. doi:10.1016/j.jphys.2018.05.004

Sarkies, M. N., White, J., Morris, M. E., Taylor, N. F., Williams, C., O'Brien, L., . . . Haines, T. P. (2018). Implementation of evidence-based weekend service recommendations for allied health managers: a cluster randomised controlled trial protocol. *Implementation Science, 13*(1), 60. doi:10.1186/s13012-018-0752-7

Schilling, P. L., Campbell Jr, D. A., Englesbe, M. J., & Davis, M. M. (2010). A comparison of in-hospital mortality risk conferred by high hospital occupancy, differences in nurse staffing levels, weekend admission, and seasonal influenza. *Med Care, 48*(3), 224-232. doi:10.1097/MLR.0b013e3181c162c0

Schliep, M. E., Alonzo, C. N., & Morris, M. A. (2017). Beyond RCTs: Innovations in research design and methods to advance implementation science. *Evidence-Based Communication Assessment and Intervention*, 1-17.

Schneider, B., Gunnarson, S. K., & Niles-Jolly, K. (1994). Creating the climate and culture of success. *Organizational dynamics, 23*(1), 17-29. doi:10.1016/0090-2616(94)90085-X

Schroeck, J. L., Ruh, C. A., Sellick, J. A., Ott, M. C., Mattappallil, A., & Mergenhagen, K. A. (2015). Factors associated with antibiotic misuse in outpatient treatment for upper respiratory tract infections. *Antimicrobial agents and chemotherapy, 59*(7), 3848-3852. doi:10.1128/AAC.00652-15

Schulz, K. F., Chalmers, I., Hayes, R. J., & Altman, D. G. (1995). Empirical evidence of bias: Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *Jama, 273*(5), 408-412. doi:10.1001/jama.1995.03520290060030

Schweickert, W. D., Pohlman, M. C., Pohlman, A. S., Nigos, C., Pawlik, A. J., Esbrook, C. L., . . . Kress, J. P. Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial. *The Lancet, 373*(9678), 1874-1882. doi:10.1016/S0140-6736(09)60658-9

Scott, S. D., Albrecht, L., O'Leary, K., Ball, G. D., Hartling, L., Hofmeyer, A., . . . Newton, A. S. (2012). Systematic review of knowledge translation strategies in the allied health professions. *Implementation Science, 7*(1), 70. doi:10.1186/1748-5908-7-70

Scrivener, K., Jones, T., Schurr, K., Graham, P. L., & Dean, C. M. (2015). After-hours or weekend rehabilitation improves outcomes and increases physical activity but does not affect length of stay: a systematic review. *J Physiother, 61*(2), 61-67. doi:10.1016/j.jphys.2015.02.017

Shaw, K. D., Taylor, N. F., & Brusco, N. K. (2013). Physiotherapy services provided outside of business hours in Australian hospitals: a national survey. *Physiotherapy Research International, 18*(2), 115-123. doi:10.1002/pri.1537

Shojania, K. G., Showstack, J., & Wachter, R. M. (2001). Assessing hospital quality: a review for clinicians. *Effective Clinical Practice, 4*(2), 82-90.

Shorr, R. I., Chandler, A., Mion, L. C., & et al. (2012). Effects of an intervention to increase bed alarm use to prevent falls in hospitalized patients: A cluster randomized trial. *Annals of internal medicine, 157*(10), 692-699. doi:10.7326/0003-4819-157-10-201211200-00005

Shorr, R. I., Chandler, A. M., Mion, L. C., Waters, T. M., Liu, M., Daniels, M. J., . . . Miller, S. T. (2012). Effects of an intervention to increase bed alarm use to prevent falls in hospitalized patients: a cluster randomized trial. *Annals of internal medicine, 157*(10), 692-699. doi:10.7326/0003-4819-157-10-201211200-00005

Sibbald, B., & Roberts, C. (1998). Understanding controlled trials Crossover trials. *BMJ : British Medical Journal, 316*(7146), 1719-1720.

Siemieniuk, R. C., Meade, M. O., Alonso-Coello, P., & et al. (2015). Corticosteroid therapy for patients hospitalized with community-acquired pneumonia: A systematic review and meta-analysis. *Annals of internal medicine, 163*(7), 519-528. doi:10.7326/M15-0715

Simpson, K. M., Porter, K., McConnell, E. S., Colón-Emeric, C., Daily, K. A., Stalzer, A., & Anderson, R. A. (2013). Tool for evaluating research implementation challenges: a sense-making protocol for addressing implementation challenges in complex research settings. *Implementation Science, 8*(1), 2. doi:10.1186/1748-5908-8-2

Singal, A. G., Higgins, P. D., & Waljee, A. K. (2014). A primer on effectiveness and efficacy trials. *Clin Transl Gastroenterol, 5*, e45. doi:10.1038/ctg.2013.13

Skinner, E. H., Hough, J., Wang, Y. T., Hough, C. R., Southby, A., Snowdon, D. A., . . . Haines, T. P. (2015). Physiotherapy departments in Australian tertiary hospitals regularly participate in and disseminate research results despite a lack of allocated staff: a prospective cross-sectional survey. *Physiotherapy theory and practice, 31*(3), 200-206. doi:10.3109/09593985.2014.982775

Skinner, E. H., Lloyd, M., Janus, E., Ong, M. L., Karahalios, A., Haines, T. P., . . . Karunajeewa, H. (2018). The IMPROVE-GAP Trial aiming to improve evidence-based management of community-acquired pneumonia: study protocol for a stepped-wedge randomised controlled trial. *Trials, 19*(1), 88. doi:10.1186/s13063-017-2407-4

Skinner, E. H., Williams, C. M., & Haines, T. P. (2015). Embedding research culture and productivity in hospital physiotherapy departments: challenges and opportunities. *Australian Health Review, 39*(3), 312-314. doi:10.1071/AH14212

Slade, S. C., Philip, K., & Morris, M. E. (2018). Frameworks for embedding a research culture in allied health practice: a rapid review. *Health research policy and systems, 16*(1), 29. doi:10.1186/s12961-018-0304-2

Smith, R. (1991). Where is the wisdom...? *BMJ, 303*(6806), 798-799.

Soh, S.-E., Morris, M. E., Watts, J. J., McGinley, J. L., & Iansek, R. (2016). Health-related quality of life in people with Parkinson. *Australian Health Review, 40*(6), 613-618. doi:10.1071/ah15113

Soh, S. E., Morris, M. E., Watts, J. J., McGinley, J. L., & Iansek, R. (2016). Health-related quality of life in people with Parkinson. *Aust Health Rev*. doi:10.1071/ah15113

Soumerai, S. B., McLaughlin, T. J., & Avorn, J. (1989). Improving drug prescribing in primary care: a critical analysis of the experimental literature. *The Milbank Quarterly*, 268-317.

Speroff, T., & O'Connor, G. T. (2004). Study designs for PDSA quality improvement research. *Qual Manag Health Care, 13*(1), 17-32.

Spicer, S. (2014). Exploring video abstracts in science journals: An overview and case study.

Stevens, K. (2013). The impact of evidence-based practice in nursing and the next big ideas. *The Online Journal of Issues in Nursing, 18*(2), 4. doi:10.3912/OJIN.Vol18No02Man04

Stevenson, K., Lewis, M., & Hay, E. (2006). Does physiotherapy management of low back pain change as a result of an evidence-based educational programme? *J Eval Clin Pract, 12*(3), 365-375. doi:10.1111/j.1365-2753.2006.00565.x

Stolberg, H. O., Norman, G., & Trop, I. (2004). Randomized Controlled Trials. *American Journal of Roentgenology, 183*(6), 1539-1544. doi:10.2214/ajr.183.6.01831539

Stone, E. G., Morton, S. C., Hulscher, M. E., Maglione, M. A., Roth, E. A., Grimshaw, J. M., . . . Shekelle, P. G. (2002). Interventions that increase use of adult immunization and cancer screening services: a meta-analysis. *Annals of internal medicine, 136*(9), 641-651. doi:10.7326/0003-4819-136-9-200205070-00006

Straus, S. E., Tetroe, J., & Graham, I. (2009). Defining knowledge translation. *Canadian Medical Association Journal, 181*(3-4), 165-168. doi:10.1503/cmaj.081229

Strech, D., Synofzik, M., & Marckmann, G. (2008). How Physicians Allocate Scarce Resources at the Bedside: A Systematic Review of Qualitative Studies. *The Journal of Medicine and Philosophy: A Forum for Bioethics and Philosophy of Medicine, 33*(1), 80-99. doi:10.1093/jmp/jhm007

Strehlenert, H. (2017). *From policy to practice: exploring the implementation of a national policy for improving health and social care.* Karolinska Institutet, Inghesalen, Widerströmska huset, Karolinska Institutet, Solna.

Taylor, N. F., Dodd, K. J., & Damiano, D. L. (2005). Progressive Resistance Exercise in Physical Therapy: A Summary of Systematic Reviews. *Physical therapy, 85*(11), 1208-1223. doi:10.1093/ptj/85.11.1208

Tetroe, J. M., Graham, I. D., Foy, R., Robinson, N., Eccles, M. P., Wensing, M., . . . Grimshaw, J. M. (2008). Health research funding agencies' support and promotion of knowledge translation: an international study. *Milbank quarterly, 86*(1), 125-155. doi:10.1111/j.1468-0009.2007.00515.x

Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Med Res Methodol, 8*, 45. doi:10.1186/1471-2288-8-45

Thornicroft, G., Lempp, H., & Tansella, M. (2011). The place of implementation science in the translational medicine continuum. *Psychological Medicine, 41*(10), 2015-2021. doi:10.1017/S0033291711000109

Titler, M. G. (2008). The evidence for evidence-based practice implementation. In R. Hughes (Ed.), *Patient safety and quality: an evidence-based handbook for nurses*. Rockville: Agency for Healthcare Research and Quality (US).

Traynor, R., DeCorby, K., & Dobbins, M. (2014). Knowledge brokering in public health: a tale of two studies. *Public Health, 128*(6), 533-544. doi:10.1016/j.puhe.2014.01.015

Treweek, S., Oxman, A. D., Alderson, P., Bossuyt, P. M., Brandt, L., Brożek, J., . . . Hill, S. (2013). Developing and evaluating communication strategies to support informed decisions and practice based on evidence (DECIDE): protocol and preliminary results. *Implementation Science, 8*(1), 6. doi:10.1186/1748-5908-8-6

Tricco, A. C., Cardoso, R., Thomas, S. M., Motiwala, S., Sullivan, S., Kealey, M. R., . . . Straus, S. E. (2016). Barriers and facilitators to uptake of systematic reviews by policy makers and health care managers: a scoping review. *Implementation Science, 11*(1), 4. doi:10.1186/s13012-016-0370-1

Trice, H. M., & Beyer, J. M. (1991). Cultural leadership in organizations. *Organization science, 2*(2), 149-169. doi:10.1287/orsc.2.2.149

Trujillo-Santos, J., Perea-Milla, E., Jiménez-Puente, A., Sánchez-Cantalejo, E., Del Toro, J., Grau, E., & Monreal, M. (2005). Bed rest or ambulation in the initial treatment of patients with acute deep vein thrombosis or pulmonary embolism: findings from the RIETE registry. *Chest, 127*(5), 1631-1636. doi:10.1378/chest.127.5.1631

Turnbull, C., Grimmer-Somers, K., Kumar, S., May, E., Law, D., & Ashworth, E. (2009). Allied, scientific and complementary health professionals: a new model for Australian allied health. *Australian Health Review, 33*(1), 27-37. doi:10.1071/AH090027

Uman, L. S. (2011). Systematic reviews and meta-analyses. *Journal of the Canadian Academy of Child and Adolescent Psychiatry, 20*(1), 57-59.

Uneke, C. J., Ndukwe, C. D., Ezeoha, A. A., Uro-Chukwu, H. C., & Ezeonu, C. T. (2015). Implementation of a health policy advisory committee as a knowledge translation platform: the Nigeria experience. *International Journal of Health Policy and Management, 4*(3), 161-168. doi:10.15171/ijhpm.2015.21

Varnava, A. M., Sedgwick, J. E. C., Deaner, A., Ranjadayalan, K., & Timmis, A. D. (2002). Restricted weekend service inappropriately delays discharge after acute myocardial infarction. *Heart, 87*(3), 216-219. doi:10.1136/heart.87.3.216

Victorian Department of Health and Human Services. (2016). *Allied Health: Therapy and Science Disciplines Position Paper*. Victoria, Australia Retrieved from https://www2.health.vic.gov.au/about/publications/policiesandguidelines/allied-health-categories-position-paper.

Voorberg, W. H., Bekkers, V. J., & Tummers, L. G. (2015). A systematic review of co-creation and co-production: Embarking on the social innovation journey. *Public Management Review, 17*(9), 1333-1357. doi:10.1080/14719037.2014.930505

Wacker, J. G. (1998). A definition of theory: research guidelines for different theory-building research methods in operations management. *Journal of operations management, 16*(4), 361-385. doi:10.1016/S0272-6963(98)00019-9

Walker, M. F., Fisher, R. J., Korner-Bitensky, N., McCluskey, A., & Carey, L. (2012). From What We Know to What We Do: Translating Stroke Rehabilitation Research into Practice. *International Journal of Stroke, 8*(1), 11-17. doi:10.1111/j.1747-4949.2012.00974.x

Wallin, L. (2009). Knowledge translation and implementation research in nursing. *International Journal of Nursing Studies, 46*(4), 576-587. doi:10.1016/j.ijnurstu.2008.05.006

Walt, G. (1994). How far does research influence policy? *The European Journal of Public Health, 4*(4), 233-235. doi:10.1093/eurpub/4.4.233

Wan, X., Wang, W., Liu, J., & Tong, T. (2014). Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. *BMC Med Res Methodol, 14*, 135. doi:10.1186/1471-2288-14-135

Waqa, G., Mavoa, H., Snowdon, W., Moodie, M., Nadakuitavuki, R., & Mc Cabe, M. (2013). Participants' perceptions of a knowledge-brokering strategy to facilitate evidence-informed policy-making in Fiji. *BMC Public Health, 13*, 725. doi:10.1186/1471-2458-13-725

Waqa, G., Mavoa, H., Snowdon, W., Moodie, M., Schultz, J., & McCabe, M. (2013). Knowledge brokering between researchers and policymakers in Fiji to develop policies to reduce obesity: a process evaluation. *Implementation Science, 8*, 74. doi:10.1186/1748-5908-8-74

Ward, V., & Hamer, S. (2009). Knowledge brokering: the missing link in the evidence to action chain? *Evid Policy, 5*(3), 267-279. doi:10.1332/174426409x463811

Watson, M. C., Bond, C. M., Grimshaw, J. M., Mollison, J., Ludbrook, A., & Walker, A. E. (2002). Educational strategies to promote evidence-based community pharmacy practice: a cluster randomized controlled trial (RCT). *Fam Pract, 19*(5), 529-536.

Weiner, B. J. (2009). A theory of organizational readiness for change. *Implementation Science, 4*, 67. doi:10.1186/1748-5908-4-67

Weiner, B. J., Amick, H., & Lee, S.-Y. D. (2008). Conceptualization and measurement of organizational readiness for change: a review of the literature in health services research and other fields. *Medical Care Research and Review, 65*(4), 379-436.

Wells, G., Shea, B., O'Connell, D., Peterson, J., Welch, V., Losos, M., & Tugwell, P. (2014). Newcastle-Ottawa quality assessment scale cohort studies.

Wennberg, D. E. (1998). Variation in the delivery of health care: the stakes are high. *Annals of internal medicine, 128*(10), 866-868. doi:10.7326/0003-4819-128-10-199805150-00012

Westfall, J., Kenny, D. A., & Judd, C. M. (2014). Statistical power and optimal design in experiments in which samples of participants respond to samples of stimuli. *Journal of Experimental Psychology: General, 143*(5), 2020.

Westfall, J. M., Mold, J., & Fagnan, L. (2007). Practice-based research—"Blue Highways" on the NIH roadmap. *Jama, 297*(4), 403-406. doi:10.1001/jama.297.4.403

Whelan Berry, K., & Alexander, P. (2005). Creating a culture of excellent service: a scholar and practitioner explore a case of successful change. *Academy of Management, 10*(2), 175-193. doi:10.1080/14697011003795651

Whelan-Berry, K. S., & Somerville, K. A. (2010). Linking change drivers and the organizational change process: A review and synthesis. *Journal of Change Management, 10*(2), 175-193.

Whitten, P., Holtz, B., Meyer, E., & Nazione, S. (2009). Telehospice: reasons for slow adoption in home hospice care. *Journal of telemedicine and telecare, 15*(4), 187-190.

Wiebe, S., Guyatt, G., Weaver, B., Matijevic, S., & Sidwell, C. (2003). Comparative responsiveness of generic and specific quality-of-life instruments. *Journal of Clinical Epidemiology, 56*(1), 52-60.

Williams, C., Miyazaki, K., Borkowski, D., McKinstry, C., Cotchet, M., & Haines, T. (2015). Research capacity and culture of the Victorian public health allied health workforce is influenced by key research support staff and location. *Australian Health Review, 39*(3), 303-311. doi:10.1071/AH14209

Wilson, K. M., Brady, T. J., Lesesne, C., & Translation, N. W. G. o. (2011). Peer reviewed: an organizing framework for translation in public health: the knowledge to action framework. *Preventing chronic disease, 8*(2).

Wilson, M. G., Grimshaw, J. M., Haynes, R. B., Hanna, S. E., Raina, P., Gruen, R., . . . Lavis, J. N. (2015). A process evaluation accompanying an attempted randomized controlled trial of an evidence service for health system policymakers. *Health Research Policy and Systems, 13*(1), 78.

Wilson, P. M., Watt, I. S., & Hardman, G. F. (2001). Survey of medical directors' views and use of the Cochrane Library. *British Journal of Clinical Governance, 6*(1), 34-39. doi:10.1108/14664100110384984

Woolf, S. H., Grol, R., Hutchinson, A., Eccles, M., & Grimshaw, J. (1999). Potential benefits, limitations, and harms of clinical guidelines. *BMJ, 318*(7182), 527-530. doi:10.1136/bmj.318.7182.527

Wright, J., Williams, R., & Wilkinson, J. R. (1998). Development and importance of health needs assessment. *BMJ, 316*(7140), 1310-1313.

Zardo, P., & Collie, A. (2015). Type, frequency and purpose of information used to inform public health policy and program decision-making. *BMC Public Health, 15*(1), 1. doi:10.1186/s12889-015-1581-0

Zwisler, A.-D., Norton, R. J., Dean, S. G., Dalal, H., Tang, L. H., Wingham, J., & Taylor, R. S. (2016). Home-based cardiac rehabilitation for people with heart failure: A systematic review and meta-analysis. *Int J Cardiol, 221*, 963-969. doi:10.1016/j.ijcard.2016.06.207

Appendix 2.1. Chapter 2 systematic review: PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Title page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Abstract page 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Background page 3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Background page 3
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Abstract page 2 Methods page 4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Methods page 4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Methods page 4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Methods page 4

			Supplementary material1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Methods page 5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Methods page 5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Methods page 5 Supplementary material3
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Methods page 5 Supplementary material2
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Methods page 6
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Methods page 6

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Methods page 5
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	Methods page 6
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Results page 6-7 Figure 2.1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow up period) and provide the citations.	Results page 7 Table 2.1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Results page 7-8 Table 2.2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Results page 8-9
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Results page 8-13
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Results page 7-8
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	Results page 9-13
DISCUSSION			

Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Discussion page 13
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Discussion page 14
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Discussion page 15
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Funding page 15

Appendix 2.2. Chapter 2 systematic review: search strategy

Population 1 AND population 2 AND intervention

Population 1	**Population 2**	**Intervention**
Health*	Decision maker*	Knowledge translation OR knowledge transfer OR knowledge implementation OR knowledge utili?ation OR knowledge dissemination OR knowledge adoption OR knowledge change* OR knowledge evaluation OR knowledge use* OR knowledge institutionali?ation OR knowledge communication
Hospital*	Policy maker*	research translation OR research transfer OR research implementation OR research utili?ation OR research dissemination OR research adoption OR research change* OR research evaluation OR research use* OR research institutionali?ation OR research communication
	Manager*	evidence translation OR evidence transfer OR evidence implementation OR evidence utili?ation OR evidence dissemination OR evidence adoption OR evidence change* OR evidence evaluation OR evidence use* OR evidence institutionali?ation OR evidence communication
	Director*	Translation of knowledge OR translation of research OR translation of evidence OR transfer of knowledge OR transfer of research OR transfer of evidence OR systematic review evidence
	Executive*	
	Leader*	
	Public health*	
	Health administrat*	
	Hospital administrat*	
	Health department*	
	Hospital department*	

Scopus 2/02/2016

1	(TITLE-ABS-KEY (**health***) OR TITLE-ABS-KEY (**hospital***)) AND PUBYEAR > **1999**	**3518001**
2	(TITLE-ABS-KEY ('decision maker*') OR TITLE-ABS-KEY ('policy maker*') OR TITLE-ABS-KEY (manager*) OR TITLE-ABS-KEY (director*) OR TITLE-ABS-KEY (executive*) OR TITLE-ABS-KEY (leader*) OR TITLE-ABS-KEY ('public health*') OR TITLE-ABS-KEY ('health administ*') OR TITLE-ABS-KEY ('hospital administ*') OR TITLE-ABS-KEY ('health department*') OR TITLE-ABS-KEY ('hospital department*')) AND PUBYEAR > 1999	**792837**
3	(TITLE-ABS-KEY (**'research translation'**) OR TITLE-ABS-KEY (**'research transfer'**) OR TITLE-ABS-KEY (**'research implementation'**) OR TITLE-ABS-KEY (**'research utili?ation'**) OR TITLE-ABS-KEY (**'research dissemination'**) OR TITLE-ABS-KEY (**'research adoption'**) OR TITLE-ABS-KEY (**'research change*'**) OR TITLE-ABS-KEY (**'research evaluation'**) OR TITLE-ABS-KEY (**'research use*'**) OR TITLE-ABS-KEY (**'research institutionali?ation'**) OR TITLE-ABS-KEY (**'research communication'**) OR TITLE-ABS-KEY (**'Knowledge translation'**) OR TITLE-ABS-KEY (**'Knowledge transfer'**) OR TITLE-ABS-KEY (**'knowledge implementation'**) OR TITLE-ABS-KEY (**'knowledge utili?ation'**) OR TITLE-ABS-KEY (**'knowledge dissemination'**) OR TITLE-ABS-KEY (**'knowledge adoption'**) OR TITLE-ABS-KEY (**'knowledge change*'**) OR TITLE-ABS-KEY (**'knowledge evaluation'**) OR TITLE-ABS-KEY (**'knowledge use*'**) OR TITLE-ABS-KEY (**'knowledge institutionali?ation'**) OR TITLE-ABS-KEY (**'knowledge communication'**) OR TITLE-ABS-KEY (**'evidence translation'**) OR TITLE-ABS-KEY (**'evidence transfer'**) OR TITLE-ABS-KEY (**'evidence implementation'**) OR TITLE-ABS-KEY (**'evidence utili?ation'**) OR TITLE-ABS-KEY (**'evidence dissemination'**) OR TITLE-ABS-KEY (**'evidence adoption'**) OR TITLE-ABS-KEY (**'evidence change*'**) OR TITLE-ABS-KEY (**'evidence evaluation'**) OR TITLE-ABS-KEY (**'evidence use*'**) OR TITLE-ABS-KEY (**'evidence institutionali?ation'**) OR TITLE-ABS-KEY (**'evidence communication'**) OR TITLE-ABS-KEY (**'translation of knowledge'**) OR TITLE-ABS-KEY (**'translation of research'**) OR TITLE-ABS-KEY (**'translation of evidence'**) OR TITLE-ABS-KEY (**'transfer of knowledge'**) OR TITLE-ABS-KEY (**'transfer of research'**) OR TITLE-ABS-KEY (**'translation of evidence'**) OR TITLE-ABS-KEY (**'systematic review evidence'**)) AND PUBYEAR > **1999**	**30628**
4	((TITLE-ABS-KEY (**'research translation'**) OR TITLE-ABS-KEY (**'research transfer'**) OR TITLE-ABS-KEY (**'research implementation'**) OR TITLE-ABS-KEY (**'research utili?ation'**) OR TITLE-ABS-KEY (**'research dissemination'**) OR TITLE-ABS-KEY (**'research adoption'**) OR TITLE-ABS-KEY (**'research change*'**) OR TITLE-ABS-KEY (**'research evaluation'**) OR TITLE-ABS-KEY (**'research use*'**) OR TITLE-ABS-KEY (**'research institutionali?ation'**) OR TITLE-ABS-KEY (**'research communication'**) OR TITLE-ABS-KEY (**'Knowledge translation'**) OR TITLE-ABS-KEY (**'Knowledge transfer'**) OR TITLE-ABS-KEY (**'knowledge implementation'**) OR TITLE-ABS-KEY (**'knowledge utili?ation'**) OR TITLE-ABS-KEY (**'knowledge dissemination'**) OR TITLE-ABS-KEY (**'knowledge adoption'**) OR TITLE-ABS-KEY (**'knowledge change*'**) OR TITLE-ABS-KEY (**'knowledge evaluation'**) OR TITLE-ABS-KEY (**'knowledge**	**2201**

	use*') OR TITLE-ABS-KEY (**'knowledge institutionali?ation'**) OR TITLE-ABS-KEY (**'knowledge communication'**) OR TITLE-ABS-KEY (**'evidence translation'**) OR TITLE-ABS-KEY (**'evidence transfer'**) OR TITLE-ABS-KEY (**'evidence implementation'**) OR TITLE-ABS-KEY (**'evidence utili?ation'**) OR TITLE-ABS-KEY (**'evidence dissemination'**) OR TITLE-ABS-KEY (**'evidence adoption'**) OR TITLE-ABS-KEY (**'evidence change*'**) OR TITLE-ABS-KEY (**'evidence evaluation'**) OR TITLE-ABS-KEY (**'evidence use*'**) OR TITLE-ABS-KEY (**'evidence institutionali?ation'**) OR TITLE-ABS-KEY (**'evidence communication'**) OR TITLE-ABS-KEY (**'translation of knowledge'**) OR TITLE-ABS-KEY (**'translation of research'**) OR TITLE-ABS-KEY (**'translation of evidence'**) OR TITLE-ABS-KEY (**'transfer of knowledge'**) OR TITLE-ABS-KEY (**'transfer of research'**) OR TITLE-ABS-KEY (**'translation of evidence'**) OR TITLE-ABS-KEY (**'systematic review evidence'**)) AND PUBYEAR > **1999**) AND ((TITLE-ABS-KEY (**'decision maker*'**) OR TITLE-ABS-KEY (**'policy maker*'**) OR TITLE-ABS-KEY (**manager***) OR TITLE-ABS-KEY (**director***) OR TITLE-ABS-KEY (**executive***) OR TITLE-ABS-KEY (**leader***) OR TITLE-ABS-KEY (**'public health*'**) OR TITLE-ABS-KEY (**'health administ*'**) OR TITLE-ABS-KEY (**'hospital administ*'**) OR TITLE-ABS-KEY (**'health department*'**) OR TITLE-ABS-KEY (**'hospital department*'**)) AND PUBYEAR > **1999**) AND ((TITLE-ABS-KEY (**health***) OR TITLE-ABS-KEY (**hospital***)) AND PUBYEAR > **1999**)	

Ovid medline 2/02/2016

1	limit 1 to yr='2000 -Current'	1600878
☐ 2	(health* or hospital*).ab,kw,sh,ti.	2802546
☐ 3	('decision maker*' or 'policy maker*' or manager* or director* or executive* or leader* or 'public health*' or 'health administrat*' or 'hospital administrat*' or 'health department*' or 'hospital department*').ab,kw,sh,ti.	399921
☐ 4	('Knowledge translation' or 'knowledge transfer' or 'knowledge implementation' or 'knowledge utili?ation' or 'knowledge dissemination' or 'knowledge adoption' or 'knowledge change*' or 'knowledge evaluation' or 'knowledge use*' or 'knowledge institutionali?ation' or 'knowledge communication' or 'research translation' or 'research transfer' or 'research implementation' or 'research utili?ation' or 'research dissemination' or 'research adoption' or 'research change*' or 'research evaluation' or 'research use*' or 'research institutionali?ation' or 'research communication' or 'evidence translation' or 'evidence transfer' or 'evidence implementation' or 'evidence utili?ation' or 'evidence dissemination' or 'evidence adoption' or	7669

	'evidence change*' or 'evidence evaluation' or 'evidence use*' or 'evidence institutionali?ation' or 'evidence communication' or 'Translation of knowledge' or 'translation of research' or 'translation of evidence' or 'transfer of knowledge' or 'transfer of research' or 'transfer of evidence' or 'systematic review evidence').ab,kw,sh,ti.	
☐ **5**	**1 and 2 and 3 and 4**	**1056**

Articles identified from publication list of experts in the field of implementation science

Author	Institution	Articles Identified
Maureen Dobbins	McMaster University	0
Penelope Fitzpatrick (Beynon)	Institute of Development Studies	1 (Beynon et al., 2012)
Anita Kothari	Western Health Sciences	0
Donna Ciliska	McMaster University	0
Rebecca LaRocca	McMaster University	0
Leslea Peirson	McMaster University	0
John Lavis	McMaster University	2 (Moat et al., 2014; M. G. Wilson et al., 2015)

Articles identified from reference screen of included articles

Reference	Citation ID	Author	Year	Title	Articles Identified
(Brownson et al., 2007)	3813	Brownson	2007	The Effect of Disseminating Evidence based Interventions That Promote Physical Activity to Health Departments	4 (Brownson, Kreuter, Arrington, & True, 2006; Kerner, Rimer, & Emmons, 2005; J. F. Kerner et al., 2005; Oldenburg, Sallis, Ffrench, & Owen, 1999)
(Bullock et al., 2013)	2580	Bullock	2012	The Personal Touch: Exchanging Knowledge Through Manager Placements in Research Teams	2 (Antil, Desrochers, Joubert, & Bouchard, 2003; Lockett et al., 2014)
(D. Campbell et al., 2011)	1156	Campbell	2011	Evidence Check: knowledge brokering to commission research reviews for policy	0
(Chambers et	3819	Chambers	2012	Use of	0

al., 2012)				evidence from systematic reviews to inform commissioning decisions: a case study	
(Champagne et al., 2014)	2472	Champagne	2014	Organizational impact of evidence informed decision making training initiatives: a case study comparison of two approaches	0
(Courtney et al., 2007)	3642	Courtney	2007	Using organizational assessment as a tool for program change	0
(Dagenais, Somé, et al., 2015)	503	Dagenais	2015	Collaborative development and implementation of a knowledge brokering program to promote research use in Burkina Faso, West Africa	0
(Dobbins, Cockerill, Barnsley, et al., 2001)	1315	Dobbins	2001	Factors of the innovation, organization, environment, and individual that predict the influence five systematic reviews had on public health decisions.	1 (Dobbins, Cockerill, & Barnsley, 2001a)
(M. Dobbins, S. E. Hanna, et al., 2009)	2873	Dobbins	2009	A randomized controlled trial evaluating the impact of knowledge	0

				translation and exchange strategies	
(Döpp et al., 2013)	761	Dopp	2013	Determinants for the effectiveness of implementing an occupational therapy intervention in routine dementia care	o
(Flanders et al., 2009)	1551	Flanders	2009	Hospitalists as Emerging Leaders in Patient Safety: Lessons Learned and Future Directions	0
(Gagliardi et al., 2008)	1349	Gagliardi	2008	Fostering knowledge exchange between researchers and decision makers: Exploring the effectiveness of a mixed-methods approach	1 (Ouimet, Amara, Landry, & Lavis, 2007)
(A. Kitson et al., 2011)	470	Kitson	2011	Clinical nursing leaders_, team members_ and service managers_ experiences of implementing evidence at a local level	0
(Uneke et al., 2015)	1676	Uneke	2015	Implementation of a health policy advisory committee as a knowledge translation platform: the Nigeria experience	0

(Waqa, Mavoa, Snowdon, Moodie, Nadakuitavuki, Mc Cabe, et al., 2013)	3862	Waqa	2013	Knowledge brokering between researchers and policymakers in Fiji to develop policies to reduce obesity: a process evaluation	0

Articles identified from systematic reviews

Reference	Author	Title	Year	Journal	Articles Identified
(S. L. Moore, Fischer, & Havranek, 2016)	Moore	Translating Health Services Research into Practice in the Safety Net	2016	Health Services Research	0
(Andrew J. Milat et al., 2015)	Milat	Narrative review of models and success factors for scaling up public health interventions	2015	Implementation Science	0
(Bornbaum et al., 2015)	Bornbaum	Exploring the function and effectiveness of knowledge brokers as facilitators of knowledge translation in health-related settings: a systematic review and thematic analysis	2015	Implementation Science	9 (D. Cameron, Russell, Rivard, Darrah, & Palisano, 2011; D. Campbell et al., 2011; Phillips; P. Robeson, Dobbins, & DeCorby, 2008; J. van Kammen, D. de Savigny, & N. Sewankambo, 2006; Jessika Van Kammen, Carin W Jansen, et al., 2006; Waqa, Mavoa, Snowdon, Moodie, Nadakuitavuki, & Mc Cabe, 2013; Waqa, Mavoa, Snowdon, Moodie, Schultz, et al., 2013; Ward, Smith, & Hamer, 2012)
(Abdullah et al., 2014)	Abdullah	Measuring the Effectiveness of Mentoring as a Knowledge Translation Intervention for	2014	Worldviews on Evidence based Nursing	0

		Implementing Empirical Evidence: A Systematic Review			
(Archambault et al., 2013)	Archambault	Wikis and Collaborative Writing Applications in Health Care: A Scoping Review	2013	J Med Internet Res	0
(Barac, Stein, Bruce, & Barwick, 2014)	Barac	Scoping review of toolkits as a knowledge translation strategy in health	2014	BMC Medical Informatics and Decision making	2 (Laura J Damschroder & Lowery, 2013; Leape et al., 2006)
(Bostrom, Slaughter, Chojecki, & Estabrooks, 2012)	Bostrom	What do we know about knowledge translation in the care of older adults? A scoping review	2012	J Am Med Dir Assocgul	1 (R. CHAMBERS, KNIGHT, & CAMPBELL, 1996)
(L. W. Chambers, Luesby, Brookman, Harris, & Lusk, 2010)	Chambers	The Seniors Health Research Transfer Network knowledge network model: system-wide implementation for health and healthcare of seniors	2010	Healthcare Management Forum	3 (Graham & Tetroe, 2007; Li et al., 2009; Paula Robeson, 2009)
(Lakshmi Murthy et al., 2012)	Murthy	Interventions to improve the use of systematic reviews in decision making by health system managers, policy makers and clinicians	2012	Cochrane Database Syst Rev	8 (Booth & Price, 2000; Ciliska, Hayward, Dobbins, Brunton, & Underwood, 1999b; DeBeck & Kerr, 2010; Gülmezoglu et al., 2004; J. N. Lavis et al., 2011; Mason, Freemantle, & Browning, 2001; Perrier et al., 2011; Rosenbaum, Glenton, & Oxman, 2010)
(G. Moore, Redman, Haines, & Todd, 2011)	Moore	What works to increase the use of research in population health policy and programmes: a review	2011	Evidence & Policy: A Journal of Research, Debate and Practice	2 (Denis, Lomas, & Stipich, 2008; R. S. Taylor, Reeves, Ewings, & Taylor, 2004)
(Williamson, Makkar, McGrath, & Redman, 2015)	Williamson	How Can the Use of Evidence in Mental Health Policy Be Increased? A	2015	Psychiatric Services	9 (Chamberlain et al., 2012; Driedger et al., 2010; Feinberg, Jones, Greenberg,

		Systematic Review			Osgood, & Bontempo, 2010; Glisson, Hemmelgarn, Green, & Williams, 2013; Luck et al., 2009; McGrath, Lingley-Pottie, Emberly, Thurston, & McLean, 2009; Saldana & Chamberlain, 2012; Stark, Innes, Szymczynska, Forrest, & Proctor, 2013; Ward et al., 2012)
(Thompson, Estabrooks, Scott-Findlay, Moore, & Wallin, 2007)	Thompson	Interventions aimed at increasing research use in nursing: a systematic review	2007	Implementation Science	0
(S. D. Scott et al., 2012)	Scott	Systematic review of knowledge translation strategies in the allied health professions	2012	Implement Sci	0
(Ospina et al., 2013)	Ospina	A systematic review of the effectiveness of knowledge translation interventions for chronic noncancer pain management	2013	Pain Research and Management	1 (Ferguson, Holdsworth, & Rafferty, 2010)
(Orton et al., 2011)	Orton	The use of research evidence in public health decision making processes: systematic review	2011	PLoS One	0
(Oliver, Lorenc, & Innvær, 2014)	Oliver	New directions in evidence based policy research: a critical analysis of the literature	2014	Health Res Policy Syst	0
(Oliver, Innvar, et al., 2014)	Oliver	A systematic review of barriers to and facilitators of the use of evidence by policymakers	2014	BMC Health Services Research	1 (D. Chambers et al., 2012)
(Noonan et al., 2014)	Noonan	Knowledge translation and	2014	Spinal cord	0

		implementation in spinal cord injury: a systematic review			
(McCormack et al., 2013)	McCormack	A realist review of interventions and strategies to promote evidence informed healthcare: a focus on change agency	2013	Implement Sci	0
(Gifford, Davies, Edwards, Griffin, & Lybanon, 2007)	Gifford	Managerial leadership for nurses' use of research evidence: an integrative review of the literature	2007	Worldviews on Evidence-Based Nursing	2 (Hodnett et al., 1996; Rutledge & Donaldson, 1995)
(Elueze, 2015)	Elueze	Evaluating the effectiveness of knowledge brokering in health research: a systematised review with some bibliometric information	2015	Health Information & Libraries Journal	5 (Frank et al., 2012; Hamel & Schrecker, 2011; Michaels, 2009; Jessika Van Kammen, Don de Savigny, & Nelson Sewankambo, 2006; Wehrens, Bekker, & Bal, 2010)
(Rebecca LaRocca et al., 2012)	LaRocca	The effectiveness of knowledge translation strategies used in public health: a systematic review.	2012	BMC public health	3 (Barwick, Peters, & Boydell, 2009; Forsetlund et al., 2003; Hanbury, Wallace, & Clark, 2009)
(D. Chambers et al., 2011)	Chambers	Maximizing the Impact of Systematic Reviews in Health Care Decision making: A Systematic Scoping Review of Knowledge-Translation Resources	2011	Milbank Quarterly	5 (D. Chambers, Grant, Warren, Pearson, & Wilson, 2010; Handoll & Madhok, 2001; Packer & Hyde, 2000; Rashiq, Barton, Harstall, Schopflocher, & Taenzer, 2006; Thornton-Jones, Hampshaw, & Soltani, 2002)
(Dagenais et al., 2013)	Dagenais	Knowledge transfer on complex social interventions in public health: a scoping study	2013	PloS one	6 (Adily, Black, Graham, & Ward, 2009; Brownson et al., 2007; Kelly et al., 2000; J. D. Klein et al., 2001; Masuda, Robinson, Elliott, & Eyles,

					2009; McCormick & Tompkins, 1998)
(Bunn & Sworn, 2011)	Bunn	Strategies to promote the impact of systematic reviews on healthcare policy: a systematic review of the literature	2011	Evidence & Policy: A Journal of Research, Debate and Practice	0
(Perrier et al., 2011)	Perrier	Interventions encouraging the use of systematic reviews by health policymakers and managers: a systematic review	2011	Implementation Science	1 (Ciliska, Hayward, Dobbins, Brunton, & Underwood, 1999a)

Appendix 2.3. Chapter 2 systematic review: data extraction form

Study details					
Citation id	Title	Author(s)	Year	Country	Study design

Setting				
Health topic	Health organisation setting	Health organisation inclusion criteria	Health organisation exclusion criteria	Health organisation n

Population			
Population	Population inclusion criteria	Population exclusion criteria	Population n

Demographics							
Baseline decision maker position	n/mean/proportion	Decision maker years experience in role	n/mean/proportion	Decision maker years experience in healthcare	n/mean/proportion	Decision maker education level	n/mean/proportion

Intervention						
Therapeutic health intervention	Implementation control	Control description	Implementation strategy	Number of strategy components	Theoretical framework informing the intervention	Strategy description

Outcome measure/s			
Measurement tool	Is the tool validated?	Follow up period	Loss to follow up

Comments
Comments

Study details					
Citation id	Title	Author(s)	Year	Country	Study design

Setting				
Health topic	Health organisation setting	Health organisation inclusion criteria	Health organisation exclusion criteria	Implementation site n

Population			
Decision maker population	Decision maker inclusion criteria	Decision maker exclusion criteria	Decision maker n

Demographics							
Baseline decision maker position	n/mean/proportion	Years experience in role	n/mean/proportion	Years experience in healthcare	n/mean/proportion	Education level	n/mean/proportion

Intervention														
Therapeutic health intervention	Implementation control	Control description	Implementation strategy (1)	Number of strategy components (1)	Theoretical framework informing the intervention (1)	Strategy description (1)	Implementation strategy (2)	Number of strategy components (2)	Theoretical framework informing the intervention (2)	Strategy description (2)	Implementation strategy (3)	Number of strategy components (3)	Theoretical framework informing the intervention (3)	Strategy description (3)

Outcome measure/s							
Measurement tool	Is the tool validated?	Follow up period	Loss to follow up	Level 1 Kirkpatrick hierarchy	Level 2 Kirkpatrick hierarchy	Level 3 Kirkpatrick hierarchy	Level 4 Kirkpatrick hierarchy

Quantitative results mean scores												
Pre - n (C)	Pre - estimate (C)	Pre - CI lower limit (C)	Pre - CI upper limit (C)	Pre - n (I)	Pre - estimate (I)	Pre - CI lower limit (I)	Pre - CI upper limit (I)	Pre - n (I-2)	Pre - estimate (I-2)	Pre - CI lower limit (I-2)	Pre - CI upper limit (I-2)	p - value

Quantitative results mean scores												
Post - n (C)	Post - estimate (C)	Post - CI lower limit (C)	Post - CI upper limit (C)	Post - n (I)	Post - estimate (I)	Post - CI lower limit (I)	Post - CI upper limit (I)	Post - n (I-2)	Post - estimate (I-2)	Post - CI lower limit (I-2)	Post - CI upper limit (I-2)	p - value

Quantitative results mean scores					
Between SD	Between SD CI lower limit	Between SD CI upper limit	Residual SD	Residual SD CI lower limit	Residual SD CI upper limit

Quantitative results mean scores										
Post - n (C)	Post - mean (C)	Post - SD (C)	Post - n (I)	Post - mean (I)	Post - SD (I)	Post - n (I-2)	Post - mean (I-2)	Post - SD (I-2)	Mean change	P-value

Quantitative results mean scores						
Post - n (all interventions)	Post - mean (all interventions)	Post - SD (all interventions)	t	T-test (I vs C)	T-test (I vs I-2 vs I-3)

Quantitative results proportion										
n (C)	Baseline positive response (C)	Follow up positive response (C)	n (I)	Baseline positive response (I)	Follow up positive response (I)	Proportion change	p-value	Combined baseline response	Combined proportion change	Combined p-value

Regression results						
n (baseline)	n (follow up)	Odds ratio	Standard error	Intercept	b-weight	p-value

Regression results							
Constant (control mean-baseline)	P-value	Time (control difference- baseline and immediate follow up)	P-value	Treatment (difference- baseline project and control)	P-value	DD (impact of intervention)	P-value

Regression results									
Constant (control mean-baseline)	P-value	DD I-1 (impact of intervention)	P-value	DD I-2 (impact of intervention)	P-value	DD I-3 (impact of intervention)	P-value	F-test (P-value)	R-squared

Comments
Comments

Appendix 2.4. Chapter 2 systematic review: reasons for full text exclusion

Study details	Excluded on	Reason
#3468 Translating Health Services Research into Practice in the Safety Net Health Services Research 2016;51(1):16-31 16p Malden, Massachusetts Wiley-Blackwell 2016	28/06/16	Review article
#2330 Narrative review of models and success factors for scaling up public health interventions Implementation Science 2015;10(1):1-11 11p BioMed Central 2015	28/06/16	Review article
#1275 Exploring the function and effectiveness of knowledge brokers as facilitators of knowledge translation in health-related settings: a systematic review and thematic analysis Implementation Science 2015;16():1-12 12p BioMed Central 2015	28/06/16	Review article
#2245 - Abdullah 2014 Abdullah, Ghadah; Rossy, Dianne; Ploeg, Jenny; Davies, Barbara; Higuchi, Kathryn; Sikora, Lindsey; Stacey, Dawn Measuring the Effectiveness of Mentoring as a Knowledge Translation Intervention for Implementing Empirical Evidence: A Systematic Review Worldviews on Evidence based Nursing 2014;11(5):284-300 17p Malden, Massachusetts Wiley-Blackwell 2014	28/06/16	Review article
#1579 - Ahuja 2012 Ahuja, T.; Taylor, S.; Dossa, A.; Vosilla, A.; Pang, W.; Mira, A.; Jennings, S. How collaboration can bring about change: Effective knowledge translation on self-monitoring of blood glucose Canadian Journal of Diabetes October 2012;1)():S4 2012 October	28/06/16	No data reported (e.g. protocol paper, abstract, ect.)
#3240 - Alamri 2015 Alamri, Sultan H.; Kennedy, Courtney C.; Marr, Sharon; Lohfeld, Lynne; Skidmore, Carly J.; Papaioannou, Alexandra Strategies to overcome barriers to implementing osteoporosis and fracture prevention guidelines in long-term care: a qualitative analysis of action plans suggested by front line staff in Ontario, Canada BMC Geriatrics Aug 1 2015;15(): 2015 Aug 1	28/06/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3795 - Archambault 2013 Archambault, Patrick M.; van de Belt, Tom H.; Grajales, Francisco J., III; Faber, Marjan J.; Kuziemsky, Craig E.; Gagnon, Susie; Bilodeau, Andrea; Rioux, Simon; Nelen, Willianne L.; Gagnon, Marie-Pierre; Turgeon, Alexis F.; Aubin, Karine; Gold, Irving; Poitras, Julien; Eysenbach, Gunther; Kremer, Jan A.; Legare, France Wikis and collaborative writing applications in health care: A scoping review Journal of Medical Internet Research Oct 2013;15(10):4-38 2013 Oct	28/06/16	Review article
#1255 - Armstrong 2011 Armstrong, Rebecca; Swinburn, Boyd; Moore, Laurence; Dobbins, Maureen; Anderson, Laurie; Petticrew, Mark; Clark, Rachel; Conning, Rebecca; Moodie, Marj; Carter, Robert An exploratory cluster randomised controlled trial of knowledge translation strategies to support evidence informed decision making in local governments (The KT4LG study). BMC Public Health 2011;11(100968562): 2011	28/06/16	No data reported (e.g. protocol paper, abstract, ect.)
#3118 - Barac 2014 Barac, Raluca; Stein, Sherry; Bruce, Beth; Barwick, Melanie Scoping review of toolkits as a knowledge translation strategy in health. BMC medical informatics and decision making 2014;14():121 2014	28/06/16	Review article
#1653 - Bennett 2013 Bennett, S.; Paina, L.; Ssengooba, F.; Waswa, D.; M'Imunya, J. M. The impact of Fogarty International Center research training programs on public health policy and program development in Kenya and Uganda BMC Public Health 2013;13(1): 2013	28/06/16	Strategy not delivered to a healthcare policy maker or manager
#2899 - Black 2002 Black, N.; Hutchings, A. Reduction in the use of surgery for glue ear: did national guidelines have an impact? Quality & Safety in Health Care 2002;11():121-4	28/06/16	Strategy not delivered to a healthcare policy maker or manager

2002		
#1277 - Bornbaum 2015 Bornbaum, C. C.; Kornas, K.; Peirson, L.; Rosella, L. C. Exploring the function and effectiveness of knowledge brokers as facilitators of knowledge translation in health-related settings: a systematic review and thematic analysis Implement Sci 2015;10(1):162 2015	28/06/16	Review article
#3729 - Bostrom 2012 Bostrom, A. M.; Slaughter, S. E.; Chojecki, D.; Estabrooks, C. A. What Do We Know About Knowledge Translation in the Care of Older Adults? A Scoping Review Journal of the American Medical Directors Association March 2012;13(3):210-219 2012 March	28/06/16	Review article
#3730 - Boström 2012 Boström, A. M.; Slaughter, S. E.; Chojecki, D.; Estabrooks, C. A. What Do We Know About Knowledge Translation in the Care of Older Adults? A Scoping Review Journal of the American Medical Directors Association 2012;13(3):210-219 2012	28/06/16	Review article
#1756 - Boulet 2008 Boulet, L. P. Improving knowledge transfer on chronic respiratory diseases: a Canadian perspective. How to translate recent advances in respiratory diseases into day-to-day care Dec 2008;12(10):758S-763S 2008 Dec	04/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#2229 - Bowen 2006 Bowen, S. Marginalized evidence: Effective knowledge translation strategies for low awareness issues Healthcare Management Forum 2006;19(3):38-44 2006	11/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#1913 - Bregman 2009 Bregman, D.; Korman, A.; Shetach, A.; Shalom, N. An internet-based simulation system for training and development of regional-healthcare-centers managers Studies in Health Technology & Informatics 2009;150():789-93 2009	04/07/16	Does not measure a relevant outcome based on the Kirkpatrick hierarchy evaluation model
#3269 - Brigham 2013 Brigham, L. L. A study of how health visitors exchange knowledge in the context of organisational and policy change Knowledge Management 2013;12(1):17-31 2013	11/07/16	Duplicate publication/data
#494 - Bullock 2012 Bullock, A.; Morris, Z. S.; Atwell, C. Collaboration between health services managers and researchers: making a difference? Journal of health services research & policy Apr 2012;17():2-10 2012 Apr	11/07/16	Duplicate publication/data
#3244 - Bunn 2011 Bunn, Frances; Sworn, Katie Strategies to promote the impact of systematic reviews on healthcare policy: a systematic review of the literature Nov 2011;7(4):403-428 2011 Nov	28/06/16	Review article
#3275 - Caldwell 2012 Caldwell, S. E. M.; Mays, N. Studying policy implementation using a macro, meso and micro frame analysis: the case of the Collaboration for Leadership in Applied Health Research & Care (CLAHRC) programme nationally and in North West London Health Research Policy and Systems 2012;10(): 2012	11/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3608 - Chambers 2010 Chambers, D.; Grant, R.; Warren, E.; Pearson, S. A.; Wilson, P. Use of systematic review evidence to inform local decision making in the National Health Service: a case study of eating disorders. Poster presentation at the Joint Cochrane and Campbell Colloquium; 2010 Oct 18-22; Keystone, Colorado, USA [abstract] Cochrane Database of Systematic Reviews, Supplement 2010;Suppl(Cd000002):63 2010	25/07/16	not a peer-reviewed publication (posters etc)

#3818 - Chambers 2010 Chambers, Duncan; Grant, Rod; Warren, Erica; Pearson, Sally-Anne; Wilson, Paul Use of systematic review evidence to inform local decision making in the National Health Service: a case study of eating disorders 2010;18():22 2010	11/07/16	Duplicate publication/data
#2234 - Chambers 2011 Chambers, D.; Wilson, P. M.; Thompson, C. A.; Hanbury, A.; Farley, K.; Light, K. Maximizing the impact of systematic reviews in health care decision making: A systematic scoping review of knowledge-translation resources Milbank Quarterly March 2011;89(1):131-156 2011 March	04/07/16	Review article
#2472 - Champagne 2014 Champagne F.; Lemieux-Charles L.; Duranceau MF.; MacKean G.; Reay T. Organizational impact of evidence informed decision making training initiatives: a case study comparison of two approaches. Implementation science : IS 2014;9():53 2014	27/10/16	Duplicate publication/data
#95 - Colantonio 2008 Colantonio, A.; Kontos, P. C.; Gilbert, J. E.; Rossiter, K.; Gray, J.; Keightley, M. L. After the crash: research-based theater for knowledge transfer The Journal of continuing education in the health professions 2008;28(3):180-185 United States 2008	04/07/16	Strategy not delivered to a healthcare policy maker or manager
#3021 - Cooke 2013 Cooke, M.; Walker, R. Research, transformational leadership and knowledge translation: A successful formula Scandinavian Journal of Caring Sciences 2013;27(1):1-2 2013	04/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#1458 - Cumpston 2004 Cumpston, M.; Clark, K.; Spithoff, D.; Ohlsson, A. The good news: evidence of the dissemination and influence of Cochrane systematic reviews [abstract] 12th Cochrane Colloquium: Bridging the Gaps; 2004 Oct 2-6; Ottawa, Ontario, Canada 2004;():51-52 2004	11/07/16	No data reported (e.g. protocol paper, abstract, ect.)
#1109 - Dagenais 2013 Dagenais C.; Queuille L.; Ridde V. Evaluation of a knowledge transfer strategy from a user fee exemption program for vulnerable populations in Burkina Faso. Global health promotion Mar 2013;20(1 Suppl):70-9 2013 Mar	11/07/16	Not specific to evidence based decision making
#504 - Dagenais 2015 Dagenais, C.; Some, T. D.; Boileau-Falardeau, M.; McSween-Cadieux, E.; Ridde, V. Collaborative development and implementation of a knowledge brokering program to promote research use in Burkina Faso, West Africa Glob Health Action 2015;8():26004 2015	14/08/16	Duplicate publication/data
#2268 - Davies 2004 Davies, B.; Dobbins, M.; Edwards, N.; Griffin, P.; Ploeg, J.; Skelly, J.; Virani, T. Methods for assessing the sustained use of research evidence in practice [abstract] 12th Cochrane Colloquium: Bridging the Gaps; 2004 Oct 2-6; Ottawa, Ontario, Canada 2004;():121-122 2004	11/07/16	No data reported (e.g. protocol paper, abstract, ect.)
#3443 - D 1999 D., Ciliska; S., Hayward; M., Dobbins; G., Brunton; J., Underwood Transferring public-health nursing research to health-system planning: assessing the relevance and accessibility of systematic reviews. The Canadian journal of nursing research = Revue canadienne de recherche en sciences infirmières 1999;31():23-36 1999	04/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3823 - DeBeck 2010 DeBeck, Kora; Kerr, Thomas The use of knowledge translation and legal proceedings to support evidence based drug policy in Canada: opportunities and ongoing challenges Open Medicine 09/21 03/26/received 04/15/rev-request 06/17/revised 06/27/accepted 2010;4(3):e167-e170 Open Medicine Publications, Inc. 2010 09/21 03/26/received 04/15/rev-request 06/17/revised 06/27/accepted	04/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#2027 - Dobbins 2010 Dobbins M.; DeCorby K.; Robeson P.; Husson H.; Tirilis D.; Greco L.	11/07/16	Does not examine the effect of a research implementation

A knowledge management tool for public health: health-evidence.ca. BMC public health 2010;10():496 2010		strategy on decision making by healthcare policy makers or managers
#83 - Donaldson 2008 Donaldson, N.; Rutledge, D.; Geiser, K.; Henriksen, K.; Battles, J. B.; Keyes, M. A.; Grady, M. L. Advances in Patient Safety Role of the External Coach in Advancing Research Translation in Hospital-Based: Performance Improvement 2008;(): Rockville (MD) Agency for Healthcare Research and Quality (US) 2008	14/08/16	Strategy not delivered to a healthcare policy maker or manager
#395 - El-Jardali 2014 El-Jardali, F.; Lavis, J.; Moat, K.; Pantoja, T.; Ataya, N. Capturing lessons learned from evidence-to-policy initiatives through structured reflection Health Research Policy & Systems 2014;12():2 2014	07/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#1509 - Ellen 2014 Ellen, M. E.; Lavis, J. N.; Wilson, M. G.; Grimshaw, J.; Haynes, R. B.; Ouimet, M.; Raina, P.; Gruen, R. Health system decision makers' feedback on summaries and tools supporting the use of systematic reviews: A qualitative study Evidence and Policy 2014;10(3):337-359 2014	07/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#1094 - Elueze 2015 Elueze, I. N. Evaluating the effectiveness of knowledge brokering in health research: a systematised review with some bibliometric information Health Information & Libraries Journal Sep 2015;32(3):168-81 2015 Sep	04/07/16	Review article
#3290 - Evans 2014 Evans, Sarah; Scarbrough, Harry Supporting knowledge translation through collaborative translational research initiatives: 'Bridging' versus 'blurring' boundary-spanning approaches in the UK CLAHRC initiative Social Science & Medicine Apr 2014;106():119-127 2014 Apr	15/08/16	Does not measure a relevant outcome based on the Kirkpatrick hierarchy evaluation model
#2879 - Falzon 2001 Falzon, L.; Booth, A. REALISE-ing their potential?: implementing local library projects to support evidence based health care...Research Evaluation to Audit Library and Information Support for EBHC Health Information & Libraries Journal 2001;18(2):65-74 10p Malden, Massachusetts Wiley-Blackwell 2001	11/07/16	Duplicate publication/data
#2880 - Falzon 2001 Falzon, L.; Booth, A. REALISE-ing their potential? Implementing local library projects to support evidence based health care Health Information and Libraries Journal Jun 2001 2001;18(2):65-74 2001 Jun 2001	11/07/16	Duplicate publication/data
#57 - Finley 2008 Finley, G. A.; Forgeron, P.; Arnaout, M. Action Research: Developing a Pediatric Cancer Pain Program in Jordan Journal of Pain and Symptom Management 2008;35(4):447-454 2008	06/07/16	Strategy not delivered to a healthcare policy maker or manager
#3829 Frank, John; Frost, Helen; Geddes, Rosemary; Haw, Sally; Jackson, Caroline; Jepson, Ruth; McAteer, John; Mooney, John Experiences of knowledge brokering for evidence informed public health, policy, and practice: 3 years of the Scottish Collaboration for Public Health Research and Policy The Lancet ;380():S39 Elsevier	11/07/16	No data reported (e.g. protocol paper, abstract, ect.)
#393 - Gerrish 2014 Gerrish, Kate; Piercy, Hilary Capacity Development for Knowledge Translation: Evaluation of an Experiential Approach through Secondment Opportunities Worldviews on Evidence based Nursing 2014;11(3):209-216 8p Malden, Massachusetts Wiley-Blackwell 2014	15/08/16	Strategy not delivered to a healthcare policy maker or manager
#2474 - Goldstine 2013 Goldstine, I.; Arratoon, C.; Buckley, N.; Deshpande, A.; Robeson, P. Organizational impact of the canadian guideline for safe and effective use of opioids for chronic non-cancer pain: Survey on opioid policy Pain Research and Management March-April 2013;18 (2)():e36	06/07/16	No data reported (e.g. protocol paper, abstract, ect.)

2013 March-April		
#406 - Hitch 2014 Hitch, Danielle; Rowan, Susan; Nicola-Richmond, Kelli A case study of knowledge brokerage in occupational therapy International Journal of Therapy & Rehabilitation 2014;21(8):389-396 2014	11/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#1671 - Kelly 2012 Kelly, A. M.; Pannifex, J.; Cetiner, E. Implementation and impact of clinical network managed evidence based practice implementation projects in Victorian emergency departments Academic Emergency Medicine June 2012;19 (6)():745-746 2012 June	14/08/16	No data reported (e.g. protocol paper, abstract, ect.)
#2327 - Kislov 2011 Kislov, R. Multiprofessional communities of practice in a large-scale healthcare collaboration: Formation, identity building and knowledge sharing Proceedings of the European Conference on Knowledge Management, ECKM 2011;2():1041-1048 2011	07/07/16	No data reported (e.g. protocol paper, abstract, ect.)
#973 - LaRocca 2012 LaRocca R.; Yost J.; Dobbins M.; Ciliska D.; Butt M. The effectiveness of knowledge translation strategies used in public health: a systematic review. BMC public health 2012;12():751 2012	04/07/16	Review article
#2815 - Mays 2013 Mays, G. P.; Hogg, R. A.; Castellanos-Cruz, D. M.; Hoover, A. G.; Fowler, L. C. Public health research implementation and translation: evidence from practice-based research networks American Journal of Preventive Medicine Dec 2013;45(6):752-62 2013 Dec	15/08/16	specific to evidence based decision making
#2883 - McCormack 2013 McCormack, B.; Rycroft-Malone, J.; Decorby, K.; Hutchinson, A. M.; Bucknall, T.; Kent, B.; Schultz, A.; Snelgrove-Clarke, E.; Stetler, C.; Titler, M.; Wallin, L.; Wilson, V. A realist review of interventions and strategies to promote evidence informed healthcare: a focus on change agency Implement Sci 2013;8():107 2013	04/07/16	Review article
#796 - Morris 2013 Morris, Zoe Slote; Bullock, Alison; Atwell, Christine Developing engagement, linkage and exchange between health services managers and researchers: Experience from the UK Journal of health services research & policy Apr 2013;18():23-29 2013 Apr	15/08/16	Not specific to evidence based decision making
#2016 - Murnaghan 2013 Murnaghan D.; Morrison W.; Griffith EJ.; Bell BL.; Duffley LA.; McGarry K.; Manske S. Knowledge exchange systems for youth health and chronic disease prevention: a tri-provincial case study. Chronic diseases and injuries in Canada Sep 2013;33(4):257-66 2013 Sep	25/07/16	Strategy not delivered to a healthcare policy maker or manager
#1933 - Murthy 2012 Murthy, Lakshmi; Shepperd, Sasha; Clarke Mike, J.; Garner Sarah, E.; Lavis John, N.; Perrier, Laure; Roberts Nia, W.; Straus Sharon, E. Interventions to improve the use of systematic reviews in decision making by health system managers, policy makers and clinicians Cochrane Database of Systematic Reviews 2012;(9): 2012	06/07/16	Review article
#1138 - O'Connor 2015 O'Connor, Patricia; Fearfull, Anne Evaluation of the Scottish Patient Safety Fellowship programme 2008-2013 Clinical Risk 2015;21(2/3):22-30 9p Sage Publications, Ltd. 2015	16/08/16	Strategy not delivered to a healthcare policy maker or manager
#3604 - Orton 2011 Orton, L.; Lloyd-Williams, F.; Taylor-Robinson, D.; O'Flaherty, M.; Capewell, S. The use of research evidence in public health decision making processes: Systematic review PLoS ONE 2011;6(7): 2011	04/07/16	Review article
#3334 - Ospina 2013 Ospina, M. B.; Taenzer, P.; Rashiq, S.; MacDermid, J. C.; Carr, E.; Chojecki, D.; Harstall, C.; Henry, J. L.	04/07/16	Review article

A systematic review of the effectiveness of knowledge translation interventions for chronic noncancer pain management (Provisional abstract) Pain Research and Management 2013;18(6):e129-141 2013		
#3635 - Pettman 2013 Pettman, T. L.; Armstrong, R.; Pollard, B.; Evans, R.; Stirrat, A.; Scott, I.; Davies-Jackson, G.; Waters, E. Using evidence in health promotion in local government: contextual realities and opportunities Health Promot J Austr 2013;24(1):72-5 2013	06/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3850 Phillips, Stephen J PILOTING KNOWLEDGE BROKERS TO PROMOTE INTEGRATED STROKE CARE IN ATLANTIC CANADA Evidence in action, acting on evidence ;():57	16/08/16	No data reported (e.g. protocol paper, abstract, ect.)
#2480 - Pinochet 2011 Pinochet, L. H. C. An organizational view on formulating information security policies in hospitals Mundo da Saude 2011;35(3):278-289 2011	14/08/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3853 - Robeson 2008 Robeson, Paula; Dobbins, Maureen; DeCorby, Kara Life as a knowledge broker in public health Journal of the Canadian Health Libraries Association/Journal de l'Association des bibliothèques de la santé du Canada 2008;29(3):79-82 2008	07/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#138 - Rosen 2000 Rosen R. Applying research to health care policy and practice: medical and managerial views on effectiveness and the role of research. Journal of health services research & policy Apr 2000;5(2):103-8 2000 Apr	06/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3000 - Rushmer 2015 Rushmer, R. K.; Cheetham, M.; Cox, L.; Crosland, A.; Gray, J.; Hughes, L.; Hunter, D. J.; McCabe, K.; Seaman, P.; Tannahill, C.; Graff, P. Research utilisation and knowledge mobilisation in the commissioning and joint planning of public health interventions to reduce alcohol-related harms: a qualitative case design using a cocreation approach (Structured abstract) Health Technology Assessment Database 2015;(1): Health Services and Delivery Research 2015	06/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3420 - Salway 2013 Salway, S.; Turner, D.; Mir, G.; Bostan, B.; Carter, L.; Skinner, J.; Gerrish, K.; Ellison, G. Towards equitable commissioning for our multiethnic society: a mixed-methods qualitative investigation of evidence utilisation by strategic commissioners and public health managers (Structured abstract) Health Technology Assessment Database 2013;(1): Health Services and Delivery Research 2013	06/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3404 - Saul 2013 Saul, Jessie E.; Willis, Cameron D.; Bitz, Jennifer; Best, Allan A time-responsive tool for informing policy making: rapid realist review Implementation Science 2013;8():103 2013	04/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#732 - Stark 2013 Stark, C.; Innes, A.; Szymczynska, P.; Forrest, L.; Proctor, K. Dementia knowledge transfer project in a rural area Rural And Remote Health 2013;13(2):2060-2060 Australia Deakin University 2013	11/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#55 - Sullivan 2013 Sullivan, E.; Hegney, D. G.; Francis, K. An action research approach to practice, service and legislative change 2013;21((Sullivan E., sullivan@dpar.com.au) Department of Nursing and Midwifery, Monash University, Melbourne, Australia):8-13 2013	06/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3858 - Taylor 2004 Taylor, R. S.; Reeves, B. C.; Ewings, P. E.; Taylor, R. J. Critical appraisal skills training for health care professionals: a randomized controlled trial [ISRCTN46272378] BMC Med Educ Dec 7 2004;4(1):30 2004 Dec 7	06/07/16	Strategy not delivered to a healthcare policy maker or manager
#296 - Thamlikitkul 2006 Thamlikitkul, V.	11/07/16	Does not examine the effect of a research implementation

Bridging the gap between knowledge and action for health: Case studies Bulletin of the World Health Organization 2006;84(8):603-607 2006		strategy on decision making by healthcare policy makers or managers
#1323 - Tomm-Bonde 2013 Tomm-Bonde,L.; Schreiber,R.S.; Allan,D.E.; MacDonald,M.; Pauly,B.; Hancock,T. Fading vision: knowledge translation in the implementation of a public health policy intervention Implementation Science 2013 2013;8(): 2013 2013	11/07/16	Intervention is not a research implementation strategy
#789 - Treweek 2013 Treweek, S.; Oxman, A. D.; Alderson, P.; Bossuyt, P. M.; Brandt, L.; Brozek, J.; Davoli, M.; Flottorp, S.; Harbour, R.; Hill, S.; Liberati, A.; Liira, H.; Schunemann, H. J.; Rosenbaum, S.; Thornton, J.; Vandvik, P. O.; Alonso-Coello, P.; Decide Consortium Developing and Evaluating Communication Strategies to Support Informed Decisions and Practice Based on Evidence (DECIDE): protocol and preliminary results Implementation Science 2013;8():6 2013	06/07/16	No data reported (e.g. protocol paper, abstract, ect.)
#1677 - Uneke 2015 Uneke, C. J.; Ezeoha, A. E.; Uro-Chukwu, H. C.; Ezeonu, C. T. Implementation of a mentorship programme on knowledge translation/management to improve policymakers' capacity for evidence informed policymaking for the control of infectious diseases of poverty in Nigeria Tropical Medicine and International Health September 2015;20():141 2015 September	05/10/16	not a peer-reviewed publication (posters etc)
#1374 - Vaandrager 2010 Vaandrager, L.; Klerkx, L.; Naaldenberg, J.; Mareeuw, F. V.; de Regt, W.; Zandvliet, J.; Molleman, G. From knowledge translation and knowledge brokerage towards knowledge co-creation: an innovation systems perspective on the public health knowledge infrastructure in The Netherlands European Journal of Public Health Nov 2010;20():234-234 2010 Nov	11/07/16	No data reported (e.g. protocol paper, abstract, ect.)
#1221 - Yousefi-Nooraie 2015 Yousefi-Nooraie, Reza; Dobbins, Maureen; Marin, Alexandra; Hanneman, Robert; Lohfeld, Lynne The evolution of social networks through the implementation of evidence informed decision making interventions: a longitudinal analysis of three public health units in Canada Implementation Science Dec 3 2015;10(): 2015 Dec 3	25/07/16	Does not examine the effect of a research implementation strategy on decision making by healthcare policy makers or managers
#3848 Does providing timely access and advice on existing reviews of research influence health authority purchasing Public Health Medicine 2000;2():20-24 2000	25/07/2016	Full-text unavailable
Evidence briefs and deliberative dialogues: perceptions and intentions to act on what was learnt Kaelan A Moat,a John N Lavis,b Sarah J Clancy,c Fadi El-Jardalid & Tomas Pantojae for the Knowledge Translation Platform Evaluation study team *Bull World Health Organ* 2014;92:20–28 doi: http://dx.doi.org/10.2471/BLT.12.116806	Included	-
A process evaluation accompanying an attempted randomized controlled trial of an evidence service for health system policymakers Michael G Wilson1,2,3*, Jeremy M Grimshaw4,5, R Brian Haynes3,6, Steven E Hanna3,8,9,10, Parminder Raina3,7, Russell Gruen8, Mathieu Ouimet9,10 and John N Lavis1,2,3,11,12 Health Research Policy and Systems (2015) 13:78 DOI 10.1186/s12961-015-0066-z	Included	-
#3878 - Beynon 2012 Beynon, Penelope; Chapoy, Christelle; Gaarder, Marie; Masset, Edoardo What difference does a policy brief make 2012;(): 2012	Included	-
#3813 - Brownson 2007 Brownson, Ross C.; Ballew, Paula; Brown, Kathrin L.; Elliott, Michael B.; Haire-	Included	-

Joshu, Debra; Heath, Gregory W.; Kreuter, Matthew W. The Effect of Disseminating Evidence based Interventions That Promote Physical Activity to Health Departments American Journal of Public Health 08/29/accepted 2007;97(10):1900-1907 American Public Health Association 2007 08/29/accepted		
#2580 - Bullock 2012 Bullock, A.; Morrisand, Z. S.; Atwell, C. The Personal Touch: Exchanging Knowledge Through Manager Placements in Research Teams Proceedings of the 13th European Conference on Knowledge Management, Vols 1 and 2 2012;():144-151 2012	Included	-
#1156 - Campbell 2011 Campbell, D.; Donald, B.; Moore, G.; Frew, D. Evidence check: Knowledge brokering to commission research reviews for policy Evidence and Policy 2011;7(1):97-107 2011	Included	-
#3819 - Chambers 2012 Chambers, Duncan; Grant, Rod; Warren, Erica; Pearson, Sally-Anne; Wilson, Paul Use of evidence from systematic reviews to inform commissioning decisions: a case study Evidence & Policy: A Journal of Research, Debate and Practice 2012;8(2):141-148 2012	Included	-
#2473 - Champagne 2014 Champagne F.; Lemieux-Charles L.; Duranceau MF.; MacKean G.; Reay T. Organizational impact of evidence informed decision making training initiatives: a case study comparison of two approaches. Implementation science : IS 2014;9():53 2014	Included	-
#3642 - Courtney 2007 Courtney KO.; Joe GW.; Rowan-Szal GA.; Simpson DD. Using organizational assessment as a tool for program change. Journal of substance abuse treatment Sep 2007;33(2):131-7 2007 Sep	Included	-
#503 - Dagenais 2015 Dagenais, C.; Some, T. D.; Boileau-Falardeau, M.; McSween-Cadieux, E.; Ridde, V. Collaborative development and implementation of a knowledge brokering program to promote research use in Burkina Faso, West Africa Glob Health Action 2015;8():26004 2015	Included	-
#3881 - Dobbins 2001 Dobbins, M.; Cockerill, R.; Barnsley, J. Factors affecting the utilization of systematic reviews. A study of public health decision makers Spring 2001;17(2):203-14 2001 Spring	Included	-
#1315 - Dobbins 2001 Dobbins M.; Cockerill R.; Barnsley J.; Ciliska D. Factors of the innovation, organization, environment, and individual that predict the influence five systematic reviews had on public health decisions. International journal of technology assessment in health care 2001;17(4):467-78 2001	Included	-
#2873 - Dobbins 2009 Dobbins, M.; Hanna, S. E.; Ciliska, D.; Manske, S.; Cameron, R.; Mercer, S. L.; O'Mara, L.; DeCorby, K.; Robeson, P. A randomized controlled trial evaluating the impact of knowledge translation and exchange strategies Implementation Science 2009;4():61 2009	Included	-
#761 - Dopp 2013 Dopp,C. M.; Graff,M. J.; Rikkert,M. G.; Nijhuis van der Sanden,M. W.; Vernooij-Dassen,M. J. Determinants for the effectiveness of implementing an occupational therapy intervention in routine dementia care.	Included	-

Implementation Science 2013;8(Journal Article):131 2013		
#1551 - Flanders 2009 Flanders, S. A.; Kaufman, S. R.; Saint, S.; Parekh, V. I. Hospitalists as emerging leaders in patient safety: lessons learned and future directions Journal of patient safety 2009;5(1):3-8 2009	Included	-
#1349 - Gagliardi 2008 Gagliardi AR.; Fraser N.; Wright FC.; Lemieux-Charles L.; Davis D. Fostering knowledge exchange between researchers and decision makers: exploring the effectiveness of a mixed-methods approach. Health policy (Amsterdam, Netherlands) Apr 2008;86(1):53-63 2008 Apr	Included	-
#470 - Kitson 2011 Kitson,Alison; Silverston,Heidi; Wiechula,Rick; Zeitz,Kathryn; Marcoionni,Danni; Page,Tammy Clinical nursing leaders', team members' and service managers' experiences of implementing evidence at a local level. Journal of Nursing Management 2011;19(4):542-556 2011	Included	-
#2005 - Traynor 2014 Traynor R.; DeCorby K.; Dobbins M. Knowledge brokering in public health: a tale of two studies. Public health Jun 2014;128(6):533-44 2014 Jun	Included	-
#1676 - Uneke 2015 Uneke, Chigozie Jesse; Ndukwe, Chinwendu Daniel; Ezeoha, Abel Abeh; Uro-Chukwu, Henry Chukwuemeka; Ezeonu, Chinonyelum Thecla Implementation of a health policy advisory committee as a knowledge translation platform: the Nigeria experience International Journal of Health Policy & Management Mar 2015;4(3):161-8 2015 Mar	Included	-
#3862 - Waqa 2013 Waqa, Gade; Mavoa, Helen; Snowdon, Wendy; Moodie, Marj; Nadakuitavuki, Rigieta; Mc Cabe, Marita; Swinburn, Boyd Participants' perceptions of a knowledge-brokering strategy to facilitate evidence informed policy making in Fiji BMC public health 2013;13(1):725 2013	Included	-
#3863 - Waqa 2013 Waqa, Gade; Mavoa, Helen; Snowdon, Wendy; Moodie, Marj; Schultz, Jimaima; McCabe, Marita; Kremer, Peter; Swinburn, Boyd Knowledge brokering between researchers and policymakers in Fiji to develop policies to reduce obesity: a process evaluation Implement Sci 2013;8():74 2013	Included	-

Appendix 4.1. Chapter 4 systematic review: full search strategy

Search strategy

Population	**AND**	**Intervention 1**	**AND**	**Intervention 2**
Hospital		Allied health		Weekend
OR		**OR**		**OR**
Acute		Physiotherap*		Saturday
OR		**OR**		**OR**
Subacute		Physical therap*		Sunday
OR		**OR**		**OR**
Ward		Occupational therap*		Out of hour
OR		**OR**		**OR**
Inpatient		Speech patholog*		After hour
		OR		**OR**
		Speech therap*		On-call
		OR		**OR**
		Language patholog*		Six day
		OR		**OR**
		Language therap*		6 day
		OR		**OR**
		Nutrition		Seven day
		OR		**OR**
		Dietetic*		7 day
		OR		
		Dietitian		
		OR		
		Dietician		
		OR		
		Social work		
		OR		
		Art therapy		
		OR		
		Chiropractic		
		OR		
		Exercise physiology		
		OR		
		Music therapy		
		OR		
		Oral Health		
		OR		
		Osteopathy		
		OR		
		Podiatry		
		OR		
		Psychology		
		OR		

Allied health assistant

Ovid MEDLINE: all fields (05/05/2017)

Search number	Search terms	Results
1	(hospital* or acute* or sub*acute* or ward* or in*patient*).af.	4445271
2	(allied*health* or physio* or physical*therap* or occupational*therap* or speech*patholog* or speech*therap* or language*patholog* or language*therap* or nutrition* or dietetic* or dietitian* or dietician* or social* or art*therap* or chiropract* or exercise*physiolog* or music*therap* or oral*health* or osteopath* or orthotic* or prosthet* or podiatr* or psycholog* or allied*health*assistant*).af.	6987526
3	(weekend* or saturday* or sunday* or out*of*hour* or after*hour* or on*call* or six*day* or 6*day* or seven*day* or 7*day*).af.	13700
4	1 AND 2 AND 3	1064
5	limit 12 to (english language and yr=‘2000 - Current’)	799

PubMed: all fields (05/05/2017)

Search number	Search terms	Results
1	((((‘hospitals’[MeSH Terms] OR ‘hospitals’[All Fields] OR ‘hospital’[All Fields]) OR ward[All Fields]) OR acute[All Fields]) OR subacute[All Fields]) OR (‘inpatients’[MeSH Terms] OR ‘inpatients’[All Fields] OR ‘inpatient’[All Fields])	All (4670869) English (4122731) 2000-2017 (3213522)
2	((((((((((((((((((((((‘allied health’) OR physiotherapy) OR ‘physical therapy’) OR ‘occupational therapy’) OR ‘speech pathology’) OR ‘speech therapy’) OR ‘language pathology’) OR ‘language therapy’) OR nutrition) OR dietetic) OR dietitian) OR dietician) OR ‘social work’) OR ‘art therapy’) OR chiropractic) OR ‘exercise physiology’) OR ‘music therapy’) OR ‘oral health’) OR osteopathy) OR orthotic) OR prosthetic) OR podiatry) OR psychology) OR ‘allied health assistant’	All (2444427) English (2108103) 2000-2017 (1523794)
3	(((((((weekend[All Fields] OR	All (35598)

	saturday[All Fields]) OR sunday[All Fields]) OR 'out of hour'[All Fields]) OR 'after hour'[All Fields]) OR 'on-call'[All Fields]) OR 'six day'[All Fields]) OR '6 day'[All Fields]) OR 'seven day'[All Fields]) OR '7 day'[All Fields]	English (33091) 2000-2017 (23499)
4	(#1 AND #2 AND #3)	All (1327) English (1256) 2000-2017 (1038)

CINAHL (2000 – current): keyword, title, CINAHL subject headings, abstract, and instrumentation fields. Search date 05/05/2017

Search number	Search terms	Limiters	Results
1	hospital# OR acute OR 'sub#acute' OR ward# OR 'in#patient#'	Published Date: 20000101-20171231; English Language	414, 101
2	'allied#health' OR physio* OR 'physical#therap*' OR 'occupational#therap*' OR 'speech#patholog*' OR 'speech#therap*' OR 'language#patholog*' OR 'language#therap*' OR nutrition OR dietetic# OR dietitian OR dietician OR 'social#work*' OR 'art therapy' OR chiropractic OR 'exercise physiology' OR music therapy' OR 'oral health' OR osteopathy OR orthotics OR prosthetics OR podiatry OR psychology OR 'allied health assistant'	Published Date: 20000101-20171231; English Language	538,207
3	weekend OR saturday OR sunday OR 'out#of#hour#' OR 'after#hour#' OR 'on#call' OR 'six#day#' OR '6#day#' OR 'seven#day#' OR '7#day#'	Published Date: 20000101-20171231; English Language	19,983
4	S1 AND S2 AND S3	Published Date: 20000101-20171231; English Language	987

Cochrane library (2000 – current): title, abstract, keywords. Search date 05/05/2017

Search number	Search terms	Results
1	'hospital':ti,ab,kw or 'acute':ti,ab,kw or 'subacute':ti,ab,kw or 'ward':ti,ab,kw or 'inpatient':ti,ab,kw (Word variations have been searched)	166391
2	'allied health':ti,ab,kw or 'physiotherapy':ti,ab,kw or 'physical therapy':ti,ab,kw or 'occupational therapy':ti,ab,kw or 'speech pathology':ti,ab,kw (Word variations have been searched)	11471
3	'speech therapy':ti,ab,kw or 'language pathology':ti,ab,kw or 'language therapy':ti,ab,kw or nutrition:ti,ab,kw or dietetic:ti,ab,kw (Word variations have been searched)	15573

4	'dietitian':ti,ab,kw or 'dietician':ti,ab,kw or 'social work':ti,ab,kw (Word variations have been searched)	1415
5	'art therapy':ti,ab,kw or chiropractic:ti,ab,kw or 'exercise physiology':ti,ab,kw or 'music therapy':ti,ab,kw or 'oral health':ti,ab,kw (Word variations have been searched)	3527
6	osteopathy:ti,ab,kw or orthotics:ti,ab,kw or prosthetics:ti,ab,kw or podiatry:ti,ab,kw or psychology:ti,ab,kw (Word variations have been searched)	13789
7	'weekend':ti,ab,kw or 'saturday':ti,ab,kw or 'sunday':ti,ab,kw or 'out of hour':ti,ab,kw or 'after hour':ti,ab,kw (Word variations have been searched)	803
8	'on-call':ti,ab,kw or 'six day':ti,ab,kw or '6 day':ti,ab,kw or 'seven day':ti,ab,kw or '7 day':ti,ab,kw (Word variations have been searched)	26104
9	#2 or #3 or #4 or #5 or #5 or #6	44451
10	#7 or #8	26845
11	#1 and #9 and #10 Publication Year from 2000 to 2017	511

Scopus (2000 – current): *title, abstract, keywords.* Search date 05/05/2017

Search number	Search terms	Results
1	(TITLE-ABS-KEY (hospital*) OR TITLE-ABS-KEY (acute*) OR TITLE-ABS-KEY (sub?acute*) OR TITLE-ABS-KEY (ward*) OR TITLE-ABS-KEY (in?patient*)) AND PUBYEAR > 1999	34,598,482
2	(TITLE-ABS-KEY (allied?health*) OR TITLE-ABS-KEY (physiotherap*) OR TITLE-ABS-KEY (physical?therap*) OR TITLE-ABS-KEY (occupational?therap*) OR TITLE-ABS-KEY (speech?patholog*) OR TITLE-ABS-KEY (speech?therap*) OR TITLE-ABS-KEY (language?patholog*) OR TITLE-ABS-KEY (language?therap*) OR TITLE-ABS-KEY (nutrition*) OR TITLE-ABS-KEY (dietitic*) OR TITLE-ABS-KEY (dietitian*) OR TITLE-ABS-KEY (dietician*) OR TITLE-ABS-KEY (social?work*)) AND PUBYEAR > 1999	11, 845, 780
3	(TITLE-ABS-KEY (weekend*) OR TITLE-ABS-KEY (saturday*) OR TITLE-ABS-KEY (sunday*) OR TITLE-ABS-KEY (out?of?hour*) OR TITLE-ABS-KEY (after?hour*) OR TITLE-ABS-KEY (on?call*) OR TITLE-ABS-KEY (six?day*) OR TITLE-ABS-KEY (6?day*) OR TITLE-ABS-KEY (seven?day) OR TITLE-ABS-KEY (7?day*)) AND PUBYEAR > 1999	34,504,587

4	((TITLE-ABS-KEY (hospital) OR TITLE-ABS-KEY (acute) OR TITLE-ABS-KEY ('sub?acute') OR TITLE-ABS-KEY (ward) OR TITLE-ABS-KEY ('in?patient')) AND PUBYEAR > 1999) AND ((TITLE-ABS-KEY (weekend) OR TITLE-ABS-KEY (saturday) OR TITLE-ABS-KEY (sunday) OR TITLE-ABS-KEY ('out?of?hour') OR TITLE-ABS-KEY ('after?hour') OR TITLE-ABS-KEY ('on?call') OR TITLE-ABS-KEY ('six?day') OR TITLE-ABS-KEY ('6?day') OR TITLE-ABS-KEY ('seven?day') OR TITLE-ABS-KEY ('7?day')) AND PUBYEAR > 1999) AND ((TITLE-ABS-KEY ('allied?health'') OR TITLE-ABS-KEY (physiotherapy) OR TITLE-ABS-KEY ('physical?therapy') OR TITLE-ABS-KEY ('occupational?therapy') OR TITLE-ABS-KEY ('speech?pathology') OR TITLE-ABS-KEY ('speech?therapy') OR TITLE-ABS-KEY ('language?pathology') OR TITLE-ABS-KEY ('language?therapy') OR TITLE-ABS-KEY (nutrition) OR TITLE-ABS-KEY (dietitic) OR TITLE-ABS-KEY (dietitian) OR TITLE-ABS-KEY (dietician) OR TITLE-ABS-KEY ('social?work')) AND PUBYEAR > 1999)	73
5	((TITLE-ABS-KEY (hospital) OR TITLE-ABS-KEY (acute) OR TITLE-ABS-KEY ('sub?acute') OR TITLE-ABS-KEY (ward) OR TITLE-ABS-KEY ('in?patient')) AND PUBYEAR > 1999) AND ((TITLE-ABS-KEY (weekend) OR TITLE-ABS-KEY (saturday) OR TITLE-ABS-KEY (sunday) OR TITLE-ABS-KEY ('out?of?hour') OR TITLE-ABS-KEY ('after?hour') OR TITLE-ABS-KEY ('on?call') OR TITLE-ABS-KEY ('six?day') OR TITLE-ABS-KEY ('6?day') OR TITLE-ABS-KEY ('seven?day') OR TITLE-ABS-KEY ('7?day')) AND PUBYEAR > 1999) AND ((TITLE-ABS-KEY ('allied?health'') OR TITLE-ABS-KEY (physiotherapy) OR TITLE-ABS-KEY ('physical?therapy') OR TITLE-ABS-KEY ('occupational?therapy') OR TITLE-ABS-KEY ('speech?pathology') OR TITLE-ABS-KEY ('speech?therapy') OR TITLE-ABS-KEY ('language?pathology') OR TITLE-ABS-KEY ('language?therapy') OR TITLE-ABS-KEY (nutrition) OR TITLE-ABS-KEY (dietitic) OR TITLE-ABS-KEY (dietitian) OR TITLE-ABS-KEY (dietician) OR TITLE-ABS-KEY ('social?work')) AND PUBYEAR > 1999) AND (LIMIT-TO (LANGUAGE , 'English'))	70

Articles identified from systematic reviews

Author, year, reference	Additional articles identified
Brusco, 2006, (Natasha K Brusco & Paratz, 2006)	0
Haas, 2016, (R Haas et al., 2016)	0
Peiris 2011 (C. L. Peiris, Taylor, & Shields, 2011)	0
Scrivener, 2015, (Scrivener et al., 2015)	0

Articles identified from reference screening of included articles

Author, year, reference	Additional articles identified
Boxall, 2004, (Boxall et al., 2004)	0
Brusco, 2007, (N. K. Brusco et al., 2007)	0
Brusco, 2014, (N. K. Brusco, Watts, Shields, Chan, et al., 2014)	0
Brusco, 2014, (N. K. Brusco, Watts, Shields, & Taylor, 2014)	0
Brusco, 2015, (Natasha Kareem Brusco et al., 2015)	0
Caruana, 2016, (Caruana et al., 2016)	0
David, 2003, (David et al., 2003)	0
DiSotto-Monastero, 2012, (DiSotto-Monastero et al., 2012)	0
English, 2014, (C. English et al., 2014)	0
English, 2015, (Coralie English et al., 2015)	0
Hakkennes, 2015, (Hakkennes et al., 2015)	0
Kinoshita, 2017, (Kinoshita et al., 2017)	0
Maidment, 2014, (Maidment et al., 2014)	0
Peiris, 2013, (Peiris et al., 2013)	0
Peiris, 2012, (C. L. Peiris et al., 2012a)	0
Pua, 2011, (Pua et al., 2011)	0
Said, 2012, (Said et al., 2012)	0

Articles identified from publication list of key authors in the field

Author	Institution	Additional articles identified
Julia Bernhardt	Florey Institute	3 (Coralie English et al., 2015; C English et al., 2016; Hillier et al., 2014)
Natasha Brusco	La Trobe University	0
Leeanne Carey	La Trobe University	0
Coralie English	University of South Australia	0
Neil Greening	University of Leicester	0
Terrence Haines	Monash University	1 (Terry P Haines et al., 2015)
Anne Holland	La Trobe University	0
Shoji Kinoshita	Jikei University	1 (Kinoshita et al., 2017)
Meg Morris	La Trobe University	0
Casey Peiris	La Trobe University	1 (C. L. Peiris et al., 2011)
Manoj Pereira	Royal Adelaide Hospital	1 (Pereira, Wire, & Stiller, 2017)
Catherine Said	University of Melbourne	0
Kate Scrivener	Macquarie University	0
Nicholas Taylor	La Trobe University	0
Kathy Stiller	South Australia Health	1 (E. Mills et al., 2017)

Appendix 4.2. Chapter 4 systematic review: inclusion and exclusion criteria

Inclusion	Exclusion
Allied health service delivered by an allied health professional or allied health assistant	Allied health service not delivered by an allied health professional or allied health assistant (e.g. nursing staff or self-directed)
Allied health service occurs on a general acute medical or surgical ward, Allied health service occurs on a subacute rehabilitation ward	Allied health service does not occur in an inpatient setting
Allied health service occurs during the weekend	Data relating specifically to weekend allied health services unable to be identified with appropriate control
Effect of allied health on patient or health service outcome is measured	Does not report on a patient or health service outcome (e.g. survey)
	Allied health service occurs in ICU/HDU, palliative, maternity, paediatric, chronic/long-term care, alternate level of care, and extended care specific hospital ward
	Duplicate publication
	Non-English language publication
	Systematic review
	Protocol
	Outpatient
	Commentary

Appendix 4.3. Chapter 4 systematic review: excluded full texts

#108 - Babu 2013 Babu, A. S. Acute exacerbations of COPD: will on-call physiotherapy allow for early rehabilitation? CHEST Jan 2013;143(1):280-1 2013 Jan	11/04/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#110 - Babu 2010 Babu, As; Noone, Ms; Haneef, M; Samuel, P The effects of 'on-call/out of hours' physical therapy in acute exacerbations of chronic obstructive pulmonary disease: a randomized controlled trial Clinical Rehabilitation 2010;24(9):802-9 2010	18/04/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#109 - Babu 2010 Babu, A. S.; Noone, M. S.; Haneef, M.; Samuel, P. The effects of 'on-call/out of hours' physical therapy in acute exacerbations of chronic obstructive pulmonary disease: a randomized controlled trial Sep 2010;24(9):802-9 2010 Sep	18/04/17	Duplicate publication
#181 - Bennett 2016 Bennett, L.; Luker, J.; English, C.; Hillier, S. Stroke survivors' perspectives on two novel models of inpatient rehabilitation: seven-day a week individual therapy or five-day a week circuit class therapy Disabil Rehabil Jul 2016;38(14):1397-406 2016 Jul	18/04/17	Does not report on a patient or health service outcome (e.g. survey)
#241 - Boxall 2004 Boxall, A.; Sayers, A.; Caplan, G. A. A cohort study of 7 day a week physiotherapy on an acute orthopaedic ward Journal of Orthopaedic Nursing 2004;8(2):96-102 Churchill Livingstone, Inc. 2004	20/04/17	Duplicate publication
#274 - Brusco 2006 Brusco, N. K.; Paratz, J. The effect of additional physiotherapy to hospital inpatients outside of regular business hours: a systematic review Physiotherapy Theory & Practice 2006;22(6):291-307 2006	18/04/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#270 - Brusco 2007 Brusco, Nk; Shields, N; Taylor, Nf; Paratz, J A Saturday physiotherapy service may decrease length of stay in patients undergoing rehabilitation in hospital: a randomised controlled trial The Australian journal of physiotherapy 2007;53(2):75-81 2007	18/04/17	Therapy not delivered by an allied health professional (e.g. nursing staff or self-directed)
#347 - Cegla 2002 Cegla, Uh; Jost, H-J; Harten, A; Weber, T; Wissmann, S Course of severe COPD with and without physiotherapy	18/04/17	Non-English language publication

with the RC-Cornet: A randomized 2 years long-term tudy. [German] Pneumologie (Stuttgart, Germany) 2002;56(7):418-24 2002		
#500 - David 2003 David, C.; Price, N.; Price, T.; Sheeran, T.; Mulherin, D. Impact of weekend physiotherapy delivery on the throughput of Rheumatology inpatients Physiotherapy 2003;89(1):25-29 2003	12/04/17	Duplicate publication
#588 - Duncan 2015 Duncan, C.; Hudson, M.; Heck, C. The impact of increased weekend physiotherapy service provision in critical care: a mixed methods study Physiotherapy Theory & Practice 2015;31(8):547-55 2015	12/04/17	Therapy occurs in ICU/HDU, palliative, mental health, maternity, paediatric, chronic/long-term care, alternative level of care, and extended care specific hospital ward
#2387 - English 2016 English, C; Bernhardt, J; Crotty, M; Esterman, A; Segal, L; Watts, J; Hillier, S Circuit Class Therapy Reduces Length of Rehabilitation Stay, But Weekend Therapy Does Not. An Exploratory Secondary Analysis of the Circit Trial Cerebrovascular Diseases 2016;42():6 2016	12/04/17	Duplicate publication
#613 - English 2014 English, Coralie; Bernhardt, Julie; Hillier, Susan Circuit Class Therapy and 7-Day-Week Therapy Increase Physiotherapy Time, But Not Patient Activity: Early Results From the CIRCIT Trial Stroke (00392499) 2014;45(10):3002-3007 Baltimore, Maryland Lippincott Williams & Wilkins 2014	20/04/17	Duplicate publication
#615 - English 2016 English, C.; Shields, N.; Brusco, N. K.; Taylor, N. F.; Watts, J. J.; Peiris, C.; Bernhardt, J.; Crotty, M.; Esterman, A.; Segal, L.; Hillier, S. Additional weekend therapy may reduce length of rehabilitation stay after stroke: a meta-analysis of individual patient data Journal of physiotherapy 2016;62(3):124-9 2016	18/04/17	Duplicate publication
#765 - Gilfillan 2016 Gilfillan, C.; Newnham, E.; Nagappan, R.; Evans, J.; Compton, J. A 7-day team-based model of care in general medicine: Implementation and outcomes at 12 months Internal Medicine Journal 2016;46(1):79-85 2016	18/04/17	Does not report on a patient or health service outcome (e.g. survey)
#790 - Gräsel 2012 Gräsel, E; Biehler, J; Schmidt, R; Schupp, W Intensification of the transition between inpatient	18/04/17	Therapy not delivered by an allied health professional (e.g.

neurological rehabilitation and home care of stroke patients. Controlled clinical trial with follow up assessment six months after discharge Clinical Rehabilitation 2012;19(7):725-736 2012		nursing staff or self-directed)
#791 - Gräsel 2005 Gräsel, E.; Biehler, J.; Schmidt, R.; Schupp, W. Intensification of the transition between inpatient neurological rehabilitation and home care of stroke patients. Controlled clinical trial with follow up assessment six months after discharge Clinical Rehabilitation 2005;19(7):725-736 2005	12/04/17	Therapy not delivered by an allied health professional (e.g. nursing staff or self-directed)
#793 - Grasel 2006 Grasel, E.; Schmidt, R.; Biehler, J.; Schupp, W. Long-term effects of the intensification of the transition between inpatient neurological rehabilitation and home care of stroke patients Clinical Rehabilitation 2006;20(7):577-83 2006	12/04/17	Therapy not delivered by an allied health professional (e.g. nursing staff or self-directed)
#792 - Gräsel 2012 Gräsel, E; Schmidt, R; Biehler, J; Schupp, W Long-term effects of the intensification of the transition between inpatient neurological rehabilitation and home care of stroke patients Clinical Rehabilitation 2012;20(7):577-583 2012	18/04/17	Therapy not delivered by an allied health professional (e.g. nursing staff or self-directed)
#823 - Gustafsson 2010 Gustafsson, L.; McKenna, K. Is there a role for meaningful activity in stroke rehabilitation? Topics in stroke rehabilitation 2010;17(2):108-18 2010	18/04/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#825 - Haas 2016 Haas, R.; Sarkies, M.; Bowles, K. A.; O'Brien, L.; Haines, T. Early commencement of physical therapy in the acute phase following elective lower limb arthroplasty produces favorable outcomes: a systematic review and meta-analysis examining allied health service models Osteoarthritis Cartilage Oct 2016;24(10):1667-81 2016 Oct	18/04/17	Duplicate publication
#2389 - Hillier 2014 Hillier, S; English, C; Bernhardt, J; Crotty, M; Esterman, A; Segal, L Circuit class and 7-day week therapy for increasing rehabilitation intensity of therapy after stroke (CIRCIT): Six month follow up and cost analysis of the CIRCIT RCT International Journal of Stroke 2014;9():22-22 WILEY-BLACKWELL 111 RIVER ST, HOBOKEN 07030-5774, NJ USA 2014	12/04/17	Duplicate publication
#910 - Hillier 2011	18/04/17	Does not report on a

Hillier, S; English, C; Crotty, M; Segal, L; Bernhardt, J; Esterman, A Circuit class or seven-day therapy for increasing intensity of rehabilitation after stroke: Protocol of the CIRCIT trial International journal of stroke 2011;6(6):560-5 2011		patient or health service outcome (e.g. survey)
#912 - Hillier 2017 Hillier, S; English, C; Crotty, M; Segal, L; Bernhardt, J; Esterman, A Circuit class or seven-day therapy for increasing intensity of rehabilitation after stroke: protocol of the CIRCIT trial International journal of stroke 2017;6(6):560-565 2017	18/04/17	Duplicate publication
#911 - Hillier 2011 Hillier, S.; English, C.; Crotty, M.; Segal, L.; Bernhardt, J.; Esterman, A. Circuit class or seven-day therapy for increasing intensity of rehabilitation after stroke: protocol of the CIRCIT trial Int J Stroke Dec 2011;6(6):560-5 2011 Dec	12/04/17	Duplicate publication
#964 - Hunt 2011 Hunt, Luise The weekend starts here. A team of physio assistants is helping patients make progress every day Frontline (20454910) 2011;17(12):30-30 London, <Blank> Chartered Society of Physiotherapy 2011	12/04/17	Therapy not delivered by an allied health professional (e.g. nursing staff or self-directed)
#1047 - Jones 2013 Jones, C; Kelliher, L; Dickinson, M; Riga, A; Worthington, T; Scott, Mj; Vandrevala, T; Fry, Ch; Karanjia, N; Quiney, N Randomized clinical trial on enhanced recovery versus standard care following open liver resection The British journal of surgery 2013;100(8):1015-24 2013	18/04/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#1067 - Kakuda 2010 Kakuda, W.; Abo, M.; Kaito, N.; Ishikawa, A.; Taguchi, K.; Yokoi, A. Six-day course of repetitive transcranial magnetic stimulation plus occupational therapy for post-stroke patients with upper limb hemiparesis: a case series study Disabil Rehabil 2010;32(10):801-7 2010	18/04/17	Outpatient
#1326 - Maidment 2012 Maidment, Zoe L.; Hordacre, Brenton G.; Barr, Christopher J. Effect of weekend physiotherapy provision on physiotherapy and hospital length of stay after total knee and total hip replacement	20/04/17	Duplicate publication

Australian Health Review 2012;36(1):265-270 Clayton, VIC, <Blank> CSIRO Publishing 2012		
#1438 - Mitchell 2017 Mitchell, D.; O'Brien, L.; Bardoel, A.; Haines, T. Challenges, uncertainties and perceived benefits of providing weekend allied health services-a managers' perspective Feb 06 2017;17(1):118 2017 Feb 06	18/04/17	Does not report on a patient or health service outcome (e.g. survey)
#1604 - Parker 2013 Parker, Am; Lord, Rk; Needham, Dm Increasing the dose of acute rehabilitation: Is there a benefit? BMC Medicine 2013;11(1): 2013	18/04/17	Commentary
#1628 - Peiris 2012 Peiris, Casey L.; Taylor, Nicholas F.; Shields, Nora Patients value patient-therapist interactions more than the amount or content of therapy during inpatient rehabilitation: a qualitative study Journal of Physiotherapy (Elsevier) 2012;58(4):261-268 New York, New York Elsevier Science 2012	18/04/17	Does not report on a patient or health service outcome (e.g. survey)
#2936 - Peiris 2016 Peiris, Cl; Shields, N; Brusco, Nk; Watts, Jj; Taylor, Nf Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial BMC Medicine 2016;11():198 2016	11/07/17	Duplicate publication
#1625 - Peiris 2013 Peiris, C. L.; Shields, N.; Brusco, N. K.; Watts, J. J.; Taylor, N. F. Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial.[Erratum appears in BMC Med. 2013;11:262] BMC Medicine 2013;11():198 2013	20/04/17	Duplicate publication
#2391 - Peiris 2011 Peiris, C. L.; Taylor, N. F.; Shields, N. Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review Arch Phys Med Rehabil Sep 2011;92(9):1490-500 2011 Sep	18/04/17	systematic review
#1627 - Peiris 2012 Peiris, C. L.; Taylor, N. F.; Shields, N. Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial Archives of Physical Medicine & Rehabilitation	20/04/17	Duplicate publication

2012;93(8):1365-70 2012		
#1622 - Peiris 2015 Peiris, C; Shields, N; Brusco, N; Watts, J; Taylor, N Little functional gain is made following discharge from inpatient rehabilitation but additional saturday rehabilitation optimises outcomes: A randomised controlled trial Physiotherapy (United Kingdom) 2015;101():eS1187-eS1188 2015	18/04/17	Duplicate publication
#1623 - Peiris 2012 Peiris, C; Shields, N; Taylor, Nf Extra physical therapy and occupational therapy increased physical activity levels in orthopedic rehabilitation: Randomized controlled trial Archives of Physical Medicine and Rehabilitation 2012;93(10):E14 2012	18/04/17	Duplicate publication
#1624 - Peiris 2015 Peiris, C; Taylor, N; Shields, N Additional Saturday rehabilitation increases physical activity and patient engagement Physiotherapy (United Kingdom) 2015;101():eS1186-eS1187 2015	18/04/17	Duplicate publication
#2390 - Pereira 2017 Pereira, Manoj; Wire, Georgina; Stiller, Kathy A Retrospective Review of the After-Hours Social Work Service in a Tertiary-Care Public Hospital in Australia Internet Journal of Allied Health Sciences and Practice 2017;15(1):1 2017	18/04/17	Does not report on a patient or health service outcome (e.g. survey)
#1643 - Petersen 2006 Petersen, M. K.; Madsen, C.; Andersen, N. T.; Soballe, K. Efficacy of multimodal optimization of mobilization and nutrition in patients undergoing hip replacement: a randomized clinical trial Jul 2006;50(6):712-7 2006 Jul	18/04/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#1689 - Pua 2011 Pua, Yong-Hao; Ong, Peck-Hoon; Chong, Hwei-Chi; Lo, Ngai-Nung Sunday Physiotherapy Reduces Inpatient Stay in Knee Arthroplasty: A Retrospective Cohort Study Archives of Physical Medicine & Rehabilitation 2011;92(6):880-885 Philadelphia, Pennsylvania W B Saunders 2011	18/04/17	Duplicate publication
#1769 - Robinson 2014 Robinson, Anna; Lord-Vince, Hannah; Williams, Rebecca The need for a 7-day therapy service on an emergency	18/04/17	Therapy occurs in ICU/HDU, palliative, mental health, maternity, paediatric,

assessment unit British Journal of Occupational Therapy 2014;77(1):19-23 Thousand Oaks, California Sage Publications Inc. 2014		chronic/long-term care, alternative level of care, and extended care specific hospital ward
#1772 - Rodriguez-Larrad 2016 Rodriguez-Larrad, A; Vellosillo-Ortega, Jm; Ruiz-Muneta, C; Abecia-Inchaurregui, Lc; Seco, J Postoperative Respiratory Exercises Reduce the Risk of Developing Pulmonary Complications in Patients Undergoing Lobectomy Archivos de bronconeumologia 2016;52(7):347-53 2016	18/04/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#1803 - Said 2012 Said, C. M.; Morris, M. E.; Woodward, M.; Churilov, L.; Bernhardt, J. Enhancing physical activity in older adults receiving hospital based rehabilitation: a phase II feasibility study BMC geriatrics 2012;12():26 2012	18/04/17	Duplicate publication
#1878 - Scrivener 2015 Scrivener, Katharine; Jones, Taryn; Schurr, Karl; Graham, Petra L.; Dean, Catherine M. After-hours or weekend rehabilitation improves outcomes and increases physical activity but does not affect length of stay: a systematic review Journal of Physiotherapy (Elsevier) 2015;61(2):61-67 New York, New York Elsevier Science 2015	18/04/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#1949 - Sim 2011 Sim, E; Tan, D; Wong, Wp; Khoon, C; Britto, J; Faizal, M; Hong, S; Lim, P; Pavanni, R; Tauqeer, Ma A very early rehabilitation trial (AVERT) for patients with stroke: The Singapore experience Physiotherapy (United Kingdom) 2011;97():eS1144 2011	18/04/17	Duplicate publication
#1991 - Stein 2009 Stein, R.; Maia, C. P.; Silveira, A. D.; Chiappa, G. R.; Myers, J.; Ribeiro, J. P. Inspiratory muscle strength as a determinant of functional capacity early after coronary artery bypass graft surgery Oct 2009;90(10):1685-91 2009 Oct	18/04/17	Therapy not delivered by an allied health professional (e.g. nursing staff or self-directed)
#2053 - Taylor 2010 Taylor, Nf; Brusco, Nk; Watts, Jj; Shields, N; Peiris, C; Sullivan, N; Kennedy, G; Teo, Ck; Farley, A; Lockwood, K; Radia-George, C A study protocol of a randomised controlled trial incorporating a health economic analysis to investigate if additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes BMC health services research 2010;10():308 2010	18/04/17	Does not report on a patient or health service outcome (e.g. survey)

#179 – Benwick 2004 Benick, Ra; Murray-Weir, M; Peterson, Mge; Sculco, Tp Efficacy of practice pattern and staff mix in decreasing length of stay and achieving functional milestones following total hip arthroplasty Topics in geriatric rehabilitation 2004;20(4):311-2 2004	27/09/17	Data relating specifically to weekend therapy unable to be identified with appropriate control
#1743 - Reuter 2017 Reuter, B; Gumbinger, C; Sauer, T; Bruder, I; Ringleb, Pa; Hacke, W; Hennerici, Mg; Kern, R; Schoser, K; Daffertshofer, M; Diehm, C; Neumaier, S; Wietholter, H; Drewitz, Ee Access, timing and frequency of very early stroke rehabilitation - insights from the Baden-Wuerttemberg stroke registry BMC Neurology 2017;16(1) (no pagination): 2017	27/09/2017	Does not report on a patient or health service outcome (e.g. survey)
#1802 - Said 2012 Said, Cm; Morris, Me; Woodward, M; Churilov, L; Bernhardt, J Enhancing physical activity in older adults receiving hospital based rehabilitation: a phase II feasibility study BMC geriatrics 2012;12():26 2012	27/09/2017	Data relating specifically to weekend therapy unable to be identified with appropriate control
#2134 - vanderPeijl 2004 van der Peijl, I. D.; Vliet Vlieland, T. P.; Versteegh, M. I.; Lok, J. J.; Munneke, M.; Dion, R. A. Exercise therapy after coronary artery bypass graft surgery: a randomized comparison of a high and low frequency exercise therapy program Annals of Thoracic Surgery 2004;77(5):1535-41 2004	27/09/2017	Data relating specifically to weekend therapy unable to be identified with appropriate control
Mills 2017 Mills Ellen, Hume Vicki, Stiller Kathy Increased allied health services to general and acute medical units decreases length of stay: comparison with a historical cohort Australian Health Review 2017	27/09/2017	Data relating specifically to weekend therapy unable to be identified with appropriate control

Appendix 5.1. Chapter 5 protocol: definition of an allied health service event

‘A specific, time defined encounter during which a person (with a known patient identifier) receives a service from an allied health professional, assistant or student.

Each allied health service event occurs within an admitted patient episode of care, an episode of non-admitted patient allied health care or an emergency department stay.

Within each episode of care a person can have one or more allied health service events.

An Allied Health Service Event may span one or more days.

There may be one or more Allied Health Service Events provided by the same allied health professional, assistant or student on the same day.

An Allied Health Service Event must be individual patient attributable and can be direct and/or indirect. A person may or may not be in physical attendance for an Allied Health Service Event.

A person may Fail to attend an Allied Health Service Event.’

[2017 National Allied Health Data Working Group (NAHDWG) endorsed National Allied Health Best Practice Data Sets]

Appendix 5.2. Chapter 5 protocol: master participation information and consent form

Allied Health Evidence based Decision making Partnership Project

Participant Information and Consent Form (PICF)

Chief Investigators
Professor Terry Haines
Professor Meg Morris
Professor Nicholas Taylor
Associate Professor Anne Holland
Professor Leeanne Carey
Dr Elizabeth Skinner
Dr Cylie Williams
Associate Professor Anne Bardoel
Professor Jenny Martin
Dr Lisa O'Brien

Principal Investigators
Dr Jennifer White
Mr Mitchell Sarkies
Ms Kathleen Philip
Ms Kellie Grant

Associate Investigators
Ms Wendy Hubbard
Dr Kelly-Ann Bowles
Professor Andrew Palmer

1. Introduction

The Allied Health Evidence based Decision making Partnership Project Committee invites you to participate in a nation-wide study assisting allied health managers to make evidence based resource allocation decisions. This National Health and Medical Research Council (NHMRC) funded Partnership Project will recruit allied health managers from health services across Australia to a 12-month randomised controlled trial.

This Participant Information and Consent Form (PICF) tells you about the research project, explains the procedures involved and will help you decide if you wish to take part in the research. Please read this information carefully and feel free to ask questions about anything that you don't understand or want to know more about. Participation in this research is entirely voluntary and your decision will not impact professional relationships with the research team.

If you decide you wish to take part in the research project, you will be asked to sign the consent section of this form. By signing consent you are stating that you:

- Understand what you have read;
- Consent to take part in the research project;
- Consent to take part in the research process as described;

You will be given a copy of this Participation Information and Consent Form to keep.

2. What is the purpose of this project?

The NHMRC funded Allied Health Evidence based Decision making Partnership Project Committee is developing an evidence based policy recommendation document for allied health resource allocation during the weekends. We wish to test the effectiveness of providing this evidence based policy recommendation or the provision of this same document with the addition of an expert knowledge broker to improve evidence based resource allocation decision making.

3. What does participation in this research project involve?

This is a national randomised controlled trial design

- If allocated to the control group, participants will experience a 12 month wait of usual care with no additional resources provided, until provision of an evidence based policy recommendation document.
- If allocated to intervention group 1 you will be provided with the evidence based policy recommendation document to help guide resource allocation decision making towards weekend allied health services.
- If allocated to intervention group 2, you will be provided with the same evidence based policy recommendation plus access to an expert knowledge broker to provide extra help in making these decisions. The knowledge broker is a Post Doctoral Research Fellow from an allied health professional background who will help facilitate the transfer and exchange of relevant information to promote evidence based decision making. Regular communication (email, phone, online forums) with the knowledge broker will be available as required to sustain engagement and facilitate problem solving. Conversations discussing perceptions and experiences towards the policy implementation will be audio-recorded.

This project will be performed over a period of 12 months, with data collected at baseline and 12 month follow up. If you wish to participate, you will be required to complete a survey interview for data collection at the beginning of the project and 12 months later at project conclusion. It is anticipated these survey interviews will take approximately 20 minutes to perform.

On completion of the study, allied health managers in each study group will be invited to participate in an audio-recorded qualitative interview exploring their experience of participation in this research and any barrier and facilitator to policy implementation.

Every participant (even those in the control group) will receive the evidence based policy recommendation document upon trial conclusion.

4. What are the possible benefits?

If allocated to either of the implementation strategy groups you might benefit from provision of synthesised or ‘pre-processed’ research evidence to inform weekend allied health resource allocation decision making.

In addition, if allocated to implementation strategy group 2, the knowledge broker will provide a mechanism for explanation, assistance, and clarification to improve understanding of how research evidence applies to your organisation.

If allocated to the control group, you will still receive the evidence based policy recommendation document upon project conclusion.

You may receive professional development benefits through seeking educational opportunities to improve evidence based decision making, and improve professional networks within and external to your health service, and with the academic sector. You may gain research interpretation skills and improved confidence in applying those skills to resource allocation decisions. This project provides an opportunity for quality improvement, and depending on decisions made, more efficient use of resources leading to improved patient outcomes and departmental budget management. The ultimate benefit will be the opportunity to develop skills in evidence based decision making and improve the resource allocation of allied health services during the weekend to practice that aligns with research evidence.

5. What are the possible risks?

This project is no different to usual practice where allied health managers make regular decisions around resource allocation. As such, we don't believe this project presents any additional risks to participants beyond usual practice.

6. Do I have to take part in this research project?

Participation in any research project is voluntary and your decision will not impact professional relationships with the research team. If you do not wish to take part, you don't have to. If you decide to take part and later change your mind, you are free to withdraw from the project and any stage, however you will no longer receive the research implementation strategy ongoing.

7. How will I be informed of the results of this research project?

Public presentations regarding this project will be made at conferences and the results will be published in a scientific journal. If you wish to receive a summary of project findings, please provide your contact details on the consent form.

8. What will happen to information about me?

The information we collect will be stored in a de-identified manner in a password-protected Monash University LabArchives file for a period of 7 years. Members of the investigative team will be able to access this information. Any information obtained in connection with this research project that can identify you will remain confidential and will only be used for the purpose of this research project. In any publication and/or presentation, information will be provided in such a way that you cannot be identified, except with your permission.

In accordance with relevant Australian and/or Victorian privacy and other relevant laws, you have the right to access the information collected and stored by the researchers about you. You also have the right to request that any information, with which you disagree, be corrected. Please contact one of the researchers named at the end of this document if you would like to access your information.

9. Ethical guidelines

Monash Health Human Research Ethics Committee (HREC/17/MonH/44) has

approved the ethical aspects of this research project. Site specific Assessment has been approved by (insert site specific assessment).

This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007) produced by the National Health and Medical Research Council of Australia. This statement has been developed to protect the interests of people who agree to participate in human research studies.

10. Who can I contact?

If you want any further information concerning this project or if you have concerns about any aspect of your involvement in the project, you can contact the principal investigator:

Name: Jenni White
Telephone: +61 (0) 447 492 943
Email: Jenni.White@monash.edu

11. Complaints

If you have any questions or concerns about your rights as a participant in this study, or if you have any complaints, you may contact:

Name: Deborah Dell
Position: Manager, Human Research Ethics Committees
Telephone: (03) 9594 4611

12. Local Complaints

If you have any complaints referring to the site specific conduct of this study, you may contact the local complaints person:

Name:
Position:
Telephone:

13. Consent

I have read this document and I understand the purposes, procedures and risks of this research project as described within it.

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.

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

Participant's name (printed) ……

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.*

Researcher's name (printed) ……

Signature *Date*

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

If you wish to receive a summary of project findings, please provide the best contact information for this to be sent to you below:

Email:_____

OR

Postal address:_____

Appendix 6.1. Chapter 6 counterbalanced design: overall effect of an implementation strategy using a single mixed effects generalised linear model

$$Y_{uic} = \alpha + (\beta_1 x_{1ui} + \ldots + \beta_n x_{nui}) + (\gamma_1 z_{1uc} + \ldots + \gamma_n z_{muc}) + b_{uic} + a_u \ldots$$

Y	= outcome for a unit of randomisation given a strategy/context combination
$_u$	= unit of randomisation (cluster)
$_i$	= implementation strategy (intervention)
$_c$	= health context
α	= overall intercept
β	= fixed slope for implementation strategy
x	= indicator variable of which implementation strategy is active
$_n$	= number of implementation strategy levels
γ	= fixed slope for health context
z	= indicator variable of which health context is active
$_m$	= number of health contexts
b_{uic}	= residual
a_u	= unit of randomisation specific deviation from the overall intercept

Where Y_{uic} is the outcome of each unit of randomisation to a given combination of implementation strategy and health context, $(\beta_1 x_{1ui} + \ldots + \beta_n x_{nui})$ refers to which of $_n$ strategies, and $(\gamma_1 z_{1uc} + \ldots + \gamma_n z_{muc})$ refers to which of $_m$ contexts.

Appendix 6.2. Chapter 6 counterbalanced design: interaction effect model

$$Y_{uic} = \alpha + (\beta_1 x_{1ui} + \ldots + \beta_n x_{nui}) + (\gamma_1 z_{1uc} + \ldots + \gamma_n z_{muc}) + \delta(x_{1ui} * z_{1uc}) + \ldots + \delta(x_{nui} * z_{1uc}) + \ldots + \delta(x_{1ui} * z_{muc}) + \ldots + \delta(x_{nui} * z_{muc}) + b_{uic} + a_u \ldots$$

Y	= outcome for a unit of randomisation given a strategy/context combination
u	= unit of randomisation (cluster)
i	= implementation strategy (intervention)
c	= health context
α	= overall intercept
β	= fixed slope for implementation strategy
x	= indicator variable of which implementation strategy is active
n	= number of implementation strategy levels
γ	= fixed slope for health context
z	= indicator variable of which health context is active
m	= number of health contexts
δ	= Interaction effect coefficient
b_{uic}	= residual
a_u	= unit of randomisation specific deviation from the overall intercept

Where δ_{ic} denotes the interaction effect terms included in the generalised linear mixed model regression analysis.