A knowledge broker facilitated intervention to improve the use of outcome measures by physical therapists

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Abstract

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Background: Standardized assessments are valid and reliable self-report and performance-based tools used to justify treatment, determine plan of care, and communicate progress with patients, providers and payers, yet physical therapists (PTs) do not routinely use them. Knowledge translation (KT) research evaluates the effectiveness of intervention strategies to improve the use of evidence in health care practice including the use of standardized assessments by PTs. Knowledge brokers (KBs) can be used to support KT, as KBs collaborate with PTs and organizations to develop strategies to implement research evidence while overcoming context specific barriers. The purpose of this dissertation was to determine if a theoretically informed multimodal KT intervention supported by an external KB would change the use of a selected outcome measure by PTs who work in inpatient rehabilitation.

Methods: Two studies, a single cohort and cluster randomized controlled trial, were conducted with PTs who worked in inpatient rehabilitation settings. Methods were replicated and scaled. Both studies used the Knowledge to Action Framework to guide the overall KT process and the Theoretical Domains Framework to guide the barrier assessment and develop the intervention. Physical therapists collaborated with the KB

to determine barriers, select an outcome measure and develop the intervention. Barriers were determined by both qualitative and quantitative methods. Intervention strategies were multi-modal and included education, audit and feedback, engagement, and KB support. The PTs in the cohort had full implementation support by the KB and the cluster randomized trial compared full implementation support to partial implementation support. Documentation of standardized assessment use was evaluated quantitatively using chart audit data and the goal attainment scale and qualitatively through focus groups. Focus groups were coded using conventional content analysis. A realist-like evaluation was conducted on the cluster randomized controlled trial to map the relationship between chart audit data to positive and negative codes rated in the focus group on the intervention strategies (mechanisms) and contextual factors. A pilot study, interviewed four patients treated by PT's in the fully supported group in the cluster trial to determine their experiences and perceptions of assessment practices while in physical therapy.

Results: The cohort included 11 PTs who worked in a sub-acute rehabilitation hospital that significantly improved the documented use of the 4 Meter Walk Test immediately following the intervention and sustained the use at 6 -month follow-up. For the cluster RCT, a total of 18 PTs, 9 in each group, participated. The fully supported site selected the Timed Up and Go test and the partially supported site selected the 10 Meter Walk Test. Both sites had short term improvement of the selected outcome measure that were not sustained at 6-month follow-up.

Both studies found the PTs reported barriers to using outcome measures including organizational challenges, policy changes, dissatisfaction with the outcome measure selected, impaired patient's functional level and environmental issues. The four patients reported positive experiences in physical therapy and discussed observational assessments including distance walked rather than use of standardized outcome measures like the TUG.

Discussion and Conclusion: In the cohort study, the KB in collaboration with the supervisor was able to implement a successful behavior change intervention. It is difficult, however, to determine if KB implementation support alone can improve the use of selected standardized assessment as multiple factors influenced outcome measures use in both studies. The realist-like evaluation in the cluster RCT highlighted the need for formal assessment of organizational factors and external policy changes when implementing a KT intervention and the need for organizational implementation support. Future KT projects should consider pragmatic designs rather than control and randomization as changes in context could not be controlled. In addition, training PTs on shared decision making using standardized outcome measures may be warranted in the future to determine patients' value of standardized assessment.

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Chapter 1.0: Introduction and Background

1.1 Context and Background of Problem

Evidence-based practice (EBP) integrates patient values, clinician expertise, and best available evidence to provide the patient best care (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). Health care workers have acknowledged the importance of EBP to drive patient care, but face many barriers to successfully using evidence to support their practice (Mota da Silva, da Cunha Menezes Costa, Garcia, & Costa, 2014; Scurlock-Evans, Upton, & Upton, 2014). In physical therapy practice, the American Physical Therapy Association (APTA) includes the use evidence to support practice in its vision statement (American Physical Therapy Association, 2013). While physical therapists have a positive attitude toward using evidence (Jette et al., 2003) and believe that using EBP is necessary, it has been difficult to implement the principles of EBP to inform examination and intervention (Fruth et al., 2010; Jette et al., 2003; Salbach, Jaglal, Korner-Bitensky, Rappolt, & Davis, 2007; Swinkels, van Peppen, Wittink, Custers, & Beurskens, 2011).

EBP includes the use of standardized assessments during physical therapy examinations. Findings from standardized assessments are used to justify treatment, determine plan of care, determine patient progress and communicate with providers, patients and payers, yet physical therapists (PTs) do not routinely use them (Jette, J. Halbert, C. Iverson, E. Miceli, & P. Shah, 2009). PTs self-report using standardized assessments less than 50% of the time (Burton, Tyson, & McGovern, 2013b; Copeland, Taylor, & Dean, 2008; Jette et al., 2009; Kirkness & Korner-Bitensky, 2002) while documented use via chart review was found to be much lower (Kirkness & Korner-Bitensky, 2002).   Jette (2009) completed a survey on 498 American Physical Therapy Association members and found of those, only 47% used standardized assessments. Setting played a role in self-reported standardized assessments use, as outpatient PTs were seven times more likely to use standardized assessments than acute care therapists, and home care therapists were 12 times more likely to use standardized assessments than acute care therapists (Jette et al., 2009). Frequent barriers to using standardized assessments reported by allied health practitioners (physical therapists, occupational therapists and speech language pathologists) include lack of time and lack of knowledge of the standardized assessments (Duncan & Murray, 2012). As setting plays an important role in barriers, context specific interventions are needed to address the barriers to using standardized assessments for allied health practitioners (Jones, Roop, Pohar, Albrecht, & Scott, 2014; Scott et al., 2012).

Knowledge translation (KT) research investigates strategies to implement best available evidence into health care practice. KT was first defined by the Canadian Institutes of Health Research in 2000 as, “a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically-sound application of knowledge to improve … health, provide more effective health services and products and strengthen the health care system” (Canadian Institute of Health Research, 2005). Since that time, the World Health Organization, National Institutes on Disability and Rehabilitation Research, and many other national and international health care organizations have focused research initiatives to determine effective strategies to translate knowledge into practice. Three recommendations have been made though systematic reviews in KT literature to help improve KT and KT research which include: (1) Interventions should be active and multi-modal, (2) interventions should be theoretically informed and (3) intervention should be tailored to the local context to target specific barriers (Bero et al., 1998; Grimshaw, 2001; Grol & Grimshaw, 2003; Jones et al., 2014; Menon, Korner-Bitensky, Kastner, McKibbon, & Straus, 2009). KT research began in the medical and nursing fields, but allied health KT research has recently started to gain momentum. Allied health literature was the primarily used for this thesis as allied health practitioners differ from medical and nursing fields based on professional degree, practical issues, practice environment, organizational structure, evaluation and treatment and social influences.

1.1.1 Effective KT Interventions are Active and Multimodal

Effective KT requires the use of implementation strategies that aim to change healthcare professional behavior, decrease health care costs, and improve patient outcomes. Implementation strategies to change provider behavior reviewed in the literature include passive strategies such as dissemination of articles, or active strategies such as continuing education meetings, computerized reminders, or educational outreach visits (Grimshaw, Eccles, Lavis, Hill, & Squires, 2012). In passive strategies, the participants are the recipients of education in the learning process, while active strategies engage participants in the learning process. Multiple systematic reviews have been conducted to determine the effectiveness of interventions on health care professional behavior, yet most interventions report only modest to moderate behavior change (Grimshaw et al., 2012). Reviews on implementation strategies in health care commonly conclude that: (1) passive dissemination strategies are ineffective in changing provider behavior, (2) most other implementation strategies produce some change in behavior, and (3) the use of multimodal implementation strategies that target several barriers to change are more likely to be effective than single intervention strategies (Bero et al., 1998; Grimshaw, 2001; Grol & Grimshaw, 2003; Jones et al., 2014; Menon et al., 2009). Multi-modal implementation strategies include more than one intervention that aim at changing health professional behavior (Bero et al., 1998).

KT research has proven that active, multi-modal strategies are most effective at changing behavior, yet there is a lack of consensus of which strategies should be implemented (Jones, Roop, Pohar, Albrecht, & Scott, 2014; Menon, Korner-Bitensky, Kastner, McKibbon, & Straus, 2009). KT interventions have historically been created through investigator intuition using educational meetings (Michie et al., 2005; Scott et al., 2012). KT interventions range from a few hours on one day to several meetings that occur over the course of one year (Jones, Roop, Pohar, Albrecht, & Scott, 2014; Menon, Korner-Bitensky, Kastner, McKibbon, & Straus, 2009). All three of these factors contribute to interventions that are heterogeneous, difficult to compare, and highly variable.

1.1.2 Effective KT Interventions are Theoretically Informed

The use of theories, models, and frameworks to guide KT interventions has been suggested as a way to improve, organize, and test the phenomena of behavior change (Eccles, Grimshaw, Walker, Johnston, & Pitts, 2005; Hudon, Gervais, & Hunt, 2014;

Kitson et al., 2008; Sudsawad, 2007). By using theoretical frameworks, researchers can systematically approach KT interventions and determine which framework(s) are most effective. After reviewing the literature on theoretical frameworks, two frameworks were selected to guide the proposed research the Knoweldge-to-Action framework (Graham et al., 2006) and the Theoretical Domains Framework (Michie et al., 2005). The use of theories, frameworks and models are infrequently integrated into allied health KT research (Field, Booth, Ilott, & Gerrish, 2014; Hudon, Gervais, & Hunt, 2014). In the systematic review by Field (2014) the use of the Knowledge-to-Action (KTA) framework in allied health KT research was evaluated and only 7% of the studies that cited the KTA framework integrated the KTA framework into the process of KT. This finding was surprising because the KTA framework has been associated with the Canadian Institute of Health Research, a leader in the field of KT (Field et al., 2014). The KTA framework is unique among KT frameworks because it includes the development of new knowledge (knowledge creation) and the implementation of the knowledge (knowledge application).

The KTA framework guides the overall KT process, but the use of a complementary framework can be used to guide specific components (barrier assessment and intervention development) of the KT process. The Theoretical Domains Framework (TDF) is a framework that was developed to guide barrier assessment and intervention design. The TDF includes 14 domains of behavior change with an interview guide to assess barriers (Cane, O'Connor, & Michie, 2012; Michie et al., 2005). The TDF has recommended intervention techniques that are matched with barriers to help investigators develop tailored interventions (Michie, Johnston, Francis, Hardeman, & Eccles, 2008).

1.1.3 Effective KT Interventions are Tailored to Local Conditions

There are many barriers to overcome when implementing KT interventions. Barriers are context dependent and include characteristics of the therapist's, patient's, the practice environment, the organization and the evidence itself (Duncan & Murray, 2012). Tailored interventions are implementation strategies that target specific barriers (Baker et al., 2010). Research on tailored interventions in allied health have cover topics such as the use of clinical practice guidelines (CPG) (Bekkering, van Tulder, et al., 2005; Bernhardsson, Larsson, et al., 2014), and the use of standardized assessments (Russell et al., 2010; Stevens & Beurskens, 2010). Barriers identified in tailored KT interventions are often based on generalized survey reports and not from barrier assessments conducted in the local setting of interest which may result in highly variable KT outcomes (Bekkering, van Tulder, et al., 2005; Bernhardsson, Larsson, et al., 2014; Campbell, Novak, McIntyre, & Lord, 2013; Kerr et al., 2010). Three articles have completed barriers assessments at the local level on the same clinicians used in the KT intervention and reported positive behavior changes (Demmelmaier, Denison, Lindberg, & Asenlof, 2012; Russell et al., 2010; Wiechula et al., 2009). The methodologies used to assess barriers have been conducted though questionnaires, semi-structured interviews, and focus groups (Hrisos et al., 2009).

The use of mixed methods to assess barriers can help the investigator build interventions that are tailored to the specific setting. Questionnaires can guide the investigator to understand the general barriers faced by the clinicians and develop focus group questions. A focus group brings together a group of clinicians who work in one setting to understand context dependent barriers. A focus group is useful to investigate therapist and patient characteristics in a practice setting, the whole practice environment, the organization and the groups' perceptions of the evidence itself.

Interventions implemented by knowledge brokers (KB) is another strategy to tailor interventions to the local level. In allied health literature, KBs range from senior clinicians that are trained in KT (Russell et al., 2010; Wiechula et al., 2009) to trained persons who meet with providers in their practice setting to give information with the intent to change practice (Brown, Gottschalk, Van Ness, Fortinsky, & Tinetti, 2005; Rebbeck, Maher, & Refshauge, 2006; Schreiber, Marchetti, Racicot, & Kaminski, 2014; Schreiber, Stern, Marchetti, & Provident, 2009). KBs use synthesized literature that can be adapted to the local context and are trained on assessment of barriers and facilitators and selecting tailoring an intervention (Russell et al., 2010). KBs have the potential at changing clinician behavior than external researchers because they have a working knowledge of the individuals, practice environment, and organizational barriers and facilitators (Russell et al., 2010). KBs can increase buy-in from the participants to improve EBP behaviors.

1.1.4 Measuring the Outcome of KT intervention

Outcomes of KT interventions can be measured (a) how clinicians put the knowledge into practice and (b) by the impact of the intervention had on the clinicians, patients and the organization (Straus, Tetroe, & Graham, 2009). The focus of this research will be primarily on the physical therapists' behavior change and perception of the intervention as clinician behavior change must occur before there is any impact on the patient and the organization. The use of mixed methods are recommended to measures both of these outcomes (Straus et al., 2009). Outcomes are measured using questionnaires, chart audits, audio recordings, and interviews (Hrisos et al., 2009) to determine change in attitude, confidence, knowledge, skill, and/or behavior following a KT intervention (Straus et al., 2009). Retained behavior change by the clinicians is infrequently measured. Only two studies in allied health reported the long term outcome (> 6 months) of a KT intervention on the use of standardized assessments (Russell et al., 2010; Schreiber et al., 2014). There is also gap in literature that uses active control groups to compare the effectiveness of KT interventions. Two studies were identified that used active control groups (Maas et al., 2015; Van Peppen, Schuurmans, Stutterheim, Lindeman, & Van Meeteren, 2009a). Both studies reported the intervention and active control groups increased their behavior, and that the behavior change of the intervention groups was significantly greater than the control (Van Peppen et al., 2009) (Maas et al., 2015).

The impact of the intervention is less frequently evaluated. The impact of the KT intervention on the clinicians has been measured by focus groups and interviews throughout the intervention for updating and modifying the intervention (Kerr et al., 2010; Matthews et al., 2015; Richardson et al., 2015; Stevens & Beurskens, 2010; Thomas & Mackintosh, 2014) and following the intervention to determine the satisfaction with the intervention, reasons for behavior change, and barriers that remained following the intervention (Kerr et al., 2010; Wiechula et al., 2009). At the patient level, outcomes have been evaluated by change in function and pain (Bekkering, van Tulder, et al., 2005; Rebbeck et al., 2006; Richardson et al., 2015). There is a gap in the literature that investigates patients' perception and satisfaction when being evaluated or treated by clinicians who participate in a KT intervention.

1.1.5 Significance/Need for Study

The effectiveness of a theoretically informed, multi-modal tailored KT intervention to increase use of standardized assessments by physical therapists who work in acute rehabilitation warrants deeper investigation due to gaps in the literature in this setting. KT interventions to increase the use of standardized assessments in allied health have been investigated in the outpatient setting (Abrams et al., 2006; Stevens & Beurskens, 2010), pediatric setting (Russell et al., 2010; Schreiber & Dole, 2012; Schreiber et al., 2014) and rehabilitation setting for individuals post-stroke (Van Peppen et al., 2009). None of the KT literature to increase the use of standardized assessments by physical therapists has reported using all three recommendations for effective KT (active, multimodal interventions, which are theoretically informed and target context specific barriers). In addition, none of the KT literature in allied health on the use of standardized assessment investigated the short and longer term use of standardized assessments in the rehabilitation setting using an active control group.

The proposed study intends to address gaps in the literature on measuring outcomes by using mixed methods to determine the immediate and 6-month retention of behavior change, determine the impact of the intervention, and investigate the impact of the intervention on patients. Mixed methods were used to determine the outcome of the KT intervention. Quantitative data analysis provides evidence of behavior change, while qualitative analysis informs researchers the reasons for the behavior change which can be used to guide future interventions. Long term analysis also helps investigators determine if the behavior was retained after the intervention was completed. Finally, few studies are investigating the impact of the intervention on the patients.

1.1.6 Prior Tailored KTA Intervention: Pilot Study

A mixed methods pilot study was conducted to address gaps in the literature and described the development and process outcome of a theoretically informed multimodal KT intervention to improve the use of standardized assessments in sub-acute rehabilitation (Chapters 4 and 5), (Romney et al., 2018; Romney et al, under review). The KT study increased the documented and self-reported use of gait speed as measured by the four-meter walk test by physical therapists. The design of the KT intervention followed the KTA framework (Graham et al., 2006), assessed barriers and facilitators through questionnaires and a focus group, and developed an intervention to match barriers with recommend KT strategies using the Theoretical Domains Framework (Michie et al., 2005; Michie et al., 2008) and evaluated the immediate and long term (> 6months) outcome. Physical therapists who worked at a sub-acute rehabilitation hospital were recruited to participate. Eleven out of 13 physical therapists who worked at the free standing sub-acute rehabilitation hospital enrolled in the study. PTs evaluated and treated patients with a variety of diagnoses such as cardiac and pulmonary disease, total joint replacement, and neurological disease and dysfunction. The intervention was carried out in four one-hour sessions over 8 weeks, which included active multimodal educational sessions, hand-outs, feedback about chart audit data, and reminders. The physical therapists enrolled in the study were active in designing the intervention based on focus group discussion. The intervention was successful at increasing the documented and self-reported use of gait speed. At baseline, a three-month retrospective chart audit was conducted and determined gait speed was not documented in patient charts, while immediately following the intervention the physical therapists increased documented use of gait speed from 0% to 68%. Using the Goal Attainment Scale, self-reported use rose from 0% to 66%. Focus group analysis revealed the physical therapists were satisfied with the intervention, but patient and practitioner related barriers to using gait speed remained.

The KTA framework was helpful to guide the overall process including: identifying a problem, assessing barriers and facilitators to using standardized assessments, adapting knowledge to the local context, selecting, tailoring, and implementing an intervention, and determining the outcome. The TDF was used to guide development of the focus group guide for barrier assessment and determined strategies used in the intervention. The knowledge broker met with the physical therapists on eight occasions and developed a working knowledge of the practice environment, the physical therapists, the patients and the organization. Input from the key stakeholders to develop the intervention was vital to the success. The PTs selected the standardized assessment used in the intervention, which increased buy-in by the group. The pilot study was the only study that follows the recommendations to use theoretical informed, multimodal, tailored intervention to increase the use of standardized assessments by physical therapists who work in a sub-acute rehabilitation hospital.

1.2 Problem Statement and Goals

There is a gap in the literature on the effectiveness of a theoretically informed, multi-modal tailored KT intervention facilitated by a knowledge broker to increase and retain the use of standardized assessments by physical therapists who work in inpatient rehabilitation measured using mixed methods and analyzed using a Realist Evaluation. In addition, there are gaps in the literature comparing patients' experiences of being evaluated by PTs in the intervention and active control groups.

Based on the gaps in research, the proposed study intends to address the following goals:

1. To determine the immediate and longer term (6 months following the intervention) effectiveness of improving documented use of a selected patient standardized assessment following a theoretically informed multi-modal tailored intervention designed and implemented by a knowledge broker (experimental groups) as compared to a tailored intervention designed, but not implemented by the knowledge broker (active control) by physical therapists who work in rehabilitation. (Chapter 6)
2. To explore and compare patients' experiences of being evaluated by PTs in the experimental and active control groups. (Chapter 7)

1.3 Research Aims, and Hypotheses

Aim 1: Determine if a theoretically informed multi-modal tailored 4 month KT intervention designed and implemented by a knowledge broker will increase (primary outcome) and sustain (secondary outcome) the use of a selected standardized assessment by physical therapists who work on the orthopedic teams in acute inpatient rehabilitation hospitals as compared to a KT intervention designed, but not implemented by the knowledge broker. (Chapter 6)

Hypothesis1a: Physical therapists documented and self-reported use of a selected standardized assessment will significantly increase immediately following the theoretical informed, multi-modal tailored intervention designed and implemented by a KB to greater extent as compared to the active control group.

Hypothesis1b: Physical therapists documented and self-reported use of a selected standardized assessment will be retained from immediately post intervention to six months to a significantly greater extent for the experimental group following the theoretical informed, multi-modal tailored intervention designed and implemented by a KB compared to the active control group.

Aim 2: Explore and compare both groups of physical therapist's satisfaction and concerns with each KT intervention on standardized assessment use (Chapter 6)

Hypothesis 2: The physical therapists in the experimental group will express greater satisfaction with the KT intervention and identify fewer barriers for implementing the standardized assessment in practice as compared to the active control group immediately after and retained at 6-month follow-up

Aim 3: Explore and compare the patients' experience who were seen by therapists in the theoretical informed, multi-modal tailored intervention designed and implemented by a KB compared to the active control group (Chapter 7)

Hypothesis 3: If the PTs in the intervention group (experimental/fully supported implementation group) educated the patients on the standardized assessment, the patients will demonstrate an understanding of the patient standardized assessment, why it's relevant to complete the test, and how the information gathered from the standardized assessment can be used to guide the plan of care.

1.4 Conceptual & Operational Definitions

1.4.1 Conceptual Definitions

<u>Barrier Assessment:</u> method(s) by which barriers and facilitators to change behavior are identified

<u>Behavior change</u>: transformation or modification of human behavior

Tailored Intervention: a number of behavior change strategies that are developed and implemented to address barrier assessment (which include barriers and facilitators) findings

1.4.2 Operational Definitions

These operational definitions will include the methods used in the thesis work.

Action Cycle: The steps to change behavior as defined by the Knowledge-to-Action framework (Graham, 2006).

Behavior change/ Outcome of the intervention: proportion of documented use of a selected patient standardized assessment divided by the number of patients with which the selected measure should have been used, as measured by chart audit. Self-reported use is measured using the Goal Attainment Scale.

Barrier assessment: Assessment strategy to determine the barriers and facilitators to using patient standardized assessments. Assesses barriers and facilitators can be at the practitioner, patient, environmental, and organizational level. Barrier assessment will be conducted through questionnaires, focus group recording and chart audit

Patient experience: Discussion by patients in focus groups or individual interviews on knowledge and relevance of the selected standardized assessment, and how the information gathered from the standardized assessment can be used to guide the care

Knowledge Broker (KB): individuals who are trained in KT strategies that can facilitate the application of best practices such as the use of standardized outcome measures. KBs collaborate with clinicians and policy makers with the intention to change practice. They understand context dependent barriers and facilitators, allowing them to tailor KT interventions by enhancing facilitators and overcoming barriers to change practice. KBs have a working knowledge of the evidence and can adapt the knowledge in a way that's useful for the clinicians. KBs roles vary depending on the context and the evidence they are trying to implement. (Bornbaum, Kornas, Peirson, & Rosella, 2015; Glegg & Hoens, 2016).

Knowledge Translation: "a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically-sound application of knowledge to improve … health …, provide more effective health services and products and strengthen the health care system" (Canadian Institute of Health Research, 2005).

Multimodal or multi-component intervention: "any intervention including two or more components." (Bero et al., 1998)

Standardized assessments: are valid and reliable questionnaires or specific protocols "that assess actual or perceived ability of an individual to carry out activities such as moving in an environment or completing personal care and to participate in life situations such as work or household management and to participate in daily life." (Jette et al., 2009)

Tailored Intervention: Use of personal interviewing, group discussion (focus groups), or a survey of targeted providers to identify barriers and facilitators to change and subsequent design of an intervention that addresses identified barriers. (Effective Practice and Organisation of Care Group (EPOC), 2002)

Educational Meetings: Participation of healthcare providers in conferences, lectures, workshops or traineeships"(Forsetlund et al., 2009)

Educational Outreach Visits: Use of a trained person who meets with providers in their practice settings to give information with the intent of change the providers practice. The information may include feedback on the performance of the provider(s) and academic detailing. (Effective Practice and Organisation of Care Group (EPOC), 2002; M. O'Brien et al., 2007)

Local Opinion Leaders: Use of providers nominated by their colleagues as 'educationally influential'. (Flodgren et al., 2011).

Audit and Feedback: Any summary of clinical performance of health care over a specified period of time. The summary may also include recommendations for clinical action. The information can be obtained from medical records, computerized databases, or observations from patients. (Effective Practice and Organisation of Care Group (EPOC), 2002)

Reminders: Patient or encounter specific information, provided verbally, on paper or on a computer screen, which is designed or intended to prompt a health professional to recall information (Shojania, Jennings, Mayhew, Eccles, & Grimshaw, 2009). This would usually be encountered through their general education; in the medical records or through interactions with peers, to remind them to perform or avoid some action to aide individual patient care. Computer aided decision support (CDSS) and computer physician order entry (CPOE) are included. (Effective Practice and Organisation of Care Group (EPOC), 2002).

Chapter II

REVEIW OF THE LITERATURE

Chapter 2.0 Review of the Literature

2.1 Introduction

The purpose of the literature review is to provide a background of knowledge translation (KT) research on the use of standardized assessments in allied health and to identify knowledge gaps or methodological limitations that will be addressed by the proposed research project. This literature review will provide details of the problem that there is a gap in the literature on the effectiveness of a theoretically informed, multi-faceted tailored KT intervention to increase use of standardized assessments by physical therapists who work in inpatient rehabilitation. This chapter will address five major areas in KT research in allied health (including physical therapists, occupational therapists, and speech-language pathologists): (1) current use, barriers and facilitators to using standardized assessments in clinical practice; (2) use of theories or conceptual frameworks to support KT, (3) determining the outcome of KT interventions; (4) KT interventions with focus tailored interventions; (5) KT intervention related to use of standardized assessments in inpatient rehabilitation.

2.2 Methods

In order to find the relevant literature, an electronic search was conducted using PubMed, ERIC, CINAHL plus, academic search premier and PsychINFO. These databases were selected based on journals indexed and systematic reviews published in KT and allied health. Search teams included: allied health, physical therapy, occupational therapy, speech-language pathology, knowledge translation, dissemination, behavior change, intervention, implementation, utilization, knowledge-to-action, barriers, facilitators, outcome measures, standardized assessments, tailored, targeted, behavior change theories, knowledge translation theories, theoretical domains framework, proxy measure, measurement, measurement methods. Search terms were mapped in order to match keywords within databases. Search terms were also exploded in OVID, expanded in EBSCO and MeSH terms were identified in PubMed. 'Allied health personnel' and 'allied health occupations' are MeSH terms used in PubMed that include occupational therapists, speech language pathologists, and physical therapists. These MeSH terms as well as keywords including "occupational therapists, speech language pathologists, and physical therapists" were used to identify articles. Reference lists of included articles were scanned. Articles were excluded if they were not published in English, were not available in full test and did not include PT, OT, or SLP. Allied health literature was highlighted as opposed to the medical or nursing literature because differences between professions include: degree, practical issues, practice environment, organizational structure, evaluation and treatment differences, and social influences. There exists a vast amount of literature in the medical field on the effectiveness of different KT strategies, yet there are gaps in literature exploring specific intervention strategies used in allied health. Some secondary articles (systematic reviews) in the medical field were included to support this literature review. One hundred and twenty-six articles were included in this narrative review.

2.3 Use of standardized assessments

Using standardized assessments are important as they justify treatment, assess and monitor health of patient, provide information about patient diagnosis, prognosis and outcome of care (Jette et al., 2009). Standardized assessments can be used to guide treatment, develop goals, improve communication with the patient and other health care professionals and prove the effectiveness of care (Jette et al., 2009). The use of standardized assessments can determine if a particular treatment worked for what patient population which will ultimately improve patient outcomes. However, many clinicians do not routinely use standardized assessments during routine therapy (Jette et al., 2009).

Self-reported use ranged from 40% to 80% in the literature (Copeland et al., 2008; Jette et al., 2009; Sibley, Straus, Inness, Salbach, & Jaglal, 2011) (Tables 1-3). Use of standardized assessments estimated based on documentation in medical charts as low as 31% (Kirkness & Korner-Bitensky, 2002). Stevens and Beurskens (2010) reported that during interviews, clinicians admitted to over-estimating their self-reported use of the standardized assessments. Literature on the use of standardized assessments by PTs is primarily based on self-report through questionnaires (Burton et al., 2013b; Copeland et al., 2008; Jette et al., 2009; Salbach, Veinot, Jaglal, Bayley, & Rolfe, 2011; Sibley, Inness, Straus, Salbach, & Jaglal, 2013; Sibley et al., 2011; Van Peppen, Maissan, Van Genderen, Van Dolder, & Van Meeteren, 2008). A limitation to self-report questionnaires is that clinicians tend to over-estimate their performance (Hrisos et al., 2009; Sibley & Salbach, 2015). Other methods in the literature that measure use of standardized assessments include chart audit (Gervais et al., 2014) and clinician focus groups or interviews (Pattison, Brooks, Cameron, & Salbach, 2015). More than one method is useful for triangulating the data regarding use of standardized assessments.

Reported use of standardized assessment in the literature varies across setting, patient population, and insurance mandate. Three studies compared differences in use across setting (Jette et al., 2009; Salbach, Guilcher, & Jaglal, 2011a; Van Peppen et al., 2008). Van Peppen et al. (2008) found that outpatient private practice therapists used recommended standardized assessments 9% of the time and rehabilitation therapists used the recommended standardized assessments 73% of the time, while Jette et al. (2009) reported that private outpatient physical therapists were 7 times more likely than acute care therapists to complete standardized assessments and home care therapists were 12 times more likely to complete standardized assessments than acute care therapists. Salbach, Guilcher & Jaglal 2011 also looked at use of standardized assessments to evaluate walking for patients with stroke across settings and self-reported use was consistently highest in the rehabilitation setting. Pattison (2015) conducted interviews with PTs who treat patients with stroke and PTs who work in rehabilitation were most likely to use standardized assessment and PTs in acute care were least likely to use standardized assessments. One explanation for the differences between these articles, was that VanPeppen (2008), Salbach (2011) and Pattison (2015) reviewed the use of standardized assessments recommended for patients with stroke, while Jette et al. (2009) reviewed standardized assessments in general. In addition, home care therapists are required to complete a standardized assessment called the OASIS in the US and this could be why home care therapists reported a high likelihood of using standardized assessments compared to the Netherlands (Jette, 2009). Bland (2013) completed an intervention to improve the use of 39 standardized assessments for patients with stroke across disciplines (PT, OT, SLP) and settings (acute, rehabilitation and outpatient). After the intervention, adherence was measured via chart audit and use ranged from 52% to 88%, with acute care and rehabilitation being higher than outpatient. Bland (2013), Salbach (2011) and Van Peppen (2008) found use of standardized assessments was highest for therapists who worked with individuals with stroke in the rehabilitation setting.

Variation of use of standardized assessments across settings across articles may also be due to the country and sample. Jette et al. (2009) conducted the assessment in the United States using members of the American Physical Therapy Association (APTA). Members of the APTA may practice more evidence based and may not be a representative sample of physical therapists in the United States, which represents about 30% of physical therapists, physical therapists assistants and physical therapy students (American Physical Therapy Association, 2015).

Mandate may be another reason for reported variation in use. In the US, Medicare Part B insurance, which covers primarily outpatient services, mandates therapists to complete standardized assessments (Centers for Medicare and Medicaid Services, 2014). Abrams et al. (2006) reported a significant change in use of seven of the nine standardized assessments for low back pain in outpatient settings where the therapists who were employed by the Transport Accident Commission. Abrams (2006) also reported that all employees of the Transport Accident Commission were mandated to use specific standardized assessments.

While the use of standardized assessments has been reported lowest in the acute care setting (Jette et al., 2003; Salbach et al., 2007), to date studies have not reported the use of standardized assessments in the sub-acute and acute rehabilitation settings with general patient populations. Jette (2009) reported the odds of using standardized assessments by therapists who work in rehabilitation (including sub-acute) was 2.63 more than those who work in acute care, which was lower than outpatient and home care. PTs who work in inpatient sub-acute and acute rehabilitation are unique from PTs who work in rehabilitation for patients with stroke because they typically treat general patient populations, rather than one particular diagnosis. PTs who work in inpatient sub-acute and acute rehabilitation may see patients with musculoskeletal, neuromuscular, cardiopulmonary or integumentary disease or dysfunction and must select from standardized assessment that cross many patient populations. Using standardized assessments in sub-acute and acute rehabilitation guides discharge planning, communication with patients, families or the health care team, and can be used to determine outcome of an intervention and patient progress. As use varies across setting, evaluation of use at the local level is needed to determine if a problem in use of standardized assessments exists in order to create KT interventions.

2.4 Barriers and Facilitators to Using Standardized Assessments in Allied Health

There are multiple barriers and facilitators to using standardized assessments in allied health and several non-validated typologies have been developed to report these barriers and facilitators (Table 2-4). One systematic review (Duncan & Murray, 2012) (Table 2), on the barriers and facilitators to using standardized assessments in allied health has been published. Duncan & Murray (2012) included 15 articles (8 quantitative, 4 qualitative and 3 mixed methods) in their review and physical therapists were predominately studied. Duncan & Murray (2012) created four categories of factors that influence use of standardized assessments based on the literature on barriers and facilitators in allied health care. Several characteristics were listed under each category which could serve as a barrier or facilitator to standardized assessment use. The categories were created by expert opinion and author consensus after reviewing the literature (Duncan & Murray, 2012). The categories related to the clinician's personal values, the organizational support, the practice environment, the patients themselves. The categories were:

(1) Knowledge, education and perceived value

(2) Support and priority

(3) Practical considerations

(4) Patient considerations

Like Duncan and Murray (2012), other authors have created their own categories of organization to describe factors the influence standardized assessment use (Stevens & Beurskens, 2010; Swinkels et al., 2011; Van Peppen et al., 2008). Stevens and Beurskens (2010) developed four classifications (therapist, organizational, patient, and measurement) through a literature review in order to conduct semi-structured interviews to determine barriers and facilitators to use. Swinkels (2011) used Stevens and Beurskens (2010) four classifications of barriers or facilitators to assess barriers through interviews and development of a questionnaire (Stevens & Beurskens, 2010; Swinkels et al., 2011). Van Peppen (2008) identified six categories that act as facilitators or barriers (personal environment, practitioner, patient, professional attitude, economic environment, and administrative environment) when developing the behavior and facilitators questionnaire. O'Connor (2017) completed a mixed methods study of allied health professionals (PT,OT, SLP) on the use of standardized assessments for children with cerebral palsy and developed a "Cultural Cone Framework" that can be used to self- assess relative strengths and modifiable behaviors when choosing practical and behavioral interventions to increase use (O'Connor, Kerr, Shields, & Imms, 2017). The "Cultural Cone Framework" of evidence-based assessment behavior was informed the trans-theoretical model and the self-determination theory. The framework has levels of motivation and levels of readiness based on five factors: time, research congruence, assessment satisfaction, child and family collaboration and organizational expectations. While expert option has created most of these typologies and designed barrier assessment questionnaires, there has been a lack of theory behind development of barrier assessment. While the Culture Cone Framework exists, it has not been used in the literature.

2.4.1 Facilitators and Barriers to Using Standardized Assessments

The most frequently reported facilitators in the literature based on a systematic review that included survey data, qualitative and mixed methods research included: positive attitude, positive perceived value, higher degree, and knowledge of the assessment (Table 1) (Duncan and Murray, 2012). Kirkness & Korner-Bitensky (2002) added from chart audit and survey data that facilitators for using standardized assessments included PTs who provided more treatments ($p<0.01$), treated patients for a longer period of time ($p<0.01$) and that payment for services was not from private insurance ($p<0.01$). Pattison et al. (2015) reported through interviews that admission notes from previous PT encounters and patient functional level influenced use of standardized assessments. O'Connor (2017) added organizational support and resources could be facilitators or barriers to standardized assessment use in evaluation of children of Cerebral Palsy. Meerhoff (2017) used mixed methods to determine the facilitators and barriers to using patient related outcome measures and found that facilitators included: availability of the measures, involvement in the implementation strategies, and insurance.

Frequently listed barriers to using standardized assessments (table 2-4) in the literature included lack of time, lack of knowledge of the measures, and that change is difficult. In addition, Swinkels (2011) found through a questionnaire that 50% of private practitioners thought there were too many measures, and 47% believed that using standardized assessments required additional compensation. Patient related barriers were highlighted by Pattison et al. (2015), through interviews with PTs who worked with patients with stroke. Pattison (2015) reported patients with stroke had barriers such as impaired cognition, aphasia, fatigue, visual neglect, impaired proprioception and number of patients on the caseload made using standardized assessment more difficult.

Barriers and facilitators for using standardized assessments were measured in a variety of ways through surveys, interviews, focus groups and mixed methods. Self-reported questionnaires asked PTs to agree or disagree on a statement and reported the outcome as either a barrier or facilitator for use (Jette et al., 2009; Swinkels et al., 2011). Jette (2009) reported facilitators for use based on percentages of agreement among the participants. Questionnaires include statements provided by the investigators which may bias the reporting of facilitators and barriers. While questionnaires provide some level of detail of the factors that influence use of standardized assessments, qualitative methods (interview or focus group) offer more insight about the relationship between factors that influence use and use itself (Sibley et al., 2013). Qualitative reports provide insight for creating interventions to increase standardized assessment use.

There are surprisingly few studies in which the relationship between of factors that influence use and use of standardized assessments has been statistically modelled. Copeland et al. (2008) reported the odds of using standardized assessments by PTs who evaluate patients with low back pain was related to knowledge of the measure

(OR=1.75, $p<0.001$) and having a Master’s degree (OR=2.5, $p=0.05$). Consideration of these two factors alone may vary across different settings depending on the clinicians who work there, which make context specific assessment more important.

Table 1: Duncan and Murray (2012) Systematic Review on Barriers and Facilitators to Using Standardized Assessments in Allied Health

Author/ Country	Design	Population/ Setting	Facilitators	Barriers
(Duncan & Murray, 2012) (Includes: Abrams, Copeland, Jette, Van Peppen)	Systematic Review, 15 papers included, 8 quan, 4 qual and 3 mixed methods	PT OT, SLP, n=2161, n=1450 PT Setting: not reported	Knowledge, education and perceived value knowledge, Master's level degree, clinical specialists, perceived value Support and priority high organizational commitment, colleagues support, management support, choice of measures Practical Considerations measures that are appropriate, do not take much time to document Patient considerations Support understanding, facilitate discharge planning, communication and treatment management, make comparative clinical assessments, easy to understand, patients do not think it's time consuming	Knowledge, education and perceived value Barriers: lack of knowledge, lack of perceived value Support and priority Barriers: low organizational priority, low support, inappropriate use of outcome data by management, restricted by measures Practical Considerations Barriers: time-patient, clinician, number of patients seen, & institutional restrictions lack of appropriate or available measures, lack of funding/high costs, lack of appropriate standardized assessments Patient considerations Barriers: outcome measures did not inform practice, too subjective, not useful in practice, poor fit, perception that they are not relevant, concerns about pts ability to complete –too complicated, confusing, high reading level, language barriers, lack cultural sensitivity, patient become disheartened if progress is slow

Table 2: Surveys Reporting Barriers, Facilitators and Use of Standardized Assessment in Allied Health

Author/ Country	Design	Population/ Setting	Facilitators	Barriers	Use
(Abrams et al., 2006) New Zealand	Uncontrolled pre-after study	PRE: 154 Private practice PT who treat LBP	Positive attitudes p=0.02	80% reported lack of time and lack of familiarity	Post intervention, p<0.05 inc in use of 7/9 recommended standardized assessments
(Burton et al., 2013b) UK	Cross-sectional survey	84 health care providers (PT, OT), 12 managers Stroke rehab	High perceived value: demonstrate effectiveness interventions and monitor pt progress	Lack of resources (time and training), lack of knowledge.	96% used at least one OM, < 50% use during pt stay, mean number of tools 3.2 (SD=1.9),
(Sibley, Straus, Inness, Salbach, & Jaglal, 2013) (Sibley et al., 2011) Canada	Cross-sectional survey	369/1000 PT balance assessments Ortho (46.3%), neuro (21.4%), geriatrics (7.9%) General rehab 24.4%	Desire to improve practice (ALL Settings) Sig differences among groups that SLS (Ortho 91.2%, Neuro 78.5%, Geri 62.1%, general 77.8%) and BERG (Ortho 58.5%, Neuro 94.9%, Geri 72.4%, general 82.2%) is useful for clinical decision Sig differences between groups that SLS (Ortho 84.8%, Neuro 72.2%, Geri 48.3%, general 72.2%), BERG (Ortho 57.9%, Neuro 87.3%, Geri 72.4%, general 84.4%), TUG (Ortho 49.7%, Neuro 75.9%, Geri 69.0%, general 74.4%) is useful for evaluating change over time	Lack of time 61.8%, lack of knowledge 44.4%, tools not available 28.7%, tools not appropriate 39.2% (n=293)	80% reported use OM >60% of the time. SLS used 79.1%, BERG 45%, TUG 27.6% No sig differences in use in practice area for assessment of static and dynamic balance. Sig differences in practice area with assessment of posture (Geri and General lowest), reactive control (Neuro highest), functional balance (ortho lowest),

					sensory contributions (neuro highest), cognitive contributions (neuro highest)
(Van Peppen et al., 2008) Netherlands	Cross-sectional survey	N=167 PT who work with pt with CVA N=57- acute care hospital (ACH) N=63-rehab (RC) N=25-home care N=22-private practice	Positive attitude (93%), familiarity (90%), ability to make a comparative clinical assessment (90%), cooperation of colleagues (83%)	Changing routines (32%), time (29%), and financial compensation (21%).	RC or ACH significantly greater use of OM than their private practice colleagues
(Salbach, Guilcher, & Jaglal, 2011b) Canada	Cross-sectional survey	270 PT who treat pt with CVA Acute care=106 (39.6%) Rehab n=43 (16%) outpatient n=28 (10.5%)	Clinical practice guideline recommendations on measures to use (40%)	Unaware or unsure that valid and reliable measures for walking exist 40.1% Lack of time (28.1%), Lack of knowledge (25.6%), OM does not meet clients' needs (23.3%), OM difficult to administer (21.1%), lack of consensus on which OM to use (17%)	Freq use >6/10 pt Chedoke-McMaster Stroke Assessment (61.1%), FIM 45.2%, gait speed test 32.2% Evaluate pt 44.6% Monitor change over time 42.9% Form a prognosis 19.4% Judge readiness for discharge 28.4%

Table 3: Mixed Methods and Qualitative Design Reporting Barriers, Facilitators and Use of Standardized Assessment in Allied Health

Author/ Country	Design	Population/ Setting	Facilitators	Barriers	Use
(Copeland et al., 2008) New Zealand	Mixed methods (Survey and Focus Group)	PT who treat LBP, n=369 Focus group n=12	Survey: master's degree (OR=2.5, CI 95% 0.99-6.36, p=0.05, knowledge of measure (OR=1.75, 95% CI 1.47-2.09, p< 0.001)	Focus group themes: (members of the focus group did not use OM): time, lack of knowledge, perception that it would not provide any useful information, not patient specific. Survey: Time (p=.14)	Only 40.3% used any OM related to LBP
(Kirkness & Korner-Bitensky, 2002) Canada	Mixed Methods (Chart review and survey)	53 PT, 265 charts	Source of payment, average length of treatment and number of treatments		31% of charts used OM at initial evaluation, 34% of PT were consistent users of SOM
(Meerhoff et al., 2017)	Mixed methods	272 PT, Interviews 21	Availability of core set, active involvement in implementation strategy, enable to be transparent about results of care. Insurance	Lack of competence, resistance to chance, lack of time, lack of available OM. Not user friendly Belief OM too long or difficult Insurance	Chart Audit: OM at pretreatment: 25.5%, OM use at pre and post treatment: 12.5%
(O'Connor et al., 2017)	Mixed methods (focus group interviews, chart audits, survey)	55 PT, OT, SLP (surveyed), 44 charts review, 3 FG with 4-7 allied health	High Users: Organizational structures, resources, therapists (support), child and family, tools themselves	Low users: organizational structures and resources	Chart audit: GMFCS: 84% (37/44 charts) Self-report CMFCS: 22% (n=12) rated 75-

					100%, 53% (n=29) rated 0-5%
(Pattison, Brooks, Cameron, & Salbach, 2015) Canada	Qualitative, semi-structured interview	28 PT wo evaluate pt with CVA. Acute care n=8, rehab n=11, outpatient n=9	Familiarity with the outcome measure, colleagues, results having meaning relevance, pt functional level, ease of use, time to administer, space, admission notes, PT students, evidence, recently graduated, reliability and validity organized stroke system, Ontario stroke network	Patient barriers: cognition, language barriers, fatigue, visual neglect, impaired proprioception Therapist: Time, lack of space and too many patients	Use: 28% did not use- 62% in acute care, 18% in rehab, 11% in outpatient
(Stevens & Beurskens, 2010) Dutch	Qualitative- semi-structured interview	11 PT-outpatient	Knowledge and competence	PT-competence and attitude (knowledge, education, routine, experience, diagnosis) Organization: practice, colleagues, pt, measurement instruments	Use: <50% used PCS or 6MWT
(Swinkels et al., 2011) Netherlands	Mixed methods (survey and interview)	Semi-structured interview, 20 PT Survey: 468/2000, 84% private practice, 16% SNF	Private practice: already use (97%), positive attitude (85%), convinced they improve treatment (85%), convinced of benefits (83%) SNF: post attitude (97%), eval effect of tx (97%), clinometrics leave room for personal considerations (96%), convinced of benefit (89%)	PP: no measurements for diagnostics (63%), change is difficult (54%), too many (50%), requires extra $ (47%) SNF: no support of management (56%), change is difficult 32%, not enough measurements (23%,) too much time 14%	Not reported

2.4.2 Differences in barriers and facilitators across clinical settings

While previous research has identified a number of different types of barriers and facilitators, research also indicates that increasing PT use of standardized assessments in treatment is not simply a matter of strengthening a list of facilitators and overcoming a set of barriers. Local treatment contexts matter. In each setting, there are specific characteristics that can act as barriers, facilitators, or neither.

Significant differences in barriers and facilitators were found across settings but varied in the literature (Table 4). Van Peppen et al. (2008) reviewed facilitators of the recommended standardized assessments for patients with stroke in acute care, rehabilitation, nursing home, and private practice and found significant differences in barriers between outpatient private practice versus rehabilitation and acute care hospital. Private practice outpatient therapists had significantly less knowledge, less experience, less training of recommended standardized assessments (Private practice to rehabilitation center, $p=0.02$, private practice-acute care hospital, $p=0.02$); private practice therapists reported more difficulty incorporating standardized assessments into their work routine, less managerial support, less support from colleagues (private practice-rehab center, $p< 0.001$, private practice-acute care hospital, $p< 0.001$, private practice-nursing home, $p=0.014$) and private practice therapists believed that they should receive additional compensation for using standardized assessments and believed that patients find using standardized assessments too time consuming (private practice-rehab center, $p=0.03$). The self-report questionnaire revealed that 73% of rehabilitation center therapists use recommended standardized assessments while only

9% of private practice therapists use the recommended standardized assessments for patients with stroke. VanPeppen et al. (2008) concluded that the differences in barriers and facilitators between settings supports tailoring implementation strategies to each setting. Salbach (2009) found similar barriers in a qualitative study with 23 PTs who treated patients with stroke. PTs reported barriers including fewer resources in private clinic, home care and rural settings, infrequent access to peers, and fewer treatment sessions allowed which restricted ability to apply best practices (Salbach et al., 2009).

Swinkels et al. (2011) also found differences in barriers and facilitators between private practice therapists and therapists who worked in skilled nursing facilities. Both settings reported barriers of lack of knowledge and that it is difficult change behavior. Private practice therapists reported that too many standardized assessments exist, while therapists who worked in skilled nursing home reported not enough measures exist. Interview data also found a barrier to using standardized assessments was a lack of organizational policy (Swinkels et al., 2011).

Sibley (2013) found differences by practice area on whether or not PTs found balance assessment useful. Practice area included orthopedics, neurology, geriatric and general rehabilitation. Significant differences were found between practice area and the perceived value of different standardized assessments (single leg stance, the Berg, and the Timed up and go). Organizational support also varied across settings. The therapists who worked at skilled nursing facilities reported a barrier of little managerial support

(Swinkels et al., 2011), while the private practitioners in Van Peppen et al. (2008) reported little managerial support.

O'Connor (2017) found differences in barriers and facilitators amongst therapists in two organizations on standardized assessment tools for treating children with cerebral palsy. High users (>50%) rated organizational structure, resources, therapists support, children and family and the tools themselves were all facilitators to using assessments, while low users (0%) rated organizational structure and resources as barriers to some extent.

VanPeppen et al. (2008) and Swinkels et al. (2011) identified differences between settings, but comparison was difficult because purpose of assessment and assessment strategies varied. Swinkels et al. (2011) reviewed the use of standardized assessments in general and VanPeppen et al. (2008) determined the use of recommended standardized assessments by a clinical practice guideline for stroke. Private practice therapists agreed in VanPeppen et al. (2008) and Swinkels et al. (2011) that additional compensation should be required to use standardized assessments. VanPeppen et al. (2008) discussed that lack of standardized assessments use among private practice outpatient therapists who treat patients with stroke was not surprising because outpatient private practice therapists may not treat as many patients with stroke as compared to therapists working in rehabilitation centers and therefore may not have the same knowledge and use of the recommended standardized assessments. The heterogeneity among setting, and organizational support suggests that different settings may have diverse barriers and facilitators and that a context specific, local, barrier assessment specific may work best when creating a behavior change intervention to address specific barriers. By understanding the factors that influence use, an intervention can be developed to overcome the barriers, and enhance the facilitators to increase the use of standardized assessments.

Table 4: Differences in barriers and facilitators reported by practice setting and patient population

	Private practice	Acute Care	Rehab	SNF
Knowledge (stroke assessments)	(-)	(+)	(+)	(0)/ (-)
Experience (stroke)	(-)	(+)	(+)	(0)
Training (stroke)	(-)	(+)	(+)	(0)
Managerial support	(-)	(+) / (-)	(+)	(+)
Support from colleagues	(-)	(+)	(+)	(+)
Compensation	(-)	(-)/ (0)	(0)	(0)
Attitude	(+)	(+)	(+)	
Enough standardized assessments	(+)/ (-)	(-)	Not Reported	(-)
Changing Routine	(-)	Not Reported	Not Reported	(-)
Organizational Policy	(-)	Not Reported	Not reported	(-)
Time	(-)	(-)	(-)	(-)
(-) = Barriers (+) = Facilitator (0) = Neither barrier or facilitator				

2.5 Models of KT

In order to address the lack of use and the barriers to using standardized assessments, researchers must select a model, theory or framework in which to base KT interventions. The use of theories, models and frameworks to guide the KT process and the develop KT interventions has been suggested as a way to improve, organize, and explore the phenomena of behavior change including use of standardized assessments by physical therapists (Eccles, Grimshaw, Walker, Johnston, & Pitts, 2005; Hudon et al., 2014; A. L. Kitson et al., 2008; Sudsawad, 2007). Confusion exists among the terms models, frameworks and theories as investigators often use the terms inter-changeably (Colquhoun, Letts, Law, MacDermid, & Missiuna, 2010; Estabrooks, Thompson, Lovely, & Hofmeyer, 2006; A. L. Kitson et al., 2008). Kitson (2008) defined conceptual frameworks as "a set of variables and relationships that should be examined in order to understand a phenomenon" (Kitson et al., 2008), model as "a specific situation that is narrower in scope and more precise on its assumptions," and theory as "a dense and logically coherent set of relationships that offer views (hypotheses) on the causal relationships and seeks to explain the phenomena" (Kitson et al., 2008).

Hudon (2014) suggested by using frameworks to guide KT research, investigators can systematically approach KT interventions and determine which framework(s) are most effective. Michie, Johnston, Francis, Hardeman, and Eccles (2008) suggested that theories should be used to design interventions because: (1) interventions will be more effective if they target the causal determinants of behavior change; (2) hypotheses can be tested; and (3) investigators who base interventions on theories can identify strategies that may result on behavior change and determine what works in different contexts (Michie et al., 2008).

Despite their importance, theories, models and frameworks are underutilized in allied health research (Davies, Walker, & Grimshaw, 2010; Hudon et al., 2014). Davies

(2010) completed a systematic review on use of theories in KT research and found only 53 of 235 (22.5%) studies used theories in some manner, while only 14 used theory explicitly.

Straus, Tetroe, and Graham (2009) highlighted numerous types of theories that can be used in KT research including (Straus et al., 2009):

- Planned action theories
- Cognitive psychology theories
- Educational theories
- Organizational theories
- Quality improvement theories

The theory selected can help to identify strategies used in KT that may result in behavior change and provides variables to evaluate the change. Several articles have been written to provide detailed descriptions and review of KT models, frameworks and theories including: adult learning theory, social cognitive theory, theory of planned behavior, diffusions of innovations, Promotion Action on Research Implementation in Health Service, Ottawa Model of Research Use, and the KTA Framework. (Colquhoun et al., 2010; Davies et al., 2010; Estabrooks et al., 2006; Sudsawad, 2007).

2.5.1 More than one model

Due to the complexities of KT and behavior, the use of more than one theory, model, or framework may be warranted to develop and test KT interventions. The KT Clearinghouse (2014) also supports the use of two or more theories, frameworks or models as they state:

> “There exist two classifications of conceptual theories and/or models of change used as reference when implementing research into practice. There are theories and/or models that describe change but not how to go about implementing change and those that are targeted for use to guide change and cause change (KT Clearinghouse., 2014).

Frameworks have been developed to guide the overall KT process (i.e. the KTA Framework or Implementation of Change Model), while other frameworks, models, theories provide specifics within that process. Framework, models and theories can be used provide guidance for barrier assessment and intervention development and may focus on the individual practitioner (Theoretical Domains Framework (TDF), Planning Model for Process Change), the organization (TDF, PARiHS), the patient or multiple levels (Table 5). When reviewing the literature in KT in allied health, only a few models, theories, and frameworks have been used. Table 5 highlights the most common used frameworks in allied health research and the purpose of the frameworks as well the steps included and the advantages, disadvantages of each.

The most commonly used framework in KT research in allied health was developed by expert opinion through careful examination of multiple theories is the Knowledge-to Action (KTA) Framework (Graham et al., 2006). The KTA Framework (Graham et al, 2006) was developed by reviewing over 60 planned action theories. It is a meta-framework used to guide the steps to KT. The outer ring of the KTA Framework is an action cycle that (FIGURE 1) identifies multiple steps in the KT process.

1. Identification of a problem: Graham (2006) suggested that an individual or group and identify a problem and search the literature that might address that problem. Alternatively, the individual or group may start by identifying the literature and determine whether there is a knowledge-practice gap (Graham, 2006).
2. Adapting knowledge to the local context or tailoring the knowledge to the specific setting.
3. Assessing barriers and facilitators to knowledge use. Graham (2006) described the purpose of this step as “those wanting to bring about change should assess for potential barriers that may limit uptake of knowledge so that these barriers may be targeted and overcome…. The barrier assessment should also identify supports or facilitators that can be taken advantage of.”
4. Selecting, tailoring and implementing the intervention
5. Monitoring Use
6. Assessing outcomes
7. Sustaining Use

The KTA Framework has previously been used with other framework in the allied health literature (Tilson and Mickan, 2014; Salbach et al., 2017). Complementary frameworks that work together to guide KT and develop intervention have previously been in allied health (Stevens & Beurskens, 2010; Tilson& Mickan, 2014). The KTA framework and PARiHS framework were used together to inform a KT intervention to increase the use of best evidence in outpatient physical therapy practice (Tilson&

Mickan, 2014). Tilson & Mickan (2014) used the KTA framework was used to provide overall guidance in development of the KT intervention and the PARiHS framework to consider the culture of the management and the evidence when creating the KT intervention. The KTA and PARiHS framework work in complementary ways as the KTA provides overall guidance while the PARiHS considers context. Salbach (2017) also used the KTA and PARiHS frameworks to inform the design of a cluster randomized controlled trail on the use of a stroke CPG.

As the PARiHS framework focuses primarily on the organization, the Theoretical Domains Framework (Michie et al, 2005) was developed through analysis of motivational, action, and organizational behavior change theories and considers practitioner, patient, organizational, and practice environment as barriers to change. The TDF provides a more comprehensive picture of the factors (barriers or facilitators) that influence behavior change. The TDF includes 14 domains (128 constructs) of behavior change including: knowledge, skills, social/professional role and identity, beliefs about capabilities, optimism, beliefs about consequences, reinforcement, intentions, goals, memory, attention and decision process, environmental content and resources, social influences, emotion, and behavioral regulation.

The KTA and TDF are two complementary frameworks that can be used to develop and implement at KT intervention to increase the use of standardized assessment in PT practice. The KTA can be used to guide the KT process, while the TDF can be used for barrier assessment at multiple levels (patient, clinician, organization) in order to select strategies and development of the intervention. The KTA and TDF were used together to develop and implement a KT intervention for the pilot project (Romney et al., 2018).

Table 5: KT Framework Overview

Frameworks	Steps	Advantages/Disadvantages
GUIDE KT PROCESS		
Implementation of Change Model (Grol, Wensign, & Eccles, 2005)	1. Development of proposal for change 2. Analysis of actual performance, targets for change 3. Problem analysis of target group and setting 4. Development and selection of strategies and measure to change practice 5. Development, testing and execution of implementation plan 6. Integration of changes in routine care 7. Continuous evaluation and (where necessary adapting plan)	**Advantages:** -Provides steps needed to guide the KT process (development and evaluation of behavior change) -Developed by reviewing practitioner, environmental and organizational theories including (cognitive, educational and motivational, social interaction, organizational and economic) **Disadvantages**: -Infrequently used in KT literature (2 studies included in this narrative review) -Lack guidance to assess barriers and build implementation strategies

Knowledge-to-Action Framework (Graham et al., 2006)	**Knowledge Creation:** 1. Knowledge Inquiry 2. Knowledge synthesis 3. Knowledge Tools/Products **Knowledge Application** 1. Identification of a problem 2. Adapting to the local context 3. Assessment of barriers and facilitators 4. Selecting, tailoring and implementing an intervention 5. Monitoring use 6. Assessing outcomes 7. Sustaining use	**Advantages:** -Knowledge creation and knowledge application cycles -Recommends distilling knowledge to level of key stakeholders -Application cycle is iterative and dynamic -Developed by 60 planned action theories -Adopted by the CIHR and WHO -Considers context, individual, environment and evidence -Most frequently used in KT literature **Disadvantages**: -Lacks guidance to assess barriers -Lack guidance to build intervention
Organizational Framework		
Promoting Action on Research Implementation in Health Services	Successful KT is a function of context (environment, where people work),	**Advantages:**

(PARiHS) (A. Kitson, Harvey, & McCormack, 1998)	nature of the evidence, and strategies being used.	-Considers context and evidence when selecting strategies used to implement the evidence -Developed by expert nurses in KT -Recommends team-based strategies to implement evidence **Disadvantages**: -Lacks guidance in barrier assessment -Lacks guidance to build intervention -Does not recommend strategies to determine outcomes
Organizational, Individual and Patient Framework		
Theoretical Domains Framework (Cane et al., 2012; Michie et al., 2005)	-14 domains need to assessed to determine barriers and facilitators of behavior change: knowledge, skills, social/professional role and identity, beliefs about capabilities, optimism, beliefs about consequences, reinforcement, intentions, goals, memory, attention and decision process, environmental content and	**Advantages:** -Validated (Cane et al., 2012; Michie et al., 2005) -Guides barrier assessment and intervention development -Developed through review of motivation, action, and organizational behavior change theories

	resources, social influences, emotion and behavioral regulation	-Considers practitioner, patient, organizational, practice environment barriers to change -Complementary taxonomy (consensus matrix) was developed to assist with intervention development -Behavior change wheel developed to guide intervention development **Disadvantages**: -Lacks guidance of overall KT process -Lacks guidance to determining outcomes
Individual Level Framework		
Planning Model for Process Change (Grol et al., 2005)	Phase of Behavior Change 1. Orientation 2. Insight 3. Acceptance 4. Change 5. Preservation of Change	**Advantages:** -Guides KT intervention development based on phase of change **Disadvantages:** -Lacks guidance of overall KT process

		-Lacks guidance to determining outcomes -Considers practitioner level only, not contextual, organizational, and patient barriers

2.5.2 Frameworks that provide high level guidance for the KT process

The KTA framework (Figure 1) and Implementation of Change Model (Figure 2), and the provide high level guidance for the KT process. The Implementation of Change Model has been used in several articles in allied health (Bernhardsson, Larsson, et al., 2014; Meerhoff et al., 2017; Stevens & Beurskens, 2010). Bernhardsson (2014) developed a KT intervention to increase the use of clinical practice guidelines on low back pain, neck pain and sub-acromial pain in physical therapy care. Self-reported behavior change after the intervention was not significant and Bernhardsson (2014) concluded that the Implementation of Change Model did not provide enough guidance to link intervention components with the target groups. Stevens & Beurskens (2010) used the Implementation of Change Model to develop a KT intervention to increase the use of standardized assessments in outpatient physical therapy practice. The outcome of the intervention using this model was not evaluated. Meerhoff (2017) used the Implementation of Change Model to implement a KT intervention to increase the use of patient reported outcome measures in outpatient physical therapy and reported some improvement of patient reported outcomes in assessment. The Implementation of Change Model is similar to the KTA Framework but it does not include evaluation of impact of the innovation as well as the knowledge creation funnel in order to distill and synthesize knowledge for end users.

The KTA framework is the most frequently used framework in physical therapy literature. It has been applied to interventions to improve evidence based treatment of cerebral palsy (Campbell et al., 2013), use of best evidence for low back pain (Tilson&

Mickan, 2014), care for patients with stroke (Nanninga, Postema, Schonherr, van Twillert, & Lettinga, 2015; Richardson et al., 2015), use of standardized assessments for PTs who work in the outpatient pediatric setting (Russell et al., 2010) and PTs who evaluate and treat patients with stroke (Sibley & Salbach, 2015) as well as EBP for allied health professional (Moore, 2017). It has been used in iterative and dynamic ways to improve clinician behaviors of examination (use of standardized assessments) and evidence-based interventions. The KTA framework has been applied a variety of settings including rehabilitation, outpatient orthopedics, outpatient pediatrics, and home care. In addition, it has been applied to specific patient populations, such as stroke and cerebral palsy.

The KTA framework provides a high level guide with steps to create and evaluate complex interventions for behavior change (including use of standardized assessments) and recommends use of mixed methods to determine the outcome and the impact of the behavior change on the clinicians, patients and organization. Use of mixed methods can help future researchers improve KT interventions. The KTA is easily applied to improve the use of standardized assessments by physical therapists who work rehabilitation, because it provides guidance in the KT process and it has been previous used to increase the use of standardized assessment by physical therapists who work in outpatient and pediatric settings.

Figure 1: Knowledge to Action Framework

Figure 1: Knowledge to Action Framework

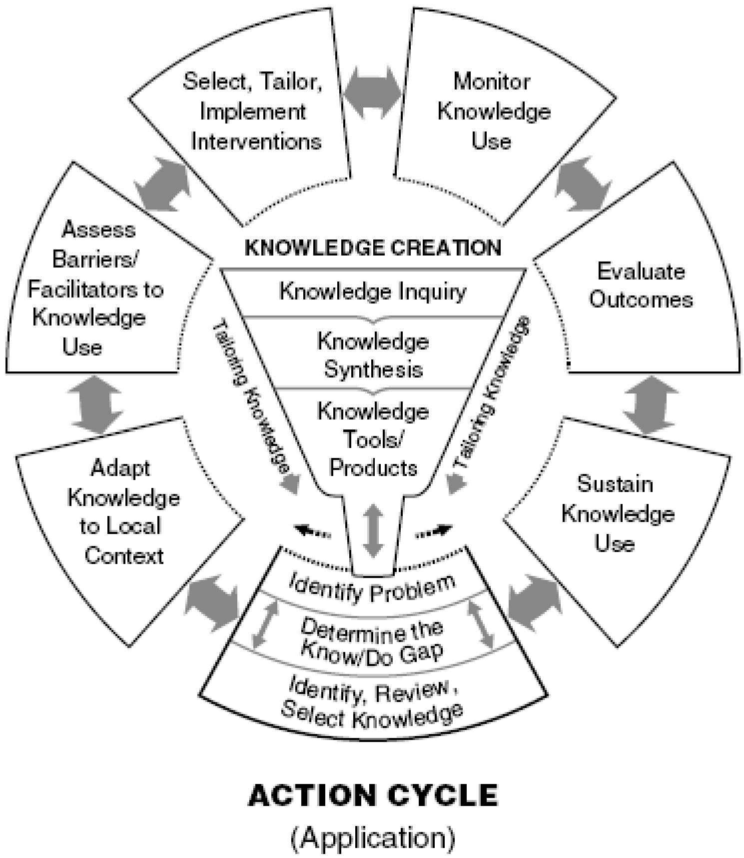
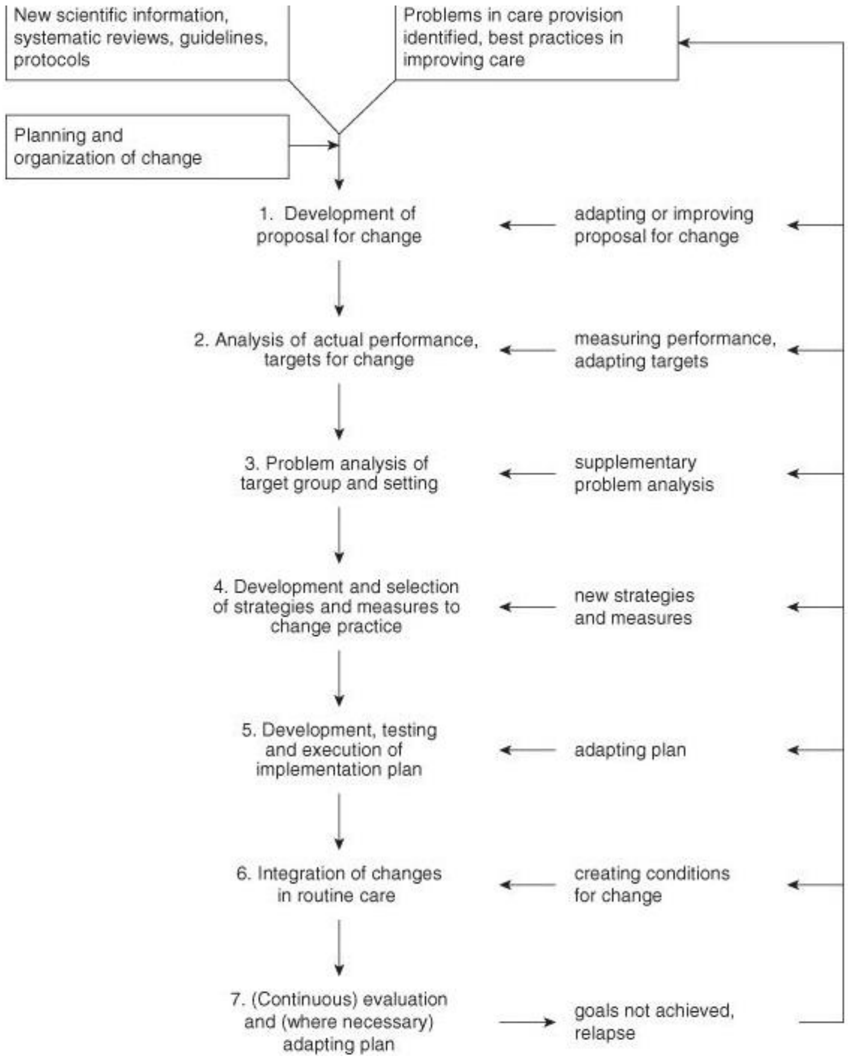


Figure 2: Implementation of Change Model

Figure 2: Implementation of Change Model



2.5.3 Frameworks that guide barrier and facilitator assessment and intervention development

In PT literature, two frameworks have commonly been used to guide barrier assessment to determine barriers and facilitators of behavior change including the Theoretical Domains Framework (Michie et al., 2005) and the Planning Model for

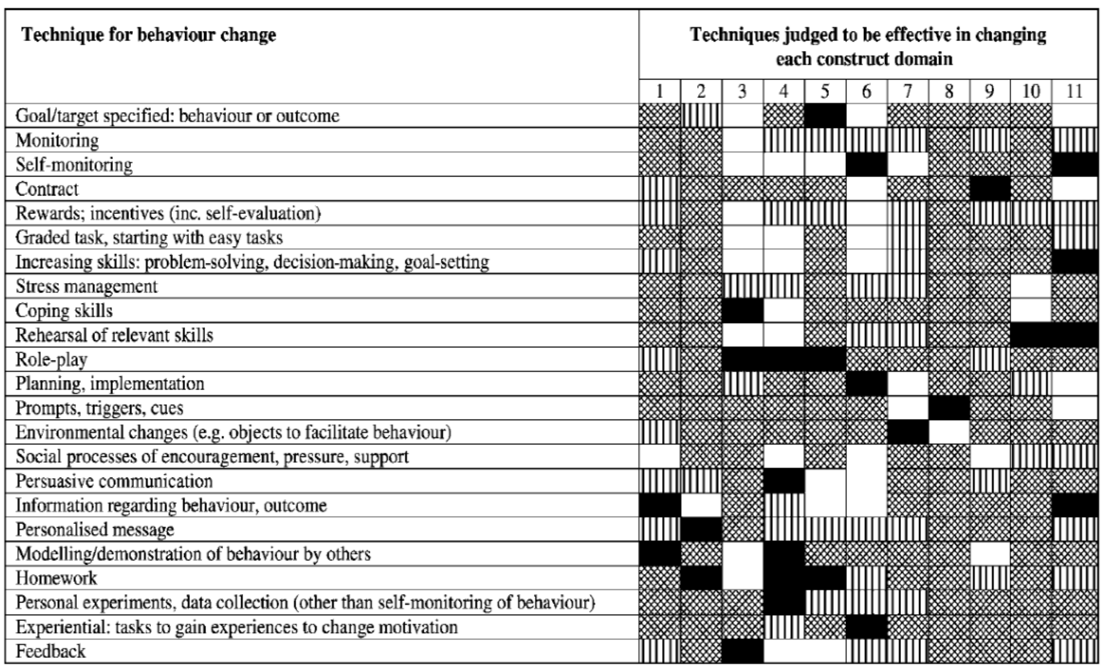
Process Change (Grol et al., 2005). The Theoretical Domains Framework (TDF) is the only validated framework in allied health to assess barriers and facilitators and develop interventions. It is also the most frequently used framework to assess barriers and facilitators.

The TDF has been used in allied health research to assess barriers and facilitators to treatment of non-specific neck pain by chiropractors (Bussieres et al., 2015), to enhance communication with patients who have low back pain by PTs (Matthews et al., 2015) and to improve PT referral for fall prevention assessment (Thomas & Mackintosh, 2014). In the literature on KT and allied health, barrier assessments are frequently conducted qualitatively using the TDF (Francis, O'Connor, & Curran, 2012), through focus groups (Matthews et al., 2015; Thomas & Mackintosh, 2014) and interviews (Bussieres et al., 2015). Qualitative assessment can be completed easily as the TDF includes sample interview questions to guide barrier assessment (Michie et al., 2005). Questions of feasibility of arise with the qualitative of barrier assessment using the TDF, so the use of questionnaires may help reduce the time burden (Thomas & Mackintosh, 2014; French et al. 2012). There is one questionnaire that was created using the TDF that relates to use of clinical practice guidelines by PTs on physical activity (Huijg et al., 2014). The Determinants of Implementation Behavior Questionnaire was developed and validated which includes 93 items assessing 18 domains based on 12 of the 14 domains in TDF (Huijg et al., 2014). Currently, no questionnaires have been published that are validated using the TDF on the use of standardized assessments.

In addition to the barrier assessment, authors of the TDF have developed two complementary taxonomies to guide intervention development, a consensus matrix and the Behavior Change Wheel (Michie et al., 2008; Michie, van Stralen, & West, 2011). The use of taxonomies to guide intervention development is a novel approach in KT literature. The consensus matrix (Figure 3) links 35 recommended techniques for behavior change with 11 of the 14 TDF domains (Michie et al., 2008). Three articles report using the TDF with the consensus matrix to determine barriers and develop a behavior change intervention (Bussieres et al., 2015; Matthews et al., 2015; Sibley et al., 2016). Unfortunately, the results of the behavior change have not been published. Mapping barrier to interventions has been completed both qualitatively through interviews (Bussieres et al., 2015) and focus groups (Matthews et al., 2015) or through barriers found on survey data (Sibley et al., 2016). Bussieres (2015) used the TDF to determine barriers and developed a behavior change intervention for chiropractors on the management of neck pain. Thirteen chiropractors were interviewed based on the interview guide in the TDF. Two assessors reviewed the interviews for themes and a 15-member expert panel formally met to design the KT intervention using the consensus matrix for a planned feasibility study with chiropractors who treated individuals with neck pain. Matthews (2015) used the consensus matrix to guide barrier assessment and developed the intervention through two focus groups in order plan an intervention to improve physical therapist's communication to patients with low back pain. Sibley (2016) reported on the development of a KT intervention targeted at increasing the use of reactive balance assessment for individuals' post-stroke. The investigators mapped a barrier survey to TDF domains through a consensus process and mapped TDF domains to the consensus matrix to develop the intervention. The final intervention strategies included interactive educational sessions and local champions. Determining the effectiveness of the intervention is planned through a controlled study (Sibely, et al., 2016).

Figure 3: Complementary Taxonomy (Michie, 2008)

Figure 3: Complementary Taxonomy



(White=Agreed Use, Black-Disagreement, Stripes-Uncertain, Cross Hatch-agreed non use

Michie (2011) also created the Behavior Change Wheel (BCW) as a complementary framework with the TDF to guide intervention development. The BCW is based on a 'behavior system' that individual capabilities, opportunities, and motivation interact and influence behavior (COM-B system). The behavior system is linked to interventions such as education, training, coercion, and environmental changes. The interventions are also linked to policies within an organization. The BCW guides selection of interventions and organizational policies that interact and can change an individual's behavior. Thomas & Mackintosh (2014) conducted a study using the TDF and the BCW for fall risk prevention strategies among physical therapists at an acute care hospital using a mixed methods design. Thomas & Mackintosh (2014) used focus groups guided by the TDF to identify barriers and the BCW to guide intervention development, but details of the design were not reported. Connell (2015) used the BCW to develop a KT intervention with researchers and clinicians to increase upper limb exercises for patients in rehabilitation after stroke. Connell (2015) conducted a behavioral analysis using the COM-B to identify areas to change prior to implementation, but details of the design were not included (Connell, McMahon, Redfern, Watkins, & Eng, 2015; Connell, McMahon, Tyson, Watkins, & Eng, 2016).

Two studies reported using the Planning Model for Process Change to guide barrier assessment and intervention development (Bekkering et al., 2003; Stevens & Beurskens, 2010). Barriers were assessed qualitatively in a focus group by Stevens and Beurskens (2010), while a questionnaire was used to assess barriers in Bekkering (2003). Steven and Beurskens (2010) developed the intervention by determining the phase of behavior change and matching interventions based on the phase with recommendations in the Planning Model (Steven and Beurskens, 2010). Bekkering (2003) did not describe the development of the intervention.

One criticism in KT research is that interventions are often created by investigators intuition without use of a theoretical framework to guide development (Michie et al., 2005; Scott et al., 2012). Behavior change theories, models and frameworks have been recommended to assist with development and refinement of the intervention. While several articles in this literature review did not report using a model, theory or framework to guide intervention development, other articles were very heterogeneous in the use of different models, theories and frameworks (Table 6).

Table 6: Use of Theories, Models or Frameworks to develop KT Interventions

Theories, Models or Frameworks	Frequency of Use
Planning Model for Process Change	2 (Bekkering, et al, 2003, Stevens & Beurskens, 2010)
Bandura's (1978) Social Cognitive Theory	1 (Demmelmair, 2012)
TDF Consensus Matrix	2-Busseires (2015), Matthews (2015)
Behavior Change Wheel	2 (Thomas, 2015, Connell, 2016)
Organizational, Behavior Change, Motivational Theories	1 (Campbell, 2010)
Total Use/Total Studies Included	8/41

While multiple frameworks have been used for barrier assessment and intervention development in allied health literature, the TDF is the only framework that has been validated and considers practitioner, patient, organizational and environmental related barriers and facilitator to change. In addition, the TDF provides guidance with barrier assessment including interview questions and matches barriers with recommended intervention strategies using the consensus matrix. The consensus matrix maps easily to intervention strategies while the behavior change wheel requires additional training for use. The TDF and consensus matrix has only been used to guide barrier assessment and develop an intervention with the purpose to increase the use standardized assessment by PTs that work in rehabilitation in the pilot work (Romney et al., 2018). To date, no literature has been published reporting the results of an intervention designed using the TDF and consensus matrix.

2.6 Methods to measure behavior change

Questionnaires are the most frequently used method to measure use of standardized assessments in allied health. There are also a number of methods that need to be evaluated to determine behavior change following a KT intervention. In order to select the best method to measure the desired behavior change this section will review (1) methods used to measure behavior change, (2) methods used in allied health and KT research, (3) the best methods used to determine change of use of standardized assessments or the impact of the intervention. A literature review was conducted to determine KT interventions used in allied health (PT, OT, and SLP) which can also be found in Tables 7 and 8. Methods for the literature review were previously reported. The methods used to determine the outcome of the KT intervention will be highlighted below.

2.6.1 Methods used to measure behavior change

In order to determine the outcome of KT intervention, we need to understand how (a) clinicians put the knowledge into practice (change behavior) and (b) the impact of the intervention on the clinicians, patients and the organization (Straus et al., 2009). The impact of a KT intervention to improve the use of standardized assessments should first be evaluated with the providers as they are the primary individuals who much change their behavior. Once the behavior change occurs the impact on the patient and organization should be evaluated. The use of mixed methods are recommended to evaluate complex KT interventions (Straus et al., 2009). Outcomes are measured using questionnaires, chart audits, audio recordings, and interviews (Hrisos et al., 2009) to determine change in attitude, confidence, knowledge, skill, and/or behavior following a

KT intervention (Straus et al., 2009). The impact of the intervention on the clinicians are frequently measured using focus groups or interviews (Kerr et al., 2010; Matthews et al., 2015; Munce et al., 2017; Richardson et al., 2015; Straus et al., 2013; Thomas et al., 2015; Wiechula et al., 2009). The impact on the patient are measured through evaluation of patient change in function, pain and satisfaction with treatment.

Methods for measuring behavior change have been categorized into direct or indirect (proxy) methods (Hrisos et al., 2009). Direct measures of behavior change include: naturalistic observation, content analysis, and simulated patients. Indirect methods include: chart review, clinician interview/questionnaire, clinical vignette and patient interview/questionnaire. Table 6 outlines the different approaches, provides a description of each and highlights some advantages and disadvantages.

Table 6: Methods to measure use of knowledge

Approach	Description	Advantages/Disadvantages
Direct Methods		
Naturalistic Observations	Unobtrusive observer who gathers information about behavior and individuals (Trochim & Donnelly, 2008)	Advantages: Improve credibility of the outcome Disadvantages: May change behavior of those being observed, timely, costly, intrusive, resource intensive
Audio and Visual Recordings	Use of recording devices to observe behavior	Advantages: data available for future analysis, scored by multiple investigators, tested for inter-rater reliability

		Disadvantages: time consuming, costly, resource intensive. Audio recordings only capture verbal and may miss non-verbal behavior.
Indirect Methods		
Content Analysis	Use of research reports, case materials or other records to measure behavior (Sudsawad, 2007)	Advantages: Useful for research only Disadvantages: Extra paperwork for participants to complete
Chart Audits	Review of paper or electronic medical records to determine documented behaviors	Advantages: Captures documented behavior, feasible to estimate practice on a large number of clinicians Disadvantages: Clinicians may not document behavior, inferences may need to be made during analysis because of incomplete documentation (Perry, Zeleznik, & Breisinger, 2014).
Questionnaires	Use of surveys to determine behavior change	Advantages: Most frequently used, can be validated Disadvantages: Often not validated, no single recommended questionnaire has been established in KT, questionnaires created to measure outcome of interest, providers over estimate performance

Clinical Vignettes	Use of written patient scenarios with questions (in open-ended or close-ended format) on behavior	Advantages: Can be validated and scored by multiple investigators Disadvantages: Most often not validated
Patient Report	having patients recall their interaction with the clinician to report on the clinician's performance	Advantages: Highest accuracy of indirect measures Disadvantages: Influenced by length of time since interaction, length of interaction, subject to recall bias, resource intensive
Simulated Patients	People who are trained to act as a particular patient for clinicians to interact and investigators to determine behavior (Hrisos et al., 2009)	Advantages: Can be scored by multiple investigators Disadvantages: Actors must be trained, actors must act consistently between clinicians, resource intensive
Clinician Interviews	Interview the clinicians (individually or focus groups) on the behavior change	Advantages: Useful to determining impact of the behavior change, explore reasons behind behavior change Disadvantages: Reporting bias if interview is conducted by investigator, resource intensive

2.6.1 Direct Methods

Direct methods are considered the 'gold standard' in measuring behavior (Hrisos et al., 2009). They occur in the natural setting and are more rigorous than indirect methods. Naturalistic observations involve observing actual patient interactions and are conducted by expert qualitative investigators which can improve the credibility of the outcome (Portney & Watkins, 2009; Trochim & Donnelly, 2008). Methods in audio and visual recording can be tested for inter-rater reliability and simulated patients are meticulously trained and act in a consistent manner when interacting with participants.

There are many limitations to the use of direct measures. They can be intrusive, costly, time-consuming, and participants may change their behavior as a result of being watched (Hrisos et al., 2009). Because of the feasibility issues with direct measures, they are used in studies with smaller sample sizes which decreases external validity. One study in this narrative review used a direct method to measure behavior change through audio recordings between PT's and patients to determine PTs ability to identify prognostic factors of back pain (Demmelmaier et al., 2012). One investigator determined if four PTs could identify prognostic factors following the KT intervention. Demmelmair (2012) confirmed the lack of feasibility with using direct methods, as the increased time it took for one investigator to analyze the data from a sample size of only four PTs.

2.6.2 Indirect Methods

Indirect methods to evaluate change in behavior are more frequently used in KT research than direct methods. They are more feasible because they do not take as much time or cost as much and they can be used to evaluate practice in a large group of providers with relatively little effort by the investigators. Indirect methods listed below include questionnaires, chart audits, content analysis, clinical vignettes, and patient interview/questionnaire.

Questionnaires

Self-report questionnaires are the most commonly used method to evaluate behavior change (Hakkennes & Green, 2006; Hrisos et al., 2009). In 32 of the 41 (80%) articles reviewed that measured the outcome of the intervention used questionnaires to determine behavior change. Many questionnaires were created by the investigators to match the outcome of interest and validity of the questionnaires was not reported. Several systematic reviews have reported that self-report questionnaires often lack construct clarity, measurement theory, and psychometric testing (Dickinson, Hrisos, Eccles, Francis, & Johnston, 2010; Dunn, 1983; Hrisos et al., 2009). Psychometric testing of questionnaires is necessary to increase the external validity (Dickinson et al., 2010).

The most frequently used and validated questionnaires to evaluate behavior change in KT research in allied health includes two generalized EBP questionnaires, first by Jette (2003) used by Bernhardsson (2014) and Schreiber (2009) (Jette et al., 2003) and the modified Fresno test (J. Tilson, 2010) used by Lizarondo (2012), McCluskey & Leovarini (2005) and Tilson (2014). These generalized EBP questionnaires that target EBP behaviors (ask, search appraise, integrate, evaluate) aren't specific enough to determine change in use of standardized assessments.

The Goal Attainment Scale (Kiresuk & Sherman, 1968) is another frequently used questionnaire that can be tailored to target the specific goal of behavior change. Two studies used the Goal Attainment Scale to measure behavior change for PT's who worked in the pediatric setting (Campbell et al., 2013; Schreiber et al., 2009). The GAS has established validity, reliability and responsiveness to change (Shaneyfelt et al., 2006). Participants self-selected goals and rated their performance on a 5 point scale (-2 to +2) (Kiresuk & Sherman, 1968). Zero represents the perceived expected level, while negative two means much less than expected and positive two means the performance was much more than expected. The GAS is criterion referenced as increments should be equal between each point and were determined by the group. The GAS is adaptable to any KT intervention, as goals and anchors are created based on the intended behavior change. Both Campbell (2013) and Schreiber (2009) provided guidance to write goals for the PTs. The GAS can be tailored to the use of standardized assessments as PTs can develop goals for use and later rate their performance and achievement towards that goal.

Chart audit

Seven KT studies in allied health included chart audits as a method for measuring behavior change to determine use of standardized assessment following an interventions (Abrams et al., 2006; Bland et al., 2013; Schreiber et al., 2014; Van Peppen et al., 2009), to determine use of an acute whiplash CPG (Rebbeck et al., 2006), to determine adherence to EBPs for low back pain (Tilson et al.,2016) and to determine use of to determine use of non-supported gait training (NSGT) for patients with hemiparesis (Perry et al., 2014). Chart audit data were presented using frequencies and proportions. Frequency of documented use of standardized assessments were reported for PTs who work at outpatient pediatric centers (Schreiber et al., 2014) and for evaluation of patients with stroke by PTs who work in rehabilitation (Van Peppen et al., 2009). Proportions of documented use of NSGT were reported based on five criteria for treatment of patients with stroke by physical therapist who work in rehabilitation. Proportions were calculated by determining frequency of documented use, divided by number of patients NSGT was appropriate to use (Perry et al., 2014).

Content analysis and Clinical Vignettes

Content analysis was used in two studies as participants were asked to complete a form to answer four questions regarding a whiplash clinical practice guideline after every patient with whiplash was evaluated (Bekkering et al., 2005). This form was used to determine behavior of use of the CPG and was created by the investigators for the study. Reliability and validity of the form was not reported. Connell (2016) used content analysis as each participant used an audit tool to rate their adherence to the intervention protocol after treating patients with stroke.

Two studies measured behavior change using clinical vignettes (Maas et al., 2015; Rutten et al., 2013). Clinical vignettes were used to measure adherence to clinical practice guidelines by outpatient PTs treating patients with low back pain (Rutten, 2013) and the upper extremity (Maas, 2015). The vignettes were developed iteratively by experts and rated on responses by the participants by indictors. Clinical vignettes ask participants to write in open comment fields their planned behavior. Rutten (2013) reported non-significant results with a quasi-experimental single group pre-test, post-test design and concluded that vignettes may reflect actual behavior as compared to questionnaires.

2.6.3 Methods used in KT interventions in allied health

While majority of KT studies to evaluate behavior change measured knowledge use through questionnaires, several also used qualitative measures such as semi-structured interviews (Connell et al., 2016; Kerr et al., 2010; Matthews et al., 2015; Nanninga et al., 2015; Richardson et al., 2015); six studies used chart audits (Abrams et al., 2006; Bland et al., 2013; Perry et al., 2014; Rebbeck et al., 2006; Schreiber et al., 2014; J. K. Tilson et al., 2016), two studies used clinical vignettes (Maas et al., 2015; Rutten et al., 2013) and one used audio recordings (Demmelmaier et al., 2012). Many investigators used more than one method to determine knowledge use (Maas et al., 2015; Perry et al., 2014; Rebbeck et al., 2006; Schreiber et al., 2014). Perry (2014) and Rebbeck (2006) found that clinicians over-estimated their behavior when comparing questionnaire and chart audit data.

Studies generally reported positive changes in knowledge, attitude, and self-efficacy, but behavior change varied throughout the literature. While most studies reported positive behavior change, four studies reported non-significant results (Campbell et al., 2013; Kerr et al., 2010; Rutten et al., 2013; Stevenson, Lewis, & Hay, 2006). Campbell (2013), Kerr (2010) and Stevenson (2006) completed RCTs, and the non-significant results were found between groups after the intervention. Rutten (2013) completed a quasi-experimental design with non-significant behavior change from pre to post intervention.

Seven studies in this review reported mixed behavior changes as they were measuring more than one behavior (Banks, Meaburn, & Phelan, 2013; Bland et al., 2013;

Rebbeck et al., 2006; Salbach et al., 2017; Schreiber & Dole, 2012; J. K. Tilson et al., 2016; Wiechula et al., 2009). Five of the seven studies had quasi-experimental pre-test post-test designs (Banks, 2013; Bland, 2013, Salbach 2017, Schreiber & Dole, Tilson and Wiechula, 2009) while two were randomized controlled trials (Rebbeck et al., 2006 and Salbach et al., 2017). Four of the studies reported mixed results using questionnaires only, while Rebbeck (2006) and Tilson (2016) used questionnaire and chart audit data and Bland (2013) used chart audit data alone.

Chart audits were completed in three studies of the 10 studies that reported outcomes on standardized assessment (Bland, 2013; Schreiber, 2014, Van Peppen, 2009). The use of chart audits most closely matches the intended behavior change as standardized assessments should be included in the evaluation and discharge of every patient, and evaluation and discharges are always documented. A questionnaire can also be used but should be triangulated with chart audit data because clinicians tend to over-estimate their behavior.

2.6.3 Evaluating the Impact of the Behavior Change

Evaluating the impact of the behavior change, is different from evaluating behavior change because the impact of the knowledge can influence patients, providers, and organization (Graham et al., 2006; Straus et al., 2009). Graham (2006) suggested "evaluating the impact of knowledge use is the only way to determine whether the efforts to promote its update were successful and worth it." (pg 21). Evaluating outcomes of the provider include satisfaction with change in practice or time it takes to complete the new behavior. Evaluating outcomes of the patient include measuring health status such as morbidity or mortality, health related quality of life, or satisfaction with care. Lastly, the organization (system or society) refers to evaluating the costs of care, length of stay, and waiting times. The impact of a KT intervention to improve the use of standardized assessments should first be evaluated with the providers as they are the primary individuals who much change their behavior. Once the behavior change occurs the impact on the patient and organization should be evaluated.

Provider outcomes

Interviews and focus groups were used to evaluate outcomes at the provider level in seven studies. Focus groups were used in four of the seven studies (Matthews et al., 2015; Munce et al., 2017; Richardson et al., 2015; Thomas et al., 2015), while interviews were completed in three studies (Kerr et al., 2010; Stevens and Beurskens 2010; Wiechula et al., 2009). The interviews highlighted the perceptions of the individual clinicians and are best used when outcomes are based on the individual level. Focus groups capture the group experience, group dynamics and culture of the group (Litosseliti, 2003; Trochim & Donnelly, 2008). A focus group can be used to understand the interactions between the groups and build and improve on interventions for the group. The proposed research aims to use the social support of the PTs as part of the intervention and use of a focus group is the most appropriate strategy to evaluate outcomes. In addition, five studies modified and refined the intervention based on clinician feedback (Kerr et al., 2010; Matthews et al., 2015; Richardson et al., 2015; Stevens and Beurskens 2010; Thomas et al., 2015). Tailoring the intervention with clinician feedback is important to enhance buy-in. Many studies did not report methods or analysis for interviews and results were reported in only four studies (Matthews et al., 2015; Munce et al., 2017; Richardson et al., 2015; Thomas et al., 2015)).

One standardized qualitative method to evaluate behavior change has been created (Menon et al., 2010). The Professional Evaluation & Reflection of Change Tool (PERFECT) can be used to interview clinicians about change in practice (Menon et al., 2010). This tool identifies individual and organizational barriers and facilitators that influence change and was developed specifically for use by rehabilitation professionals. It has 33 interview questions and is broken into four sections including: problem identification, assessment, treatment, and referral practices (Menon et al., 2010). It has been tested for face and content validity. This interview tool provides a standardized way for investigators to conduct barrier assessments and measuring behavior change. Further validation and research reporting the effective use of this tool is needed.

Patient outcomes

Patient outcomes were evaluated in five studies through patient functional self-report questionnaires, patient satisfaction questionnaires (Bekkering, van Tulder, et al., 2005; Rebbeck et al., 2006; Richardson et al., 2015; Willems, Schroder, Post, van der Weijden, & Visser-Meily, 2013) and interviews (Connell et al., 2016). Bekkering (2005) and Rebbeck (2006) completed cluster randomized trails and found that there were no differences between groups based on functional self-report questionnaires post-intervention for whiplash and low back pain respectively. Richardson (2015) completed a case study and found functional outcomes on self-reported questionnaires did improve pre-to-post for patients with stroke. Willems (2013) found that patient's perceptions of exercise improved pre-post while Connell (2016) found through interviews that patient's perceptions of exercise were mixed.

Patient perception and satisfaction are the only outcomes appropriate to evaluate at the patient level following KT interventions on improving physical therapists use of standardized assessment because standardized assessments are evaluative tools and not intervention strategies to improve patient function or pain. Due to the lack of qualitative research on evaluating patient outcomes in physical therapy and KT an additional search was conducted to determine patient satisfaction, perception and experiences with physical therapy using qualitative methods. Articles on patient perceptions and PT primarily reviewed the overall experience of treatment, including treatment for low back pain (Hush, Cameron, & Mackey, 2011), constraint inducted movement therapy (Merlo, Goodman, McClenaghan, & Fritz, 2013), outpatient rehabilitation (Del Bano-Aledo, Medina-Mirapeix, Escolar-Reina, Montilla-Herrador, & Collins, 2014) and PTs in the emergency department (Sheppard, Anaf, & Gordon, 2010). Themes from patients' perception of PT included therapists' interpersonal skills and characteristics, providing information and education, and technical expertise (Del Bano-Aledo et al., 2014). Satisfaction related to interpersonal skills process of care, organization, outcomes and expectations of the patient (Hush et al., 2011). Levack (2015) completed a systematic review and found that involving patents' in goal setting has been shown to positively influence outcomes related to quality of life, but did influence physical outcomes (Levack et al., 2015; Peiris, Taylor, & Shields, 2012). Peiris (2012) conducted a qualitative study with 19 adults in inpatient rehabilitation and found that that patient's valued the interaction between the therapists over the amount therapy they received while in rehabilitation(Peiris et al., 2012) While satisfaction in physical therapy is high, there is a gap in the literature exploring patients' experiences while walking in inpatient rehabilitation. The proposed research explored patient experiences, perceptions and satisfaction of the evaluation process with the physical therapists.

2.7 Interventions

Methods to search the literature on KT interventions in allied health (physical therapists, occupational therapists and speech language pathologist) are described in the beginning of chapter II (section 2.2).   A few seminal articles that were published in the medical literature were used to highlight the key findings in KT. Allied health literature was highlighted as opposed to medical literature because the differences within each profession include: degree, practical issues, practice environment, organizational structure, evaluation and treatment differences, and social influences.

Effective KT requires the use of implementation strategies that aim to change behavior. This topic is becoming so central in KT research that the journal, *Implementation Science* was developed in 2006 with aim of promoting the uptake of research findings into routine healthcare (BioMed Central, 2012). The Cochrane Collaboration has also recognized the importance of KT and has dedicated a Cochrane Review Group (CRG) named Effective Practice and Organization of Care Group (EPOC) with the purpose to prepare and maintain systematic reviews of interventions. EPOC includes a taxonomy of types of interventions that focus on professional, financial, organizational and regulatory interventions that are designed to improve professional practice and the delivery of effective health services (Mowatt, Grimshaw, Davis, & Mazmanian, 2001). EPOC has conducted and published 110 systematic reviews on 5 types of interventions that include: professional, organizational, financial, structural, and regulatory (Effective Practice and Organisation of Care Group (EPOC), 2015). The main outcome of the proposed research is professional behavior change and interventions will primarily target the professional and components of the intervention may also target parts of the organization. Organizational interventions address changes in who delivers health care, how care is organized and where care is delivered. Financial interventions include considerations about capitation, salary, fee for service, and mixed systems of payment and target payment in primary care. Regulatory intervention include changes in medical liability, peer review procedures, management of consumer complaints and licensing requirements for health professionals (Mowatt et al., 2001).

Professional interventions listed by EPOC include: distribution of educational material, educational meetings, local consensus process, educational outreach visits, local opinion leaders, patient mediated intervention, audit and feedback, reminders, tailored, mass media and other (Effective Practice and Organisation of Care Group (EPOC), 2002). Interventions are also characterized as passive or active. Passive strategies include dissemination of articles (distribution of educational material), and active strategies include interactive meetings, computerized reminders, or educational outreach visits (Grimshaw et al., 2012). In passive strategies, the participants are the recipients in the learning process, while active strategies engage participants in the learning process. Grimshaw (2012) completed an overview of the systematic reviews published on health care professional behavior, and found outcomes to most interventions report only modest to moderate behavior change (Grimshaw et al., 2012). The most effective KT intervention compared in Grimshaw's 2012 review was the use of local opinion leaders at 12% median absolute improvement, while printed material, educational meetings, educational outcomes and audit and feedback ranged from 4-6%. Reviews on implementation strategies in health care (primarily by physicians and nurses) commonly conclude that: (1) passive dissemination strategies are ineffective in changing provider behavior, (2) most other implementation strategies produce some change in behavior, and (3) the use of multifaceted implementation strategies that target several barriers to change are more likely to be effective than single intervention strategies (Bero et al., 1998; Dadich, 2010; Grimshaw, 2001; Grimshaw et al., 2012; Grol & Grimshaw, 2003).

Six systematic reviews were included in this narrative review that explore KT intervention in allied health (Dizon, Grimmer-Somers, & Kumar, 2012; Hakkennes & Dodd, 2008; Jones et al., 2014; Menon et al., 2009; Scott et al., 2012; van der Wees et al., 2008). The systematic reviews included agree and elaborate to the themes found in the medical field. These conclusions include: (1) passive strategies are most often used in KT interventions, while they are generally ineffective at changing knowledge and behavior, (2) active multi-component KT strategies are effective in changing PT knowledge and behavior, (3) there is no consensus on what multicomponent interventions are most effective, but recommendations were made to select and tailor interventions based on barrier assessments, (4) pooling of data was not possible because methodological rigor was weak, and (5) the majority of the literature focused on change in practitioner behavior and infrequently reported on patient outcomes or change in health care costs (Jones et al., 2014; Menon et al., 2009; Scott et al., 2012). Interestingly, Van der wees (2009) concluded that multi-component interventions have mixed effectiveness on behavior change in PTs and recommended the use of barrier assessments to guide interventions.

Since the original review, a systematic review on the use of interventions to improve the use of outcome measures was published (Colquhoun et al., 2017). The common finding from the reviews included: weak (case studies) study design with consistent improvement in beliefs, attitudes, and skills, but inconsistently improvement in behavior. The review included 11 studies, but only three used quasi-experimental or experimental designs and concluded that poor intervention description and quality of studies limited their recommendations.

There are insufficient descriptions of KT interventions including use of theory, barriers targeted, development of intervention, and how outcomes were assessed. Scott (2012) and Jones (2014) recommended that future research follow the WIDER recommendations to improve reporting and comparison across KT interventions. WIDER recommendations were created by the Workgroup for Intervention Development and Evaluation Research (WIDER) to improve reporting of the content of behavioral change interventions (Albrecht, Archibald, Arseneau, & Scott, 2013). In the systematic review by Jones (2014), none of the 26 articles included followed all four recommendations and that only three of the 26 articles met two of the four criteria. These recommendations emerged from CONsolidated Standards of Reporting Trials (CONSORT) and include:

1. Detailed description of interventions in published papers
2. Clarification of assumed change process and design principles
3. Access to intervention manuals/protocols
4. Detailed description of active control conditions

The proposed research will aim to follow the WIDER recommendations so other KT investigators will be able to replicate, further develop, and scale-up the intervention (Albrecht et al., 2013). In addition, the proposed research will follow the recommendations in both medicine and allied health to use multi-faceted strategies that target barriers to change using tailored interventions. EPOC defines tailored interventions as “use of personal interviewing, group discussion (‘focus group’), or a survey of targeted providers to identify barriers to change and subsequent design of an intervention that address identified barriers” (Effective Practice and Organisation of Care Group (EPOC), 2002).

Methods used in KT intervention research in allied health range from cluster randomized controlled trials, quasi-experimental pre-test post-test, mixed methods, qualitative research and case reports. Studies included in the review were based in Australia, Canada, Ireland, the Netherlands, Scotland, Sweden, United Kingdom, and the

United States. Physical therapists were most frequently studied. Topic ranged from general evidence based practice (Christensen et al., 2017; Lizarondo, Grimmer-Somers, Kumar, & Crockett, 2012; McCluskey & Lovarini, 2005; Schreiber et al., 2009; Tilsonet al., 2014), use of clinical practice guidelines (Bekkering, van Tulder, et al., 2005; Bernhardsson, Larsson, et al., 2014; Maas et al., 2015; Rebbeck et al., 2006; Rutten et al., 2013; Salbach et al., 2017; Willems, Schroder, van der Weijden, Post, & Visser-Meily, 2016), use of standardized assessments (Abrams et al., 2006; Bland et al., 2013; Kall, Larsson, & Bernhardsson, 2016; Meerhoff et al., 2017; Schreiber & Dole, 2012; Schreiber et al., 2014; Stevens & Beurskens, 2010), to specific interventions such as: use of fall prevention strategies (Brown et al., 2005), clinical and home based rehabilitation (Nanninga et al., 2015), use of non-supported gait training (Perry et al., 2014), use of virtual reality for treatment after stroke (Levac, 2016), use of upper extremity exercise after stroke (Connell, 2016), use of balance programs for patients with PD (Leavy, 2017), evidence based practice in rehabilitation (Moore, 2018).

There were several methodological limitations in the literature reviewed including: lack of control group, lack of detailed description of barrier assessment, intervention development, and outcome assessment, lack of barrier assessment and tailored intervention at the local level, lack of mixed methods to evaluate the outcome, and use of non-validated questionnaires to determine outcome. These methodological decisions made comparisons across the literature difficult, limiting external validity of the findings, and limiting ability to replicate and scale-up interventions. Only twelve of the 41 articles included in Table 7 and 8 included a control group for comparison, which limits external validity of the findings (Bekkering, Hendriks, et al., 2005; Bernhardsson, Larsson, et al., 2014; Campbell et al., 2013; Kerr et al., 2010; Maas et al., 2015; Marsland & Bowman, 2010; Rebbeck et al., 2006; Stevenson et al., 2006; Van Peppen et al., 2009). The highest level of evidence used to compare groups across intervention was a cluster randomized controlled design. In addition, mixed methods have been recommended to assess complex KT interventions because it allows investigators to determine knowledge use and explore the impact of the knowledge on the patients, organization, and providers. Only seven of the 41 articles used mixed methods to determine the impact of the intervention (Connell et al., 2016; Kerr et al., 2010; Levac et al., 2016; Russell et al., 2010; Schreiber et al., 2014; Sibley & Salbach, 2015; Tilsonet al., 2014). Six articles used the KTA framework (Campbell et al., 2013; Nanninga et al., 2015; Richardson et al., 2015; Russell et al., 2010; Sibley & Salbach, 2015; Tilson& Mickan, 2014), three articles used Implementation of Change Model (Bernhardsson, Larsson, et al., 2014; Stevens & Beurskens, 2010) and one used the Promoting Action on Research Implementation in Health Services model (Tilson& Mickan, 2014). Outcomes were primarily assessed at the clinician/practitioner level through non-validated self-reported measures. The majority of the barrier assessments were conducted through a group of general clinicians, as opposed to determining context specific barriers at the local level. The use of knowledge brokers to determine barriers and develop an intervention tailored to the local level is the most practical strategy in KT, yet KBs were underutilized and under-reported in the literature. Despite the methodological limitation the majority of articles included interventions that were active and multi-modal or multi-faceted, but 33/41 were not developed and tailored by barrier assessment at the local level (Table 7 and 8).

Table 7: Knowledge Translation Interventions in Allied Health

Author, Location	Study Design/ Theory	Participants/ Setting	Focus of KT intervention	Intervention/ Theory	Outcome
(Abrams et al., 2006) Australia	Quasi-experimental, pre-test, post-test No Theory	N=154 pre, 164 post, outpatient PT who treat LBP	Outcome measure use in LBP	**Active multi modal** educational seminars, materials, decision algorithm, updated websites, peer contact, requirement of use by Transportation Accident Commission	**Practitioner**: Questionnaire: Sig change in attitude, sig dec in perceived barriers, sig inc in use of 7/9 recommend standardized assessments Audit: Pre: 30% Post: 66% using OM
(Banks et al., 2013) UK	Quasi-experimental, pre-test, post-test No Theory	N=37 PT, musculoskeletal, outpatient	E.g. Clinical competencies-pt centered approach, effective communication, expertise in movement, ability to reflex on clinical skills.	**Active multi modal Online**: 3 modules, 7 hours, 20 clinical/ professional competencies. Self-directing learning, lectures, practical demonstration.	**Practitioner** Questionnaire: VAS mark of competence in 20 areas. 2 significant, structural differentiation (12%), manual handling skills (14.6%). 17/20 improved. Small but not significant drop in documentation (-2%), reflection (-1.3%) analysis of evidence (-0.7).

(Bland et al., 2013; Lang et al., 2011)	Retrospective cohort	N =118, PT, OT, SLP	Use of 39 assessments for patients with stroke	**Active, multimodal** Audit and feedback, education meetings, 25 meetings over 17 months	**Practitioner** Chart audit to measure adherence of each discipline to a number of assessments selected. Adherence ranged from 52-88%. Audit and feedback was not effective
(Brown et al., 2005) US	Quasi-experimental, pre-test, post-test No Theory	94 PT	Falls prevention	**Active multi modal** educational session opinion leaders, outreach visits, training manuals/risk factor checklists (also available online), working groups, newsletters/media	**Practitioner** Questionnaire: At post-interventions (follow-up between 6-24 weeks) Sig increase in self-perceived knowledge fall risk factors Sig increase self-perceived practice behavior Those with greater knowledge of fall risk factors were 1.4x more likely to use them post intervention (OR 1.4; 95% CI 1.0-2.1)
(Christensen et al., 2017)	Case study	N=66 PT, 15 locations of ped hospital (inpt, outpt,	Use evidence to support patient care and produce new knowledge (Started	**Active Multimodal** research coordinator hired, development of clinical outcome groups,	**Practitioner:** Questionnaire: Development of recommendations 16.3 to 68.2%

		development, sports and ortho)	2006-2012 updated 2013-2015)	time (6 hr/year for KT work), knowledge brokers, education, leadership support	Research involvement 5.1 to 50%, presentations 1 to 44 and publications 0 to 7.
(Connell, McMahon, Harris, Watkins, & Eng, 2014; Connell et al., 2015; Connell et al., 2016) England	Case Series	N=23 (3 sites, 8 PT, 11 OT, 4 assistant) 12 patients	Upper Limb Exercise Program in Stroke (PRACTISE)	**Active, multimodal** Tool kit, audit tool, organizational support end team engagement **BCW- COM-B**	**Practitioner** Content Analysis Audit tool: 98% screened for exercise program 70-88% of appropriate were provided with exercises. Interviews: Qual: positive attitudes. Difficulty including family members in ex program. Monitoring progress was a challenge. **Patients:** mixed perceptions on value of exercise, Mixed perceptions of involving family to help with exercise
(Fruth et al., 2010) US	Quasi-experimental, pre-test, post-test No Theory	24 PT (4 settings) (private OP, hospital-based OP, acute care, long term rehab)	McKenzie versus spinal stabilization, spinal mobilization versus manipulation, interventions for pt with breast CA, FES and CVA	**Passive, Single:** **Educational Presentation:** Students developed 4 in-services based on setting	**Practitioner** Questionnaire: 1-week post presentation: 90% new info 3-month post: 68.5% integrated topic into practice
(Levac et al., 2016) Canada	Quasi Experimental, Pre-test, post test	N=11 (7 OT, 4 PT), Clients n=39	Use of motor learning strategies	**Active, Multi-modal**	**Practitioner** Questionnaire: Sig inc confidence Interviews:

			in virtual reality-based stroke rehab	e-learning modules, hands on learning, reminders, mentorship	Clinical reasoning (no change) Motor Learning Strategy Rating Instrument-20 Behavior no change
(Lizarondo et al., 2012) Australia	Quasi-experimental, pre-test, post-test No Theory	PT=19 OT=36 DN=12 SW=16 SP=10	EBP knowledge, skill and behavior	**Active, single** Journal club (2 facilitators were trained in iCAHE model, and taught to JC members) one per month for 6 months Principles of adult learning theory	**Practitioner** Questionnaire: Sig inc PT Attitude Sig inc Knowledge Sig inc in EBP behavior: Adaptive Fresno test Sig inc in EBP behavior (EBP questionnaire) *PT, SW, DN only
(Marsland & Bowman, 2010) Australia	RCT No Theory	PT 13C, 14I OT23 C, 21 I SLP 16C, 14 I SW 2C 6I Psych 3C 2I Early ed 3C 3I	Goal writing	**Active, single** Intervention: education on goal writing workshop using SMART 50-minutes, 3 & 6-month f/u Control: workshop on EBP Principles of adult learning, andragogy	**Practitioner** Questionnaire: SMART-GEM, (Goal evaluating method) 3-month p=0.014 6-month p=0.02

(McCluskey & Lovarini, 2005) Australia	Quasi-experimental, pre-test, post-test No Theory	N=114 OT	EBP	**Active, Multi-modal** EBP education 2-day workshop with outreach for 8 months. Support- emails, phones and one work visit Principles of adult learning theory and social cognitive theory	**Practitioner** Questionnaire: Adapted Fresno Test Inc knowledge (mean difference 20.6) Modest Behavior change (critical appraisal) 6% to 18% to 18%.
(McEwen, Szurek, Polatajko, & Rappolt, 2005) Canada	Quasi-experimental, pre-test, post-test No Theory	N=108 nurses, PT, OT, SLP		**Active, Multi-modal** Online learning module with mentored support 4 modules	**Practitioner** Questionnaire: Current practice survey (n=69) Significant inc in practice at 3 and 6 months: Start to 3 months Mean (SD) 44.3(5.9) to 47.3 (5.6) $p<0.01$ Start to 6-month follow-up 44.3 (5.9) to 47.9 (5.1) $p<0.001$
(McKenna et al., 2005) Canada	Cross-sectional No Theory	N=213 OT	Use of online resource	**Passive single** Viewed evidence-based practice system online (OTseeker)	**Practitioner** Questionnaire: Practice change: 13.6% after accessing OT seeker

(Nanninga et al., 2015) Netherlands	Case report/Pilot KTA	Stroke unit 9 PT 4 pt	Combining clinical and home rehabilitation for pt with CVA	9 PT implemented program to see 4 pt both inpatient and at home. Home care included practice of whole parts, clinical care aimed at specific tasks from home	**Practitioner** Interview **Eval Outcomes**: Barriers: PT expertise and time treating patients at home and in clinic. Financial-insurance Organizational-productivity standards
(Perry et al., 2014) US	Quasi-experimental, pre-test, post-test No Theory	2 PT team leaders, 10 PT, 1 PTA, 4-5 rehab aides	Use of Non-supported gait training (NSGT)	**Active, Multimodal** 1. Quarterly staff meetings on NSGT 2. Group and individual dialogue, re: successes, challenges, solutions and clinical decision making 3. Ongoing monitoring of and aggregate feedback, chart audits 4. Ongoing reminders, role modeling, clinical consolations	**Practitioner** Chart Audit Post: 3 months 50% used NSGT, 6 months 60% and 1-year post training 73% Questionnaire: Inc knowledge: pre: 19% post: 78%. Use: Pre: 33% reported 6-month Post: 66%
(Rappolt, Pearce, McEwen, & Polatajko, 2005) Canada	Qualitative	N=52 nursing, PT, OT, SLP (6 hospitals)	Rehab education program for stroke	**Active, single** Online learning module with mentored support 4 modules (Time not reported)	**Practitioner** Questionnaire: 6 hospitals reported between 33-82% improved practice

(Rebbeck et al., 2006) Australia	RCT No theory	27 PT, 103 patients	CPG-acute whiplash	**Active, Multi-modal** 1-day, 8-hour workshop, interactive sessions, practice versus passive dissemination	**Practitioner** Questionnaire: Behavior change: 44% reported they used 2/5 recommend treatments Chart Audit: 32% actual **Patient** Not sig Patient change: Functional rating index, core outcome measure, global perceived effect. Not sig difference in satisfaction **Financial** No sig difference in cost
(Rutten et al., 2013) Netherlands	Quasi-experimental, pre-test, post-test Diffusions of innovations	N=8 practices, N=32 PT, including 8 managers	Low back pain CPG	**Passive, Single** Educational intervention for guidelines adherence	**Practitioner** Clinical vignettes Overall adherence, not significant p =.138
(Schreiber & Dole, 2012) US	Quasi-experimental, pre-test, post-test	11 PT, 8 completed post survey	Use of standardized assessment in peds PT	**Active, Multi-modal** Educational session with 90 minutes KT session and follow-up online interaction	**Practitioner** Questionnaire: Knowledge: sig with selecting, administering, interpreting and sharing Behavior: sig change with interpreting only, no change with administering

(Schreiber et al., 2014) US	Quasi-experimental, pre-test, post-test	17 PT, pediatric	Use of peds standardized assessments PEDI, GMFM 66, GMFM 88, TUG, TUDS, 30 sec walk tests	**Active, Multi-modal** 2 hr Educational session, meetings, printed material, follow-up, reminders, online CDSS	**Practitioner** Questionnaire and chart audit: Freq of documented use of OM increased at the intervention and remained high 8-month f/u (table 2)
(Schreiber et al., 2009) US	Quasi-experimental, mixed methods	5 PT	EBP	**Passive, Single** Educational Session: Workshop on EBP	**Practitioner** Questionnaire: Behavior: modest improvements with reading articles, searching and incorporating based on GAS
(Stevenson et al., 2006) UK	RCT	30 PT	Management of LBP	**Active, Multi-modal** Opinion leader EBP education sessions, identify research needs/priorities, critical appraisal of literature Passive dissemination (control group): printed material	**Practitioner** Questionnaire: At post-intervention: Non-sig differences in attitudes toward EBP Non-sig differences in self-perceived practice behavior

(Tilsonet al., 2014; J. K. Tilson et al., 2016) US	Quasi-experimental Mixed methods KTA, PARIHS	18 PT	EBP, therapists made best practice list for lumbar spine conditions	**Active, Multi-modal** 6-month educational program, key stakeholder created best evidence list	**Practitioner** Questionnaire: Sig differences in self-reported behavior change (20.4% inc in mean score) EBPIS 6-month follow-up Self-efficacy and behaviors sig increase from baseline to long term follow-up. Knowledge and skills trended upward. Positive attitudes remained. Chart Audit: on 6 behaviors: Only one behavior (depression screen) sig. inc. One remained high (HEP), 4/6 were <50% adherence

Van Peppen, 2009	RCT	30 PT, 15 intervention-training by expert tutor 15 control, training by novice	Use of standardized assessment in rehab for pt with CVA	**Active, Multi-modal** educational session, peer assessment, discussion, reflective thinking PEPCiS- 5- 2-hour sessions over 14 weeks on EBP and standardized assessment, clinical decision making, stroke management, goal writing, pt communication.	**Practitioner:** Chart Audit: freq of use of standardized assessment, intervention from 3 to 6, control 3 to 4 (p=0.07). Questionnaire: self-reported use (p=0.48) Appreciation of expert training style: (p<0.001) toward intervention Participant commitment: no differences Satisfaction with program: 8.0/10 intervention versus 6.9/10 control

Table 8: Tailored Knowledge Translation Interventions in Allied Health

TAILORED INTERVENTIONS							
Author, Location	Study Design/ Theory	Participants/ Setting	Focus of KT intervention	Barrier Assessment General Group of Clinicians/ Theory	Barrier Assessment Conducted at Local Setting/ Theory	Intervention/ Theory	Outcome
(Bekkering et al., 2003; Bekkering, Hendriks, et al., 2005;	Clustered RCT	Intervention n=37, control =48 (68 practices)	Non-use of CPG for LBP (diagnosis and tx).	Identified 5 discrepancies between LBP CPG and		**Active, Multi-modal** 2 workshops, education,	**Practitioner** Content Analysis: PT Intervention group: limited pt

Bekkering, van Tulder, et al., 2005) Netherlands		PT who work in primary care with pt with LBP.	Surveyed random selected PT practices (76 practices, 173 PT), not intervention group	current practice -created intervention to match barrier -training was pilot tested **Planning model for Process Change**		discussion, role play and feedback, 8-12 PT interactive groups Control- passive dissemination of guidelines *Pt w/ LBP completed PT	tx OR 2.39, 95% CI 1.12-5.12 Set functional goals: OR 1.99, 95% CI 1.06 to 3.72 Active interventions OR 2.79, 95% CI 1.19-5.55, adequate pt edu OR 3.59, 95% CI 1.35-9.55. adherence to all 4 criteria (42%), OR 2.05, 95% CI 1.15-3.65 **Patient**: *Pt outcome: no differences (QBPDS, NRS, sick leave, BBQ, PCI
(Bernhardsson, Johansson, Nilsen, Oberg, & Larsson, 2014; Bernhardsson, Larsson, et al., 2014) Sweden	Quasi-experimental, pre-test, post-test Implementation of Change Model	168 PT intervention 88 PT control	CPG (neck pain, LBP and subacromial pain)	Barrier assessment, by prior survey (adapted Jette) Barriers matched to intervention		**Active, Multi-modal** Implementation of CPG (neck pain, LBP, subacromial pain) Printed guidelines, guideline website, 3-hour interactive seminar (9-28PT), website, e-mail reminders, pt	**Practitioner** Questionnaire: Awareness: Intervention 59%, control 44% (p=0.03) Find guidelines: 40% v 16%, p< 0.001, easy access: 26% v 7%, p< 0.001,

						information leaflets	use: 63% v 48%; p=0.043; pre to post: awareness: change 27.9% (p<0.001), find CPG: 25.2% change, p< 0.001 easy to access change 17.4%, p<0.001, use change 9.2%, p=0.091
(Bussieres et al., 2015) Canada	Qualitative	Intervention Development	Care of non-specific neck pain	Interviewed 13 chiropractors **TDF**		**Active, Multi-modal** Online edu, webinar, clinical vignettes, videos Intervention created by 15 experts using semi-structured interviews and **consensus matrix**	Not Tested
(Campbell et al., 2013) Australia	Cluster RCT Tailored KTA	N=73 inter-vention N=62-control, OT, PT, SLP, SW, psy	Use of best evidence for clinicians working with pt with CP. Online evidence support system	Barriers ID by: Meetings between managers, policy makers, researchers, senior clinicians, KB		**Active, Multi-modal** Interventions: 3-day workshop, paid EBP work,	**Practitioner** Questionnaire: GAS Self- and peer rated Behavior: not significant between groups

			with succinct summarized.	and observation of clinical staff. Intervention based on modifiable barriers. Match intervention with theory and strategy and rationale. Developed by researchers, knowledge brokers (Senior staff), policy makers and manages		computerized system Didactic, interactive, role playing, and reflective	or within (pre-post), intervention group scores were higher. Inc knowledge ES 2.97 Attitude (no change, high pre)
(Demmelmaier et al., 2012) Sweden	Case report	N=4 PT outpatient	Identification of red and yellow flag indicators for pt with LBP over the phone		Barrier assessment: focus group Based on barriers reported by participants and social cognitive theory	**Active, Multi-modal** 20 min info, 6-3-hour workshops on knowledge and skill acquisition on phone call, yellow flag, LBP	**Practitioner** Audio recording and interview Improved, self-efficacy, knowledge and skill. 0-2/10 baseline to 6-10/10 post intervention

(Kall et al., 2016) Sweden	Prospective, non-randomized, controlled trial Implementation of Change Model	Baseline: 217 PT (n=169 intervention, n=102 control) 6-month follow-up (277 intervention, 171 control)	Use of outcome measures based on CPG- LBP, neck pain, shoulder pain	Barrier assessment: previous survey Bernhardsson)		3 hr seminar (1.5 hr-guideline development process, results and recommendations, .5 guidelines and OM, 1 hr active group discussion. Easy to use website, bi-monthly email reminders, patient info leaflets, email and phone support by project manager	**Practitioner** Questionnaires: Freq use: Baseline (intervention 49.1%, control 37.6%) Follow-up: intervention 54.8%, control 35.6%)
(Kerr et al., 2010) Scotland	RCT, mixed methods	47 nurses, 9 Allied health =35 smoking cessation education program N=37 control group	Education to elderly pt on smoking cessation	Barrier assessment: previous research Attitudes, knowledge, behavior, satisfaction. Intervention was matched to barrier No theory to drive intervention		**Active, single** 1-day training, spread over 3 days to dec group size. Edu intervention	**Practitioner** Questionnaire: Attitude RMANOVA: group and time F=16.76, p<0.001) Knowledge RMANOVA: group and time F=22/27, p< 0.001) Behavior RMANOVA: group F=16.25, p< 0.001, interaction p=0.636

							Eval outcomes: enhanced confidence
(Leavy, Kwak, Hagstromer, & Franzen, 2017) Protocol Sweden	Quasi-experimental non-randomized controlled design Effectiveness-implementation type 1 hybrid Aaron's conceptual model for dynamic adaptation	4-6 rehab clinics for patients with PD.	HiBalance Program for patients with PD		Focus group interviews **CFIR**	2x3 hr sessions of edu on HiBalance Program, additional support	**NOT REPORTED** **Practitioner** Focus group interviews- knowledge, beliefs, relative advantage, adaptability, self-efficacy, complexity. **Patient** Attendance, questionnaire, miniBEST score, ABC, steps per day
(Maas et al., 2015) Netherlands	Cluster RCT	PT=149, 20 practices	CPG of neck, shoulder, hand and sub-acromial pain	General barrier assessment from previous literature (Rutten, Bekkering)		**Active single** 4- 3 hours sessions over 6 months, 4 pt cases following CPG Intervention group: Peer assessments: roles: 1 PT, 1 assessor, 1 pt, 1 coach	**Practitioner** Clinical vignettes Both Peer assessment and Case discussion sig improvement from baseline. Questionnaire: Peer assessment sig greater than case discussion with adherence

						Case Discussion: discussed cases	(effect=22.52, p=0.03)
(Matthews et al., 2015) Ireland	case-report	2 PT (intervention development)	Use of autonomy supportive communication style for chronic LBP	2 focus groups **TDF**		**Active, Multi-modal** **Consensus Matrix-**matched modifiable barriers to recommended behavior change techniques. Cont ed., audio recording, self-monitoring, reflection, goal setting, action plan	**Practitioner** Focus group: Eval Outcomes Acceptable intervention, addressed many barriers, barriers still remained- lack of social support, pt related, organizational related
(Meerhoff et al., 2017) Dutch	Implementation of change model	355 PTs, 66 practices	Use of patient reported outcome measures in outpatient PT to an outcomes registry		Semi-structured interviews	**Active, Multi-modal** KB, workshop, communication with EHR.	**Practitioner:** Questionnaire: Improvements in acceptability, practicality, implementation. Use pretreatment rose: 25.5 to 71.2% Use pre and post rose: 12.2 to 29.5
(Moore et al., 2018)	Pre-test, post-test	Allied health clinicians	1: synthesize, adapt and make recommendations of EBP practices,		Barriers assessment completed by	All therapists: 4 meetings a year lead by champions	**Practitioner:** Questionnaires:

US	KTA	2009 n=136, 2012 n=115, 2015 n=121. 6-12 specialists and 1-2 leaders	2. Implement the practices in 3 levels of care. **BRAIN Specialists:** 6 hr review course on research design, measurement concepts, basic stats. Review lit on PT/OT/SLP assessments and interventions, and MSK and peds assessment and intervention. Meetings 6-8x/yr, 6-12 specialists, 1-2 leaders 47-52 Champions		champions (ongoing) Surveys (2009, 2012, 2015)	who provide edu, complete barrier assessment and model behavior, mentor and provide feedback Incentives, organizational support, professional development Champions: 5 hrs/ month	on EBP perspectives, use and barrier Inc us of OM: 74% to 91% and EBP practices (62% to 82% (2012-2015). 2012: differences in those involved in BRAIN versus those not involved
(Richardson et al., 2015) Canada	Case-report, qualitative KTA	8 PT and OT Home Care 10 pt >6 months post CVA	Task oriented approach		3 stakeholder meetings identified barriers and facilitators to implement	**Active, Multi-modal** 4 workshops- 3 hours each, online learning platform, videos, audit and feedback	**Practitioner** Focus group Eval Outcome: Satisfied with intervention, many pt barriers to overcome implementations **Patient** Functional improvements

							with TUG, SIS-16, BI
(Russell et al., 2010) Canada	Quasi-experimental, pre-test, post-test Mixed methods KTA	25 knowledge brokers 122 PT Pediatric	Use of 4 standardized assessments in pediatric PT		KB were provided with ppt, intranet site, discussion board, manual and instruction on OM (Reported in Rivard, et al 2010)	**Active, Multi-modal** KB conducted interventions as they saw suited their practice based on training (Reported in Rivard, et al 2010)	**Practitioner** Questionnaire: Knowledge and use increased across all 4 measures, $p<0.001$ Culture of research and supervisor support associated with use of GMFCS
(Salbach, Guilcher, et al., 2011b; Salbach, Guilcher, Jaglal, & Davis, 2010; Salbach et al., 2007; Salbach, Veinot, et al., 2011; Sibley, Inness, et al., 2013; Sibley & Salbach, 2015; Sibley et al., 2011; Sibley, Straus, et al., 2013)	Mixed Methods, intervention development KTA	Intervention Development	Use of balance and gait assessments for patients with CVA	Balance: Cross-sectional survey 369 PT Chart Audit (lack of knowledge, low priority, lack of time personnel, tools not available) Gait: Survey 270 PT, Interview of 23 PT: Lack of knowledge,		**Active, Multi-modal** Possible strategies: education and coaching. Knowledge tool-online synthesize resource, sessions by expert, case-based, practice new skills	N/A

				negative perception of quality and clinical utility			
(Bayley et al., 2012; Munce et al., 2017; Salbach et al., 2017) Canada	Cluster randomized RCT KTA, PARiHS	20 sites, 10 active, 10 passive Active: 113 HCP, 49 patients of 7 treatments, 57 HCP, 40 pt of 11 treatments	Use of stroke CPG		Barrier assessment: Focus groups- lack of time, inadequate staffing, equipment, communication, training and education Ongoing: Facilitators	**Active, Multimodal:** facilitator, 2-day training workshop and promoted guideline implementation **Passive:** guideline mailed	Questionnaire: Self-reported checklist Barriers and Facilitators: Presence/absence of facilitation, belief the intervention was practical, environmental factors, team communication and collaboration Facilitated Experimental group: improvement in sit to stand training (p=0.028) and walking (p=0.043). Passive standing balance training (p=0.037)

							Unsuccessful at improving 18 other treatments
(Stevens & Beurskens, 2010) Netherlands	Qualitative Implementation of Change Model	11 PT, private practice	Use of standardized assessments in primary care PT: 6MWT and PCS (pain scale)	Barrier assessment: qualitative, semi-structured: Domains: PT, organization, patient and measurement instrument **Planning Model for Process Change**		**Active, Multi-modal** Tested intervention 1. Testing x2 (adjusted instruments, self-analysis list, edu program) 2. 3 sessions totaling 2.5 hr edu program, active teaching, role-playing.	Not Reported
(Swinkels et al., 2015)	Controlled Before after study	N=261 (175 intervention, 86 control)	Private practice or nursing home PTs	General barrier assessment – survey		**Active multimodal** Educational session, toolkit. 4 half day sessions over 4-5 months	Questionnaire: Intervention: improved use 26% to 41% Control 45 to 48% Attitude no effect
(Thomas & Mackintosh, 2014)	Case report	Not reported	Referral from acute care for falls prevention follow-up	Mixed methods: chart audit to determine current use,		**Active, Multi-modal** 1 session per month, 18	Eval outcomes: Piloted tested with key

Australia				focus group (not detailed) **TDF**		months, **BCW** matching barriers with interventions. Edu session, development of pathway and processes	stakeholders and seen as feasible. Not reported
(Wiechula et al., 2009) Australia	Quasi-experimental, pre-test, post-test	7 groups, nurses, MD, dieticians, Hospital Based	Each group creates goals and strategies to achieve goals. Must be evidence based Care for older adults: 7 topics (continence, confusion, functional decline, nutrition, pain, clinical assessment, best travelled path		Trained facilitator (KB) on KT toolkit, facilitators worked with groups of hospital staff to make quality improvements. Described current practice, set standard, measured through audit, took action. Facilitators and practitioners created intervention and goals	**Active, Multi-modal** Facilitators (KB) used KT toolkits to guide practice Groups described and set the standard (using affinity diagram, Ishikawa cause and effect diagram, Pareto chart, measured (audit, SMART), took action (Plan, do, study, act(PDSA)), Reviewed and share	**Practitioner** Questionnaire: <u>Pain Group:</u> started using scale 75% inc <u>Nutrition Group:</u> - reporting wt and ht on admission 37% to 56%, 14% to 45%, BMI 5% to 46%, food and fluid intake 90%. <u>Functional decline Group:</u> start 37% dec, to 92% inc <u>Confusion</u>: not measured (planned, knowledge edu)

							Continence: not measured (planned) Clinical assessment & Best travelled path: not measured and skipped steps in KT Toolkit
(Willems et al., 2013; Willems et al., 2016) Netherlands	Non-controlled Trial	Stroke Units (12 hospitals, 10 rehab centers) 2-3 KBs trained at each unit (n=42) PTs: Pre: n=750, Post: n=502 Patients: Pre: n= 248, Post: n=217	Stroke CPG Physical Activity (Encourage functional tasks, provide exercise, evaluate exercise, encourage to do as much as possible I, encourage physical activity, review importance of exercise to pt and family)		2 KB trained in project management skills, knowledge of neuro rehab, implementation strategies- assess barriers, and monitor behavior. Provided with good practice list, support from project coordinator.	KB's to employ activities to implement guideline they saw fit. Specific activities were suggested, KB were told to tailor them	**Practitioner:** Questionnaire: No difference in HP behavior (pre-post). PT's actually decreased. KB increased their encouragement **Patients:** Perception of encouragement to be active Pre: 26%, post: 48% p<0.00

2.7.1 Tailored Interventions

Tailoring interventions is important to target specific barriers and facilitators at the local level which is recommend for KT interventions and interventions that were tailored based on barrier assessments were found in Table 8. Knowledge brokers are individuals who can tailor interventions at the local level. This section aims to describe knowledge brokers and the use of knowledge brokers in allied health literature as well as provide details of tailored interventions used in allied health.

2.7.2 Knowledge Brokers

Knowledge brokers are individuals who can adapt knowledge, assess barriers and tailor interventions following the KTA Framework. The Canadian Health Services Research Foundation defines knowledge brokering as:

> "All the activity that links decision makers with researchers, facilitating their interaction so that they are able to better understand each other's goals and professional cultures, influence each other's work, forge new partnerships, and promote the use of research-based evidence in decision-making" http://www.chsrf.ca/brokering/index_e.php.

Knowledge brokers (KBs) are individuals who are trained in KT strategies and can facilitate the application of best practices such as the use of standardized outcome measures (Bornbaum et al., 2015; Glegg & Hoens, 2016). KBs collaborate with clinicians and policy makers with the intention to change practice (Glegg & Hoens, 2016). They understand context dependent barriers and facilitators, allowing them to tailor KT interventions by enhancing facilitators and overcoming barriers to change practice. KBs have a working knowledge of the evidence and can adapt the knowledge in a way that's useful for the clinicians. KBs roles vary depending on the context and the evidence they are trying to implement. Internal KBs are employed and embedded within the organization and external KBs are researchers or consultants contracted to work with the organization (Bornbaum et al., 2015).

Glegg & Hoen (2016) described five roles of knowledge brokering:

- Knowledge managers who make evidence more accessible and create, translate, diffuse and apply knowledge
- Linkage agents who develop positive relationships between researchers, clinicians and decision makers
- Capacity Builders who build knowledge users' understanding and skills and enhance capacity for evidence informed practice
- Facilitators who facilitate practice change
- Evaluators who evaluate the process

There are many skills and attributes that a knowledge broker must possess to be effective including: Communication, motivation, expertise (clinician and researcher), expertise in gathering, appraisal, synthesizing, interpreting evidence, skilled mediator, team builder, flexibility, responsive, diplomatic, excellent business and communication skills (Dobbins et al., 2009).

Bornbaum (2015) completed a systematic review of knowledge brokering as facilitators of KT in the general medical field. Twenty-nine articles were included in the review, and findings included: tasks among KB's varied and how effective their role in facilitating KT processes were unclear. Bornbaum (2015) used a table to identify activities of KB including knowledge management, linkage and exchange and capacity building with numerous tasks completed by KBs. Tasks of knowledge brokering included: identify, engage and connect with key stakeholders, facilitate collaboration, identify relevant information, facilitate development of interpersonal skills, project coordinator, support communication, network development, maintenance and facilitation, evaluate change, and support sustainability.

Knowledge brokering has been outlined as a strategy for adapting knowledge, barrier assessment and tailoring interventions in KT and allied health by Russell (2010), Christensen (2017), Willems (2016) and Meerhoff (2017). Schreiber (2014) described himself as a KB in the paper, but did not describe tasks related to KT. Others have used terms similar to describe people who facilitate KT including: Champions (Moore, 2018), Facilitators (Salbach et al., 2017; Weichula et al., 2009) and Opinion Leaders (Perry et al., 2014). Similar to Bornbaum (2015), roles and tasks among the KB's in allied health literature varied and effectiveness of the KB as an intervention strategy remains unclear. In most studies, external KB's and researchers supported internal KB's to guide clinicians to make behavior change. The external KB's or researchers trained clinicians in evidence and methods of KT and provided easy to use resources for the internal KB's and physical therapists. Internal KB's had protected time away from patient treatment in order complete KB activities (Moore et al., 2018; Russell et al., 2010; Weichula et al., 2009; and Willems et al., 2016). An external KB who creates resources, trains clinicians and adapts the knowledge to the local level to reduce the burden on the clinicians and organization (Schrieber et al., 2014).

2.7.3 Tailored Interventions

In the literature on tailored interventions, researchers and/or organizational leaders identified the problem or a topic to be studied. Problems ranged from proper diagnosis and treatment of low back pain (Bekkering et al., 2003; Demmelmaier et al., 2012), education of health care works to educate older adults on smoking cessation strategies (Kerr et al., 2010), fundamentals of care for older adults (Wiechula et al., 2009), use of best evidence to examine and treat patients with cerebral palsy (Campbell et al., 2013), use of clinical practice guidelines (Bekkering, van Tulder, et al., 2005; Bernhardsson, Larsson, et al., 2014; Maas et al., 2015) and use of standardized assessments (Russell et al., 2010; Stevens & Beurskens, 2010).

Adapting the knowledge to the local context was completed using a variety of methods including Knowledge Brokers (Russell et al., 2010; Schrieber et al., 2014; Wiechula et al., 2009), as a collaboration between the investigators and the clinicians/organizational leadership (Tilson et al., 2013; Moore et al., 2017), focus groups (Nanninga et al., 2015), interviews (Sibley & Salbach, 2015)

Tilson (2013) worked with the clinicians to adapt the knowledge as the clinicians researched the best available evidence and created a “best evidence list.” This strategy placed a burden on the clinicians as they met for 6 months outside of work hours to develop the list and adapt the knowledge. Nanninga (2015) completed 2 focus groups to adapt to the local context (Nanninga et al., 2015).   Sibley & Salbach (2015) described knowledge adaptation through a qualitative study where clinicians discussed their preferred learning styles, the preferred learning styles included educational session by an expert, using cases and opportunities to practice would be implemented during the intervention (Sibley & Salbach, 2015).   Moore (2018) used clinicians and organizational leadership to adapt knowledge through training and reviewing the literature to create an intranet of recommended evidence-based practices for the rehabilitation clinicians (PT, OT, SLP) at their organization. External knowledge brokers and collaboration may reduce the time burden on the organization and can enhance buy-in.

Many of the barriers and facilitators to using standardized assessments have been identified though questionnaires and focus groups and were discussed in detail in the previous section. The use of theoretical frameworks to guide barrier assessment has previously been discussed. The intervention studies included in tables 7 and 8 assessed barriers through knowledge brokers, questionnaires, semi-structured interviews, chart audits, and focus groups. Two studies described more than one strategy to assess barriers and knowledge (Sibley & Salbach, 2015; Thomas & Mackintosh, 2014).

Knowledge brokers were trained in assessing barriers in Russell (2010), Wiechula (2008), Meerhoff (2017) and Willems (2016). Trained knowledge brokers can assess barriers at the contextual level, but detailed reports of the steps included in barrier assessment were not included in the articles. A sister paper to Russell (2010), Rivard et al. (2010) described the brokering activities of the 24 KBs (Rivard et al., 2010). Rivard (2010) analyzed the KB process through weekly activity logs and semi-structured interviews. The KBs reported using various levels of brokering activities, but themes included highly valued connection between the research team and their colleagues and the importance of understanding the practice and organization to influence the transfer of knowledge (Rivard et al., 2010). KBs have an understanding of organizational and practice barriers that need to be addressed during the intervention. Meerhoff (2017) used KB to help implement patient reported outcome measures in outpatient physical therapy. Willems (2016) used KB's to help implemented a stroke CPG to improve physical activity. The KB's were trained in suggested activities but were able to tailor the activities to their practice setting. Willems (2016) found that KB's were the only clinicians that changed their behavior. Similar to KBs, Salbach (2017) reported using facilitators to address barriers to implementing stroke recommendations and Moore (2018) used local champions to help address barriers to implementing EBP recommendations for rehabilitation professionals. Salbach (2017) found that facilitation significantly improved use of the one of the 19 recommended behaviors. Moore (2018) found that there were differences in use of the recommendations by those trained in the battery of recommendations.

Sibley and Salbach (2015) reported using chart audits to determine current knowledge use, and barrier and facilitator surveys to guide intervention development of balance assessments in stroke. Sibley and Salbach (2015) also reported using chart audits and interviews to assess barriers and current knowledge use to guide the development of an intervention to increase the use of gait assessment for patients with stroke.   Thomas and Mackintosh (2014) also used two methods for barrier assessment through chart audits to determine current behavior and a focus group to assess barriers and facilitators. Three studies reported using interviews or focus groups to assess barriers, but did not include the methods for determining barriers in the article (Bussieres et al., 2015; Matthews et al., 2015; Nanninga et al., 2015).

Participants included in the barrier assessment were organizational leaders, managers, a general sample of allied health practitioners or the actual allied health providers in the context where they were working. Several articles based the barrier assessment on focus groups or questionnaires which guided intervention development on a similar population and not from the clinicians in the setting in which the KT intervention was applied and evaluated (Bekkering, van Tulder, et al., 2005; Bernhardsson, Larsson, et al., 2014; Campbell et al., 2013; Kerr et al., 2010; Sibley & Salbach, 2015). Campbell (2013) and Kerr (2010) reported lack of behavior change as a result of the intervention. Campbell (2013) discussed the lack of behavior change may have been due to the barrier assessment and intervention not being tailored to each clinic, rather it was tailored to the whole organization. The literature that completed barriers assessments on the actual clinicians via focus group or questionnaires reported positive behavior changes (Demmelmaier et al., 2012; Russell et al., 2010; Wiechula et al., 2009).

Barrier assessment in the literature have been conducted in a variety of ways. It has been established that context specific barrier assessments are needed to tailored interventions, but no single method to assess barriers has been recommended. The use of more than one method may assist in intervention development. Questionnaires are the most feasible methods to determine barriers and facilitators to knowledge use. Questionnaires provide only general information about the individuals and the group but do not provide enough insight to develop interventions to address the factors that influence use. Focus groups are useful for assessing barriers when working with a group of clinicians. By conducting a focus group, the investigator can learn more about the culture, leaders among the group, and the patient population. The focus group can also be used to investigate the perception of different implementation strategies. Knowledge brokers who assess barriers through focus groups can easily tailor an intervention keeping both the individuals and context in mind.

2.6.6 Select, tailor, and implement intervention

Interventions targeted practitioner knowledge, attitude, confidence, skill and behavior. Interventions in two articles also targeted the organization by educating on need to access articles, need for paid EBP time or policy changes to support the use of EBP (Bekkering, van Tulder, et al., 2005; Campbell et al., 2013). Interventions also targeted the patient by measuring patient outcomes following the intervention (Bekkering, van Tulder, et al., 2005; Richardson et al., 2015).

Duncan & Murray (2012) recommended that meaningful interventions should be multi-modal and directed at the modifiable barriers of the practitioner, organization, patients and/or the measure itself. Two articles discussed addressing modifiable barriers through the intervention (Bussieres et al., 2015; Campbell et al., 2013). Campbell et al. (2013) explained modifiable barriers interventions were:

> "Based on whether or not the barrier was modifiable by a pragmatically feasible intervention. Modifiable barriers included lack of skill, time, and knowledge. Partially and non-modifiable barriers were: beliefs that the evidence was considered non-clinically relevant, the staff did not have access to full databases and the some staff had negative attitudes toward EBP." (Campbell et al., 2013).

Bussieres (2015) discussed designing an intervention to overcome modifiable barriers and enhance the enablers. Fifteen chiropractors and seven KT researchers attended a two-day meeting to map out the intervention based on the effectiveness of the intervention strategy and feasibility (Bussieres et al, 2015). This strategy enhanced buy-in and engagement in the intervention.

As most studies used active multi-component interventions to target practitioner behavior, there was a gap in knowledge on which strategy is most effective for rehabilitation. PTs who work in inpatient sub-acute or acute rehabilitation are different from most PTs, because physical handling skills are required to assist patients with mobility related activities, communication with the health care team and families occur on a daily/weekly basis, clinical judgements must be made for readiness and safety to return home and require knowledge and skills to evaluate treat many diagnoses (cardiac, pulmonary, integumentary, musculoskeletal, neuromuscular). These factors make it more difficult to select standardized assessments that are reliable and valid in many patient populations and also emphasize the importance of selecting active multi-component interventions that are tailored to the local setting.

All interventions were multi-component and consisted of educational training, workshops, role-play, audit and feedback (Bland et al., 2013 and Perry et al., 2014), email reminders, incentives, and/or opinion leaders or knowledge brokers. The most frequently reported intervention was educational workshop using small groups to promote interaction. Bekkering (2005) and Stevens and Beurskens (2010) pilot tested the intervention and made refinements. Control groups received passive dissemination of guidelines (Bekkering, Hendriks, et al., 2005; Salbach et al., 2017), workshops on communication (Kerr et al., 2010) or no intervention (Bernhardsson, Larsson, et al., 2014). Due to the heterogeneity of the study designs it was difficult to determine if any one intervention was more effective than another. Interventions ranged from 3 hours to several sessions over a one-year period.

2.8 Interventions to increase the use of standardized assessments

In allied health literature, one systematic review has been published on the use of standardized outcome measures (Colquhoun et al., 2017). The findings of the systematic review found overall methodological quality was weak as only one RCT (Van Peppen et al., 2009), two controlled before after studies (Swinkels et al., 2015 and Kall et al., 2016), and seven before-after studies and one retrospective cohort study (Bland, 2013) were included. Most studies did not use theoretical frameworks, but the KTA was used by Schreiber (2014) and Russell (2010). This narrative review included seven articles included in the systematic review as well as three additional studies (Schreiber et al., 2012, Stevens & Beurskens 2010, and Meerhoff et al., 2017). This narrative review did not include the articles with mental health workers and prosthetists or articles on educational programs alone as the search term 'educational programs' was not included in this narrative review.

In allied health literature in this review, there were ten studies that evaluated the use of standardized assessments in physical therapy practice (Abrams et al., 2006; Bland et al., 2013; Kall et al., 2016; Meerhoff et al., 2017; Russell et al., 2010; Schreiber & Dole, 2012; Schreiber et al., 2014; Stevens & Beurskens, 2010; Swinkels et al., 2015; Van Peppen et al., 2009). Three interventions focused on standardized assessment use by pediatric physical therapists (Russell et al., 2010; Schreiber & Dole, 2012; Schreiber et al., 2014), four in outpatient PT practice (Abrams et al., 2006; Kall et al., 2016; Meerhoff et al., 2017; Stevens & Beurskens, 2010) and two in stroke rehabilitation (Bland et al., 2013; Van Peppen et al., 2009) and one with home care and outpatient PT practices (Swinkels et al., 2015). All interventions were active and multi-modal. There was heterogeneity in the studies use of recommended KT strategies such as locally tailored interventions and use of theory. Two studies used tailored interventions (Russell et al., 2010; Stevens & Beurskens, 2010). Five studies used frameworks to guide their intervention development: Russell (2010) and Schreiber (2014) used the KTA Framework and Stevens and Beuskens (2010), Kall (2016) and Meerhoff (2017) used the Implementation of Change Model to guide KT. Outcomes were measured primarily through questionnaires. Abrams (2006), Schreiber (2014), Bland (2013) and Van Peppen (2009) used chart audit to determine frequency of standardized assessment use. The studies on KT and standardized assessments varied in practice setting, strategy to implement the intervention, use of theory to support design and outcomes. Only Van Peppen (2009) used an active control group to increase the use of standardized assessments in stroke rehabilitation. There was a gap in the literature on use of an active control group on KT intervention aimed to increase the use of standardized assessment in general inpatient rehabilitation.

Stevens & Beurskens (2010) developed and implemented a multi-faceted tailored intervention using Implementation of Change Model on the use of two outcome measure in outpatient physical therapy practice. Although, this article used theory and a multi-faceted tailored intervention, the outcome of the intervention was not reported. Stevens & Beurskens (2010) discussed that it was not the intent to evaluate the effectiveness of the strategy, but report on the development of the tailored intervention. Russell et al. (2010) conducted a study to increase the use of four standardized assessments in pediatric physical therapy practice. Knowledge brokers, or clinicians who were trained in KT strategies carried out the KT intervention in each local clinic. Russell (2010) did not use theory to support the research design, but the intervention was tailored because knowledge brokers addressed barriers in the local clinics. No formal discussion of barrier assessment matched with intervention strategies were included in this paper. Russell (2010) found favorable results of familiarity and use of the four standardized assessments by physical therapists at 6, 12 and 18 months following the intervention. Two other studies have been published on the use of standardized assessments in pediatric physical therapy (Schreiber & Dole, 2012; Schreiber et al., 2014). Both studies did not integrate theory to inform intervention design and no formal barrier assessments were conducted. In Schreiber & Dole (2012), the intervention included 90 minute educational session with follow-up and online discussion (Schreiber & Dole, 2012). Eight participants completed the intervention and 16-week follow-up. Participants reported significant differences in knowledge following the intervention, but no significant differences were found with use of the measures. In Schreiber (2014), the intervention was carried out by a knowledge broker (the first author) who worked part time in the clinic (Schreiber et al., 2014). The intervention included educational sessions, meetings, printed material, follow-up, reminders, and online clinical decision support systems. During the meetings, barriers were discussed and supports were identified. It was unclear whether the interventions targeted specific barriers identified by the participants. The frequency of documented use of standardized assessments increased after the intervention and remained above pre-intervention frequency at 8 months. Abrams (2006) completed a quasi-experimental one group pre-test, post-test study that was not tailored or theory driven. A random sample of 300 primary care (outpatient) physical therapists were surveyed before and after an intervention to increase the use of standardized assessments for patients with low back pain. The therapists saw patients that were insured by the Transportation Accident Commission. The active multi-modal intervention included educational seminars, online support, peer contact, decision algorithms, and documentation changes that required the use of standardized assessments. Post intervention participants reported significant increase in use of seven of the nine recommended standardized assessments, and chart audit revealed increased use of standardized assessments from 30 to 66%. Van Peppen (2009) completed a randomized controlled trial with 30 PTs to increase the use of recommended assessment for patients with stroke. The intervention was conducted by either an expert (intervention group) or novice (control group) in standardized assessments for stroke. Documented use of standardized assessment rose in both groups, but the intervention group was significantly greater. There was not a significant difference in self-reported use via a questionnaire.

Bland (2013) conducted chart audits to determine the use of 39 assessments for patients with stroke. The intervention included audit and feedback and educational meetings. Adherence ranged from 52-88% with PTs having the highest adherence and acute care and rehabilitation settings had higher adherence than outpatient. Bland (2013) concluded that feedback through structured events were only effective 40% of the time and that feedback was not as effective as they hoped. Kall (2016) completed a non-randomized controlled trial using the Implementation of Change Model to improve the use of outcome measures for pain (low back, neck and shoulder). The intervention consisted of one 3-hour seminar including one hour of active discussion with email reminders, emails and phone support by project managers. The control group received passive dissemination of the recommendations. The questionnaire found that the intervention group changed from 49.1 to 54.8% and the control group changed from

37.6 to 35.6%. Meerhoff (2017) found that their intervention which included KBs, workshops, education and changes to the electronic health records improved use of patient reported outcome measures at pre-treatment from 25.5% to 71.2%, while use at both pre and post treatment rose from 12.2% to 29.5%. Swinkels (2015) reported on the use of an educational workshop and a toolkit to improve the use of 19 suggested tools in outpatient practice and 14 tools in nursing homes. Swinkels (2015) found that use of the suggested tools rose from 26% to 41% in the intervention and 45 to 48% for the control. Studies had variable outcomes in use of the recommended standardized assessments.

2.9 Relevance of the Literature Review to the Proposed Study

To date there is a lack of literature on the effectiveness of a theoretically informed, multi-faceted tailored KT intervention to increase the use and retention of standardized assessments by physical therapist who work in rehabilitation and evaluate outcomes of the patient. The KTA Framework was most frequently used and outlines the steps needed to design, implement and determine outcomes of a KT intervention.

There were many limitations in strategies to measure barriers and facilitators to using standardized assessments: including (1) the barrier assessment was frequently conducted using similar group of clinicians, but not in the local context; (2) non-validated questionnaires, designed by expert opinion, were used to assess barriers and facilitators to using standardized assessments; (3) there was a lack of use of framework to guide barrier assessments. Factors that influence use of standardized assessments were context specific and focus groups are useful for determining which factors influence use when tailoring an intervention. Questionnaires can help determine the general barriers or facilitators of the group, but a focus group provides more insight into the barriers and facilitators to using standardized assessments. The TDF is optimal for guiding barrier assessment as it includes 14 domains that impact behavior and has been validated for use with assessing barriers.

KT intervention should include active and multi-component interventions that target local factors that will influence change. Interventions should be described in detail in order to replicate and scale-up KT. As most KT interventions are designed by investigator intuition, the TDF consensus matrix is a novel approach to design KT interventions, but one that is theoretically informed. The use of knowledge brokers to implement the intervention can also tailor interventions to the local context. Mixed methods are useful for measuring behavior change and the impact of the change on the clinicians and patients. Chart audits are the most accurate proxy measures of documented use of standardized assessment, while valid self-report questionnaires help triangulate the data. Focus groups are useful for determining the impact of the intervention on the individuals and the group. Qualitative methods should explore patient perceptions of PTs who participate in KT intervention.

There are gaps using experimental research designs with a mixed methods design and on physical therapists who work in the inpatient rehabilitation setting. In addition, the use of active control groups has not been previously reported. PTs who work in sub-acute or acute rehabilitation are different from PTs in other settings because of the requirements of physical handling skills, daily communication with the health care team, clinical judgements about safety and independence, and evaluative skills must cross many diagnoses (cardiac, pulmonary, integumentary, musculoskeletal, and neuromuscular). These factors make it more difficult to select standardized assessment that are reliable and valid in many patient populations and are a reason why KT research is relevant in this practice setting.

To date, no KT study has reported interviewing patients to determine their experiences being evaluated and treated in rehabilitation. Review of literature on patient experiences in physical therapy commonly concluded that patient satisfaction is related to interpersonal skills/ communication, the therapists providing information and education, and technical expertise (Del Bano-Aledo et al., 2014). The intervention aims to increase therapists' communication, education, and expertise of the standardized assessments which may translate to patient care and be discussed during the focus group.

2.9 Pilot Work

A mixed methods pilot study was conducted using a non-intervention control group. The KT study was theoretically informed, multi-modal and tailored to increase the documented and self-reported use of gait speed as measured by the four-meter walk test by physical therapists who work in rehabilitation. The KT intervention followed the KTA framework (Graham et al., 2006), assessed barriers and facilitators through questionnaires and a focus group, and developed an intervention to match barriers with recommend KT strategies using the Theoretical Domains Framework (Michie et al., 2005; Michie et al., 2008). The questionnaire was modified from previous literature, developed in graduate study work, and tested for face and content validity by a group of 9 expert physical therapists using a modified Delphi method. The questionnaire covered barriers and facilitators to evidence-based practice and use of standardized assessments. The questionnaire on use of standardized assessment was developed using the TDF framework. (See Appendix). The intervention was evaluated immediately and long term (> 6months). Physical therapists who worked at a sub-acute rehabilitation hospital were recruited to participate.

Eleven out of 13 physical therapists who worked at the free standing sub-acute rehabilitation hospital enrolled in the study. Six PTs were in the non-intervention control group. PTs evaluated and treated patients with a variety of diagnoses such as cardiac and pulmonary disease, total joint replacement, and neurological disease and dysfunction. The intervention was carried out in four-one-hour session over 8 weeks, which included active multimodal educational sessions, hand-outs, feedback about chart audit data, and reminders by a knowledge broker. The physical therapists enrolled in the study were active in designing the intervention based on focus group discussion. The intervention was successful at increasing the documented and self-reported use of gait speed. At baseline, a three-month retrospective chart audit was conducted and determined gait speed was not documented, while immediately following the intervention the documented use increased to 68% in the intervention group. Using the Goal Attainment Scale, self-reported use rose from 0% to 66%. Focus group analysis revealed the physical therapists were satisfied with the intervention, but patient and practitioner related barriers to using gait speed remained.

Pilot Work Take-Homes

The KTA framework was helpful to identify a problem, assess barriers and facilitators to using standardized assessments, adapt knowledge to the local context, select tailor and implement an intervention, and determine the outcome. Using the questionnaire as part of the barrier assessment, I was able to learn about the participants and it eased facilitation of the focus group. As the knowledge broker who implemented the intervention, I met with the physical therapists on eight occasions and developed a working knowledge of the practice environment, the physical therapists, the patients they treated and the organization. I was accepted by the group because of my frequent interactions. Input from the key stakeholders during the focus groups developed the intervention which was vital to the success. The PTs selected the standardized assessment used in the intervention, which increased buy-in by the group. To date this is the only study that follows the recommendations to use theoretical informed, multimodal, tailored intervention to increase the use of standardized assessments by physical therapists who work in a sub-acute rehabilitation hospital. The supervisor trained the post-hoc control group on the 4 meter walk test at months 4-6. The post-hoc non-intervention control group increased documentation of gait speed at 4-6 (IE 24% and discharge 35%) and 6-8 months (IE 25% and DC 47%). This emphasizes the importance of the culture of the organization as influential in KT.

The proposed research scaled the pilot study by replicating the process of developing a tailored KT intervention. This may inform future research with KT intervention design. The proposed research used an active control group, who works within the organization, but at a different facility. The culture of the active control group may be a barrier or facilitator to use and emphasizes the importance of mixed methods to triangulate the data and assess the outcomes. In addition, there are plans to explore patient perceptions of the PTs evaluation and treatment who are involved in the KT intervention. This is the first time, patients will be interviewed via a focus group to determine the impact of a KT intervention.

Future research should test frameworks to design KT interventions so comparisons can be made. Detailed intervention reporting is also needed to compare outcomes. Larger studies using KBs to tailor interventions to the local context will enhance KT and improve use of standardized assessments and EBP behaviors. Research needs to determine strategies to train KBs in KT in order to determine the effectiveness of larger scale interventions and ultimately measure improvements in patient care and organizational outcomes.

2.10 References

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Chapter III

METHODS

This chapter describes the planned methods for the research that was proposed.

Additional information regarding actual methods used for analysis will also be described and more information will be provided in chapters 6-8.

3.1 Research Aims and Hypotheses

3.1.1 Aims and Hypotheses

Aim 1: Determine if a theoretically informed multi-modal tailored 4 month KT intervention designed and implemented by a knowledge broker would increase (primary outcome) and sustain (secondary outcome) the use of a selected standardized assessment by physical therapists who work on the orthopedic teams in acute inpatient rehabilitation hospitals as compared to a KT intervention designed, but not implemented by the knowledge broker. (Chapter 6)

Hypothesis1a: Physical therapists documented and self-reported use of a selected standardized assessment would significantly increase immediately following the theoretical informed, multi-modal tailored intervention designed and implemented by a KB to greater extent as compared to the active control group.

Hypothesis1b: Physical therapists documented and self-reported use of a selected standardized assessment would be retained from immediately post intervention to six months post intervention to a significantly greater extent for the experimental group following the theoretical informed, multi-modal tailored intervention designed and implemented by a KB compared to the active control group.

Rationale: Hypothesis 1a and 1b were based on pilot study data and multiple systematic reviews to conclude multi-modal intervention change physical therapy behavior. In addition, four studies on multimodal interventions increased the documented and self-reported use of standardized assessments (Abrams et al., 2006; Russell et al., 2010; Schreiber & Dole, 2012; Schreiber et al., 2014). The hypothesis continued that intervention group would have higher documented and self-reported use of the standardized assessments as compared to the control group based on results Maas (2015) and Van Peppen (2009). Maas (2015) and Van Peppen (2009) were the only two controlled trials in the initial literature review where the control group received an active intervention that was related to the outcome, the use of clinical practice guidelines (CPG) for the upper extremity (Maas et al., 2015), and the use of standardized assessments in stroke rehabilitation (Van Peppen et al., 2009). In both studies, both groups increased their behavior following the intervention, and behavior change was significant higher in the intervention groups (Maas et al., 2015; Van Peppen et al., 2009). Last, the retention of behavior change hypothesis was based on the pilot study and Schreiber (2014). Both the pilot study and Schreiber (2014) completed chart audits to determine use of standardized assessments at 6 months follow-up and found the documented use was retained (Schreiber et al., 2014).

Aim 2: Explore and compare both groups of physical therapist's satisfaction and concerns with each KT intervention on standardized assessment use

Hypothesis 2: The physical therapists in the KB designed and implemented KT intervention group will express greater satisfaction with the KT intervention and identify fewer barriers for implementing the standardized assessment in practice as compared to the active control group immediately after and retained at 6-month follow-up.

Aim 2 Rationale: This hypothesis was based on the pilot study data, the participants in the intervention were satisfied with the intervention components such as practicing the skill of completing the outcome measure, documentation changes, hand-outs and patient education.

Aim 3: Explore and compare the patients' experience who were seen by therapists in the theoretical informed, multi-modal tailored intervention designed and implemented by a KB compared to the active control group

Hypothesis 3: Patients who were treated by clinicians in the intervention group would demonstrate an understanding of the patient standardized assessment, why it's relevant to complete the test, and how the information gathered from the standardized assessment can be used to guide the plan of care.

Aim 3 Rationale: This was an exploratory aim and hypothesis. To date, no KT study data has reported interviewing patients to determine their experiences. Review of literature on patient experiences in physical therapy commonly concluded that patient satisfaction is related to interpersonal skills/ communication, the therapists providing information and education, and technical expertise (Del Bano-Aledo et al., 2014). The intervention aimed to increase therapists' communication, education, and expertise of the standardized assessments which may translate to patient care and be discussed during the focus group. It was hypothesized that patients would have an understanding of the standardized assessment because part of the intervention would focus on patient education of the measure. Questions were posed to the experimental and control groups on current patient education and communication strategies regarding standardized assessments during the focus group (EOV 1) and suggestions for improvement were made. During EOV 2, the experimental group were educated on how to educate the patients on relevance of the measures and reasons for use.

3.2 Research Design

3.2.1 Title of Research

A cluster randomized trial of a multimodal tailored intervention facilitated by a knowledge broker to increase the use of a selected standardized assessment among physical therapists who work in inpatient acute rehabilitation hospitals.

3.2.2 Introduction

Cluster randomization was selected to prevent contamination across physical therapists. The unit of randomization and analysis was the acute inpatient rehabilitation hospital.

The main goals of the cluster randomized trial were to:

1. Determine if physical therapists who work on the orthopedic teams in acute inpatient rehabilitation hospitals would improve (immediately post) and sustain the documented and self-reported use (6 months following the intervention) of a selected standardized assessment following a theoretically informed multi-modal tailored 4-month intervention designed and implemented by a knowledge broker as compared to a tailored intervention designed, but not implemented by the knowledge broker.
2. Explore and compare patients' experiences of being evaluated by PTs in the experimental and active control groups.

The main outcomes were at the level of the cluster/case (inpatient rehabilitation hospital)

3.2.3 Methods

Trial Design:

A mixed methods cluster randomized controlled trial was conducted in two inpatient acute rehabilitation hospitals within the same organization aimed to improve the use of a selected standardized assessment by physical therapists who work on orthopedic teams in inpatient rehabilitation. The intervention consisted of 4 monthly meetings, with a 6-month follow-up. Mixed methods were used to determine the change of use of the standardized assessment and evaluate the impact of the intervention. Chart audits were conducted at baseline, month 2, 4, and 8-10. Focus groups were conducted at months 1, 2, 3, 4, 10. The experimental group (enhanced arm/fully supported implementation) received a theoretically informed tailored multi-modal intervention designed and implemented by a knowledge broker to increase the use of a selected standardized assessment in clinical practice. The active control arm (partially supported group) received a theoretically informed tailored multifaceted intervention that was designed, but not implemented by the knowledge broker. The partially supported group self-implemented the intervention. Randomization by rehabilitation hospital occurred after the intervention was designed.

The proposed research planned to conduct four patient focus groups to compare the patients' experience with therapists in the different groups across time points during the intervention. Due to recruiting issues, only one focus group was conducted and one individual interview with four patients from the experimental group only as we were unable to recruit from the active control arm.

The KT intervention with the PTs was developed through a local barrier assessment and the therapists' selected the standardized assessment and developed the intervention. The local barrier assessment included audit and feedback, a survey and a focus group. The chart audit determined current use of standardized assessments. The survey questionnaire was used assess current use of standardized assessments, and barriers, and facilitators to evidence-based practice and using standardized assessments (Appendix A). The 85 question survey contained a question on which outcome measure the participants would like to use more frequently, to help guide selection of the standardized assessment. A focus group was used to provide feedback of questionnaire data, confirm barriers and facilitators, and determine the strategies used in the intervention based on the Theoretical Domains Framework consensus matrix.

The experimental group had four educational outreach visits over a four-month period. The plans for the intervention included: two of the four outreach visits occur simultaneously with focus groups and provide feedback from chart audit data on current use of the selected standardized assessment and designed the intervention by determining strategies to increase the use of the selected assessment. The investigator had planned to implement the action plan in the two additional outreach visits. Strategies were tailored to the group and included: distribution of educational materials, an interactive educational meeting, and reminders. The active control arm had two educational outreach visits where the intervention/action plan was designed, but not implemented by the investigator. The active control arm met to self-implement the intervention during months 2 and 4 through meetings.

Outcomes were assessed to determine documented and self-reported use of the selected standardized assessment through chart audit at baseline, immediately post intervention and 6-month follow-up. Focus groups were planned to be conducted at post intervention and follow-up to explore and compare the impact of the intervention on behavior change, facilitators to change and barriers that remained among each group. Each of the meetings with both groups (Months 1, 2,3,4, 10) were recorded for comparison. In addition, four focus groups were planned with patients of the therapists' in each group to explore and compare their experiences with therapists in the different groups. Due to recruiting issues, only one focus group was conducted and one individual interview with four patients from the experimental group. The originally proposed research activity including intervention and data collection time points are included in the table below.

Originally Proposed Research Activity Time points:

Activity	**Month**									
	1	2	3	4	5	6	7	8	9	10
Experimental Arm										
Data Collection										
Chart Audit 1	x									
Barrier Questionnaire	x									
GAS 1	x									
Focus Group 1	x									
Chart Audit 2			x							
Focus Group 2			x							
GAS 2						x				
Chart Audit 3						x				
Chart Audit 4										X
GAS 3										X
Focus Group 3										X
Intervention										
Focus group 1: EOV 1, Feedback on Chart audit 1, discussion of action plan	x									
EOV 2*: Implementation of action plan including educational meeting, distribution of materials, reminders		x								
Focus group 2: EOV 3, Feedback on Chart audit 2, discussion of action plan			x							
EOV 4* Implementation of action plan (educational meetings, distribution of materials, reminders)				x						
Active Control Arm										
Data Collection										

Chart Audit 1	x									
Barrier Questionnaire	x									
GAS 1	x									
Focus Group 1	x									
GAS 2						x				
Focus Group 2						x				
Chart Audit 2										x
GAS 3										x
Focus Group 3										x
Intervention										
Focus group 1: EOV 1, Feedback on Chart audit 1, discussion of action plan	x									
Self-directed intervention		x								
EOV 2: discussion of action plan			x							
Self-directed intervention				x						
Patient Group-Data Collection										
Focus Group (Intervention)					x		x			
Focus Group (Control)					x		x			
GAS: Goal Attainment Scale, EOV: educational outreach visit Action plan: the steps needed involved increase use of standardized assessments in practice * EOV will be customized- activities may or may not occur based on barrier assessment Focus group: data collection and intervention										

The study design, methods and analysis plan changed during and after implementation. Details can be found in chapter 6 and 8. A realist evaluation was conducted on the mixed methods, two site cluster randomized controlled trial (Pawson & Tilley, 1997; Salter &Kothari, 2014). Each monthly meeting was used to collect data and design and implement the intervention. The analysis by cluster randomized trail using factorial ANOVA changed to a comparative case series and a realist evaluation was conducted. Realist Evaluation was selected to attempt to explain the causal relationships between the intervention, context and the outcome. The realist evaluation attempts to answer the question: “what works, for whom, under what circumstances…and why? (Pawson & Tilley, 1997). The quantitative and qualitative data were analyzed using the Realist Evaluation. The experimental group name was changed to fully supported implementation and the active control group was changed to partially supported implementation group. In addition, each meeting was used to implement the intervention and collect data, so Focus Groups were recorded at months 1,2,3,4, and 10 for both groups. We recorded the meeting where the partially supported group met without the KB as questions were provided to the group. Charts were audited at baseline (3-month retrospective), months 2, 4 and 8-10. The GAS was collected at months 2, 4 and 10. In addition, data collection periods for the patient arm were changed due to issues with recruitment. Details of recruitment issues can be found in chapters 7 and 8. Only one focus group with 3 patients and one individual interview was conducted at months 6 and 9 for only patient in the intervention/fully supported implementation group.

3.2.4 Paradigms/ Frameworks

The Knowledge-to-Action (KTA) framework (Graham et al., 2006) and Theoretical Domain Framework (Michie et al., 2005) were used to guide the project. The KTA framework identified several action steps needed to translate evidence into practice (Graham, 2006). The KTA framework suggests that interventions must be tailored to overcome specific barriers and facilitators (at the patient, practitioner, organizational, and environmental level) faced by the key stakeholders. The KTA framework was selected because it provides detailed steps in the behavior change process to guide the KT intervention. The steps are iterative and dynamic and can occur in any order. The KTA framework is the most frequently used framework in allied health literature (Field et al., 2014) and is unique from other frameworks because of the knowledge creation cycle, adapting knowledge to the local context, and it provides guidance to examining outcomes and monitoring knowledge use (Graham et al., 2006; Straus et al., 2009).

The Theoretical Domains Framework (TDF) was used in order to identify barriers and tailor an intervention (Michie et al., 2005; Michie et al., 2008). The TDF guided barrier assessment through 8 of the 14 domains of behavior change. In addition, a complementary taxonomy matches barriers with recommended behavior change techniques or strategies to guide intervention development (Michie et al., 2008). The TDF was selected based on the numerous behavior change domains it measures, psychometric properties, and previous use in allied health literature.

The Consolidated Framework for Implementation Research (Damschroder et al., 2009). was added for analysis prior to the Realist Evaluation after the original proposal. The CFIR contains five major domains with 37 constructs including: intervention characteristics, outer setting, inner setting, characteristics of the individuals and process (Damschroder et al., 2009). The inner setting is defined as the structural and cultural context, while the outer setting is defined as economic, political and social environment in which the organization resides. Intervention characteristics includes the strength and quality of the evidence, the source of the innovation, and ability to adapt and trial the innovation. The process includes the planning and engaging of individuals involved in the implementation. Characteristics of the individuals includes attitudes, confidence and stage of behavior change (Damschroder et al., 2009). The CFIR was developed through identifying domains of several implementation theories and creating general domains that influence implementation research. The CFIR can be used to describe what works for whom, but it does not allow for causal associations among constructs (Damschroder et al., 2009). The CFIR works within a realist evaluation as all of the constructs can be coded into context and mechanism. CFIR Codes were moved into context and mechanism and analyzed using a realist evaluation to determine the interaction and causal relationships between mechanisms and contextual factors and their influence on the outcome. The CFIR was selected as framework for analysis because of the multiple contextual factors that could be coded using the CFIR code book (Team., 2014) (http://www.cfirguide.org/tools.html). In addition, the CFIR constructs are also rated on valence (positive, negative, mixed or no influence) and strength (1 or 2) which was useful when identifying the causal relationships of the context and mechanism and the outcome (Damschroder et al., 2009).

3.2.5 Role of the researcher

The researcher (knowledge broker) conducted all interventions and data analyses. The experimental group had four educational outreach visits that occurred at lunch time with the participants. The partially supported group had two EOVs by the KB to design the intervention. Each of the EOV were used to design and implement the intervention and collect data. Strategies used in the intervention were designed in collaboration with the participants and tailored to the local context. The strategies for both groups included audit and feedback, goal creation, and engagement. The fully supported group also received hand-outs, tailored education, support to develop a tracking sheet and a reminder system. The researcher did not implement the intervention for the active control group/partially supported group. The partially supported implementation group received two EOVs where the researcher discussed implementation strategies including: education, environmental changes, reminders and a tracking sheets. The partially supported group self-implemented these strategies at months 2 and 4.

The researcher conducted focus groups at each meeting to determine current barriers and facilitators for using standardized assessments, develop the intervention, and determine the impact of the intervention. The researcher provided questions to the active control group/partially supported group and audio recorded meetings where the KB was not present.

The researcher planned to conduct four patient focus groups to compare the patients' experience with therapists in the different groups. Due to recruiting issues, only one focus group was conducted and one individual interview with patients from the experimental group.

Bias occurred as the primary investigator was highly involved in the intervention design and implementation as well as data collection. To decrease bias a second investigator was present at all the focus groups. In addition, randomization after the intervention design was completed to decrease research bias.

3.3 Participants

3.3.1 Eligibility Criteria for Clusters

The aim was to identify two clusters from one organization with two inpatient acute rehabilitation hospitals. Kessler Institute for Rehabilitation was identified and recruited by the investigators as the organization because it had two acute rehabilitation hospitals with similar patient populations. The organizational leadership recommended recruitment of PTs on the orthopedic teams at Saddle Brook and Chester locations because of similar patient populations at the two hospitals and the limited use of standardized assessments within those teams.

Inclusion Criteria

Physical therapists who worked full time on the inpatient orthopedic teams in the acute rehabilitation hospital were included.

Exclusion Criteria

3.3.2 Recruitment

Kessler Institute for Rehabilitation was recruited through several meetings with the organizational leadership including the medical director, director of research, managers, and supervisors. After interest was identified, a representative to assist with the research process from Kessler was added to the study and IRB approval was obtained. An information email was then sent to the physical therapist's supervisors for recruitment of the PTs. The emails introduced the primary investigator, study purpose, benefits to participants, and anticipated time requirements. The supervisor's set-up a recruitment meeting with the investigators and the eligible PTs. Eligible PTs worked full time at the rehabilitation hospital on the orthopedic teams.

Randomization occurred after the barrier assessment meeting in both groups by a researcher using a coin. Physical therapists/supervisors were blinded by study hypothesis. Blinding by cluster and outcome did not occur because participants are highly involved in the research.

3.3.4 Consent procedures and confidentiality

This study was approved by the Rutgers University and Kessler Institute for Rehabilitation IRBs. The recruitment meeting introduced the study, answered questions, and if the participants wished to enroll, consent forms were signed. The study staff obtaining consent signed and dated the consent form, and provided a copy to the participant. In addition, a secondary consent was signed prior to focus group to acknowledge participation with recordings.

Data from the questionnaire, chart audit, and focus group and GAS was entered into investigators computer that was password protected and all efforts were made to keep personal information confidential. Data were de-identified and coded. Participants were provided with a unique ID number that was stored separately from the study data on the investigators computer. Chart audit data were organized through patient medical record number so the research team did not have a link between patient name and private health information. Medical record number was used to track which charts have been audited.

3.3.5 Patient Focus Group Recruitment:

One physical therapist at each site who consented to participate in the KT project and completed CITI training (as required by Kessler) were asked to distribute recruitment flyers to inpatients they treated during the months 4-10 of the intervention. Patients could only be recruited if they signed an agreement to be contacted for research purposes as part of their admission paper work to Kessler Institute for Rehabilitation. After checking for agreement, the PTs distributed the recruitment flyer which provided details about the study purpose, eligibility, time requirements, potential benefits to participating, and contact information for the primary investigator. The PTs were also provided with a short recruitment script to read to the potential participants. PT's confirmed interested patients' phone numbers for the PI to contact after discharge. Plans to cover transportation costs were in place. Each focus group was less than one hour and occurred at a mutually agreed upon time with the participants. During the study, it was identified that transportation to focus groups meetings one month after being discharged from the rehabilitation hospitals was difficult, so the study was modified and patients were allowed to complete the focus group and interview over the phone.

Inclusion Criteria

Inpatients with orthopedic or medically complex diagnoses treated by PTs on the orthopedic teams enrolled in the KT study were included.

Exclusion Criteria

Individuals with co-morbid neurological disease/dysfunction that would impact cognitive ability as determined by the treating therapists were excluded. Individuals still being treated by their physical therapist were excluded.

3.3.6 Consent procedures and confidentiality for patient focus group

This study was approved by the Rutgers University and Kessler Institute for Rehabilitation IRBs. The study was explained to the potential participants by the Principal Investigator, the consent was read, and questions were answered. If they wished to enroll, the participants signed the consent form. The study staff obtaining consent also signed and dated the consent form, and a copy was given to the participant.

Recorded data and transcription of the focus groups was entered and stored on the investigators computer that was password protected and all efforts were made to keep personal information confidential. Participants were provided a unique ID numbers and transcribed data were de-identified.

3.4 Intervention

3.4.1 Development of the Intervention

The intervention was developed and tailored by the knowledge broker from input from the key stakeholders in three steps:

1. Chart audits were conducted to determine the current use of standardized assessments.
2. Participants completed a questionnaire on barriers and facilitators to EBP and using standardized assessments.

3. Data from the chart audit and questionnaire were presented to the participants in a focus group with the purpose to: (1) discuss and confirm the findings (barriers and facilitators) of the chart review and questionnaire, (2) select a standardized assessment, and (3) determine intervention strategies with input from the key stakeholders (physical therapists).

Chart Audit Data Baseline

A three-month retrospective chart audit was used to determine the baseline documented use of any standardized assessments. Data were collected including: patient age, patient diagnosis, patient assistance level, therapist who documented initial evaluation and discharge, and documentation of standardized assessment at initial evaluation and discharge. Chart audit data were recorded using the patient Medical Record number, and no patient names were stored with the data. Use of medical record number was to ensure each chart was reviewed only once. The baseline chart audit data was summarized descriptively including number of charts audited, mean and range of patient ages, patient diagnoses and documentation of standardized assessments at initial evaluation and discharge using proportions. The data were presented as a group and not at the individual therapist level.

Baseline chart audits were extracted by date, 3 months prior to intervention start and coded by patient medical record number. All patient charts in the 3-month time frame were reviewed and PTs who evaluated and discharged the patient were linked to the chart. The baseline chart audits included all PTs in the hospital. The baseline chart audit was done to establish the clinic condition. PT name was recorded (and coded) during baseline chart audit, so the consented PTs were compared to themselves to determine change in documentation of standardized assessment following the intervention.

3.4.2 Questionnaire

The barrier assessment questionnaire contained two sections: evidence-based practice (EBP) and use of standardized assessments. The first section was used to determine the barriers and facilitators to practicing evidence based. This section was modified from previous questionnaires (Jette et al., 2003; Salbach, 2010; Salbach et al., 2007) and contained questions on intrinsic and extrinsic factors that assist or limit use of EBP. The questionnaire includes 35 questions in five domains: confidence, behavior, educational preparation, access to resources and barriers. The Evidence Based Practice Confidence Scale (EPIC) by Salbach (2010) was used for the confidence domain. The EPIC was selected because of its established validity and reliability (Salbach, Jaglal, & Williams, 2013). The EPIC has 11 questions based on confidence performing EBP skills (ask, search, appraise, integrate and evaluate). Participants rated their confidence from 0% to 100%, with 0% meaning not confident at all and 100% being completely confident. The behavior section asked the participants to rate on a scale from zero to greater than 8 times how often they completed EBP behaviors over the past eight weeks. Educational preparation section asked participants if they learned EBP as part of their academic training or continuing education. Facility support and resources section asked participants to rate from strongly disagree to strongly agree if they have support from colleagues, patients, their supervisors and the organization to practice using evidence.

Participants were asked to rate their top three barriers from a list of barriers with open comment fields. The EBP questionnaire including all domains was tested for face and construct validity as well as ease of use through a panel of 9 expert physical therapists. Ease of use was also assessed through a group of 13 end users. See appendix for details of the development and validation of these questionnaires (Appendix A).

The second section focused on the facilitators and barriers to using standardized assessments and was modified from a previous questionnaire (Swinkels et al., 2011). Questions from the Swinkels (2011) questionnaire were placed in the TDF domains, which included only 8 of the 12 original domains (Michie, 2005). An additional question on which standardized assessment the participants wanted to use more frequently was added to guide intervention development. Additional domains and questions were not added prior to validity testing because of the length of the questionnaire. To address any missing questions or domains, experts were asked if there were any missing items from the questionnaire. This questionnaire was tested for face and construct validity as well as ease of use through a panel of 9 expert physical therapists and 13 end users. Adjustments were made based on expert opinion. The final questionnaire had 50 questions, covering eight of the 14 TDF constructs (knowledge, motivation and goals, beliefs about capability's, skill, behavior, social/professional role and identity, environmental context and resources, and beliefs about consequences). Additional questions were not added to address the 4 other domains as the experts did not indicate items were missing. The responses from this questionnaire guided the focus group discussion. Responses were rated on a five-point Likert scale, 1 being completely disagree to 5 being completely agree. An additional section asked participants to list the top five standardized assessments they used and rate the percentage of time they used each measure on appropriate patients, and how confident they were using the measure.

The EBP section of the questionnaire was selected based on frequent use of these questionnaires in the literature. The standardized assessment section was developed and validated for use in the study because there were no valid and reliable questionnaires based on use of standardized assessments in the literature. Only preliminary validity and reliability was established with the questionnaire, further research needs to establish construct validity and reliability. Further details of the development and validation of the barrier assessment questionnaire are included in appendix A and chapter 4.

Data from the questionnaire was presented descriptively to the group in a hand-out. Means or medians, ranges were presented to the group for both the EBP and the standardized assessment sections.

3.4.3 Baseline Focus Group

The purpose of the baseline focus group was to: (1) discuss and confirm the findings of the chart review and questionnaire, (2) select a standardized assessment, (3) determine intervention strategies with input from the key stakeholders (physical therapists and supervisor), and (4) select a goal for use. Interview questions were based on the TDF and the facilitators and barriers identified in the barrier assessment. Questions regarding the efficacy of suggested behavior change techniques from Michie

(2005) was included in the focus group. For example, if lack of skill was identified in the questionnaire as a barrier, during the focus group, the investigator discussed if practicing the standardized assessment with the participants and patients would be an ideal strategy to include in the intervention. This addresses the barrier of lack of skill with the suggested technique "rehearsal."

The investigators determined two standardized assessments to present to the group based on the responses to: "Which standardized assessments would you like to use more?" in the questionnaire. After tallying the responses, the investigators selected the two standardized assessments that were performance based, and easy to use and interpret and had at least adequate psychometric properties (reliability and validity testing based on Rehabmeasures.org). The standardized assessments selected were recommended for use by the APTA (EDGE task force or section recommendations published on PTNow.org). Each group was asked to select one assessment based on group consensus of 80%. Disagreement was handled through discussion.

Plans were for each group to select a comparable outcome measure/standardized assessment based on the two standardized assessment the investigators selected to present. Ideally the comparable selected standardized assessment would be functionally based and easy to use (comprise of only a few steps). The groups selected comparable measures as the experimental group selected the Timed Up and Go Test (TUG) and the active control group selected the 10 meter walk test.

Plans for focus group 2 (experimental group only, month 3) were to (1) determine the ongoing barriers that may limit knowledge uptake, (2) identify new or ongoing supports or facilitators that can be used in the second intervention, and (3) select intervention strategies for the second intervention with input from the key stakeholders. In reality, each of the four meeting with the participants in the experimental group (months 1,2 3,4) and two meetings with the active control group (months 1 and 3) as well as meetings were the KB was not present (months 2 and 4) were used to address these steps as well as to discuss use of standardized assessment for patient education.

3.4.5 Intervention Outline

Experimental Arm: The intervention consisted of four educational outreach visits over a four-month period. Two of the outreach visits provided feedback from chart audit data on current use of the selected standardized assessment and designed the intervention by determining strategies to increase the use of the selected standardized assessment (month 1 and 3). The investigator implemented the tailored intervention in the two additional outreach visits. The outreach visits were ordered as: design action plan, implementation of action plan, refinement and new design, and implementation. Strategies were tailored to the cluster and included: distribution of educational materials, an interactive educational meeting, and reminders.

Documentation in the medical record of the selected standardized assessment was uniform in each group based on input from the supervisor and clinicians.

Documentation occurred in an open comment field of the examination template and discharge summary.

Active Control Arm: The active control arm consisted of a tailored intervention through two educational outreach visits to design an intervention to increase the use of a selected standardized assessment. The first educational outreach visit (month 1) reported chart audit and questionnaire data. The second EOV provided audit and feedback data (month 3).

The EOV's included a discussion and feedback on how to use the measure more frequently, discussion on reviewing the evidence, practice, equipment needs, patients, and documentation. The group self-implemented the intervention in meetings during months 2 and 4.

3.5 Outcomes

3.5.1 Primary Outcome: Documented Use at Initial Evaluation and Discharge

Documented Use was the primary outcome and determined using chart audit data by calculating two proportions (one at initial evaluation and another at discharge). Each proportion was calculated by determining if the selected patient standardized assessment was documented in a patient chart (Yes/No), divided by the number of appropriate patient charts the assessment should have been documented for each therapist and then averaging across the group. Criteria for determining which charts were appropriate was defined by each group as ambulation greater than 20 feet and requiring minimum assistance or less assistance. "Not appropriate" charts were excluded from the analysis. A chart extraction form was used to extract data including:

patient age, diagnosis, assistance level, therapist documenting initial evaluation and discharge, and if the standardized assessment was documented (Yes/No) at initial evaluation and discharge. The proportions were calculated for each PT and then averaged across each group (cluster) for comparison. Two separate proportions per cluster, one at initial evaluation and one at discharge were calculated, because different therapists may evaluate and discharge the same patient and patients' status may change over time (e.g. The patient may not be appropriate for the standardized assessment at initial evaluation and may be appropriate at discharge).

3.5.2 Self-reported use:

Self-reported use was a secondary approach to evaluate outcome measure use and was measured using the Goal Attainment Scale (GAS). Participants selected goals (percentage) for use of the selected standardized assessment and rated their performance at month 2, immediately post the intervention (month 4) and follow-up (Month 10). The experimental (fully supported) group selected 75% documented use at initial evaluation and discharge and the active control (partially supported) group selected 50% at initial evaluation and 60% at discharge.

The GAS is a five point criterion referenced scale that asks participants to score from -2 to +2 on their perceived level of performance (Kiresuk & Sherman, 1968; Kiresuk, Smith, & Cardillo, 1994). The participants were asked to select an expected goal with guidance from the research team and rated their performance on the goal. Zero was used at the perceived expected level while negative two means much less than expected and positive two means much more than expected. The GAS was developed for adults with mental health issues as a program evaluation tool that facilitates patient participation in the goal-setting process (Kiresuk & Sherman, 1968). It can be individualized to measure up to eight goals of behavior change (Kiresuk & Sherman, 1968; Kiresuk et al., 1994). The GAS has good predictive and convergent validity, test-retest reliability, intra-rater reliability, and responsiveness in the rehabilitation population (Hurn, Kneebone, & Cropley, 2006). Kiresuk, Smith, and Cardillo (1994) recommend that the raters are not involved with goal setting in order to improve reliability, but this is not feasible in our research (Kiresuk et al., 1994). This scale has been previously applied in KT research (Campbell et al., 2013; Schreiber & Dole, 2012), but validity, reliability and responsiveness of the measure have not been established in KT literature.

3.5.3 Qualitative Data Collection (Physical Therapists)

We had planned a follow-up (month 10) focus group, (focus group 3 for the intervention group and focus group 2 in the control arm), to compare the experiences of the intervention between the two groups. Experiences were determined by satisfaction with the intervention, perceived facilitators for changing their behavior and barriers that remained. Ultimately, all focus groups used to compare experiences for qualitative data collection.

Each focus group was recorded and transcribed. The focus groups and interview were transcribed by a graduate research assistant using Express Scribe Transcription Software NCH® and an Infinity foot pedal. The transcriptions were copied into a Microsoft Word document and were checked for accuracy by WR. Plans for open coding to occurred were in place through write notes, observations, and comments in the margins of potentially relevant information of the transcribed focus group (Lincoln & Guba, 1985; Merriam, 2009). Similar notes, observations and comments were grouped together into categories or themes (Lincoln & Guba, 1985; Merriam, 2009). Appropriate categories will be associated with TDF domains. Categories were compared across groups. We started analyzing the focus groups using open coding and associating categories with the TDF domains, but ultimately switched to the CFIR using a deductive approach on Nvivo for analysis because of the multiple organizational constructs found in the CFIR that were not in the TDF.

For the realist evaluation, all focus groups (baseline and months 1, 2, 3, 4, 10) were transcribed verbatim and imported into NVivo 11 for further analysis. A deductive approach was used to analyze the focus group data with the CFIR (Damschroder et al, 2009) before the Realist Evaluation was conducted (Pawson & Tilley, 1997). Nodes were entered as codes into NVivo 11 following the 37 constructs (5 domains) in the CFIR codebook (http://www.cfirguide.org/tools.html). The valence and strength of each of the CFIR codes that were used were also rated. Strength (1 or 2) was coded based on the number of quotes, agreement among participants and consensus between raters. Valence was rated based on quotes being positive, negative, mixed or no influence on the implementation efforts. One focus group was coded and rated by one investigator (WR) and discussed and confirmed with another investigator (JED). WR then coded all focus groups for the fully supported implementation group and discussed and confirmed codes with JED. IW was then then brought into the coding process for discussion and confirmation with WR and JED. This process was repeated for the partially supported implementation groups' focus groups.

Valence was rated at each month as we noticed that strength and valence of the CFIR codes differed across focus groups within groups. We also coded and rated meetings for the partially supported implementation group where the KB was not present because they followed an outline of questions provided by the KB and the meetings were audio recorded. All CFIR codes were then mapped into Contextual (CFIR-C) and Mechanistic (CFIR-M) factors for the Realist Evaluation. CFIR constructs including the Inner Setting [Compatibility, Available Resources, Relative Priority, Goals and Feedback] and Outer Setting [External Policy and Incentives] and Characteristics of the Individuals [Knowledge and Beliefs] were coded as Context factors (CFIR-C). CFIR constructs of Process [Planning, Engagement-Key Stakeholders, Engagement External Agent] and Characteristics of the Intervention/Innovation [Evidence Strength and Quality, Complexity] were coded into Mechanism (CFIR-M). The strongest quotes were extracted to support the ratings and codes. A heat map was developed by the investigators to show changes in the CFIR rating (strength and valence) across time. We then compared the CFIR ratings across time points to the chart audit data.

Establishing Trustworthiness of the Qualitative Data

Several steps were planned to establish trustworthiness of the qualitative data collection for the physical therapists. Trustworthiness was established through determining credibility and confirmability of the data (Lincoln & Guba, 1985; Trochim & Donnelly, 2008). Credibility was established through: member checking, peer debriefing, triangulation, and prolonged engagement. Confirmability was established through audit trail, external audit, triangulation and briefing and debriefing.

Member checking is a process where categories, interpretations and conclusion are brought back to the members of the group for confirmation (Merriam, 2009). This was conducted informally during the focus group as points were summarized and discussed. Member checking assists to establish credibility or internal validity of the data (Trochim & Donnelly, 2008). Peer debriefing is another process to establish credibility where another researcher reviewed the transcripts, interpretations and conclusion to see if the results were consistent (Merriam, 2009). The peer debriefing process was conducted by the research team after the primary investigator completed the first round of analysis and through meetings before and after each focus group interview. Triangulation of data occurred through notes taken during the focus groups, review of transcribed data and comparison of the qualitative and quantitative data (Trochim & Donnelly, 2008). Prolonged engagement occurred through multiple interactions with each group as my understanding of the culture and social setting increased and we developed rapport with the PTs.

An external audit was conducted as the multiple investigators examined the data collection process and the findings to provide feedback that improved interpretations (Lincoln & Guba, 1985). Reflexive journaling is a process where the investigator writes about biases prior to the intervention (Lincoln & Guba, 1985). In the journal, I wrote reasons for methodological decisions, and reflected on what was happening during the study based on my values and interests (Lincoln & Guba, 1985). Reflexivity also occurred before and after each focus group meeting during briefing and debriefing sessions. Potential biases included: feelings that the experimental group would improve their documented use greater than the control arm, so my behavior could have been different during focus groups for each cluster. We attempted to reduce early bias by randomizating after the first focus group. Awareness of my non-verbal and verbal communication in subsequent focus groups and EOV was needed in order to reduce bias. An audit trail was used to document how the data were collected, before and after each focus group (Lincoln & Guba, 1985). The document recorded the method, questions, and plan for the focus group, and variations.

In addition, the trustworthiness of the CFIR coding and the Realist Evaluation were established through the rigorous consensus process and use of multiple investigators. We used an iterative process and multiple investigators (WR, JED, IW, JSP, NS) to analyze data. The chart audit data were used primarily to describe the Outcome of the C-M-O, while focus group data and CFIR ratings were used triangulate the Outcome within the Context and the Mechanisms. As the interaction of C-M-O changed across time, we used heat map to visualize the strength and valence of each of the CFIR codes across each focus group by site to determine the fluctuating influence of the context and mechanism on the outcome. The CFIR coding and rating were reviewed together to see if there were any patterns in documented outcome measure use and Context or Mechanism codes.

3.5.4 Patient Focus Group

The patient focus group was planned to explore and compare the patients' examination and evaluation experiences with therapists in the different groups. The focus group was selected so individuals could compare and reflect on their experiences. Unfortunately, due to recruitment issues, only patients treated by therapists in the experimental group were recruited and only one focus group was conducted. More details on this process are included in Chapter 7.

The researcher was not involved in patient care, and no interaction with patient prior to the focus group took place to attempt to reduce research bias. The focus group and interview was recorded and transcribed. Member checking, peer review, external audit and reflexive journaling was conducted to increase trustworthiness and credibility as described above.

3.6 Sample Size

3.6.1 Sample Size Calculation

The pilot study chart audit data were used to determine effect size, power and the sample size for the proposed research. The primary outcome used to determine the sample size was the proportion of documented use of the standardized assessment at initial evaluation and discharge from the pilot work. The pilot study found the experimental group (n=11) average proportion across PTs of documented use at initial evaluation went from 0 at baseline to 0.65 (s.d.=0.29) immediate post intervention and went from 0 to 0.04 (s.d.=0.09) for the post hoc control group. For discharge, average documented use for the experimental group went from 0 to .664 (s.d.= .29), and 0 to .024 (s.d.=.064) for the control group. An effect size was calculated using the F-value from the factorial repeated measures ANOVA, with time and group as factors. The effect size was calculated using $r=\sqrt{F/(F+1)}$ (A. Field, 2009) (pg 502). Cohen's d was calculated using an effect size calculator at: http://www.psychometrica.de/effect_size.html#fvalue.

Effect size

	Initial Evaluation	Discharge
Cohen's d	2.655	2.862
Effect size	.970	.982

The pilot study was a non-randomized trial with a non-intervention control group. There was a significant interaction effect between groups and time for documentation of standardized assessments at initial evaluation ($F=24.146$, $p<0.001$), and discharge ($F=28.057$, $p<0.001$). The effect size was very large in the pilot work based on a non-intervention control group. The proposed study planned to use an active control group, so the anticipated effect size for the proposed research was reduced. Using the G*Power calculator, the anticipated effect size was reduced from .97 to .7, the a-priori alpha set at .05, power set at 80%, number of groups 2, number of measurement 3, correlation among repeated measures .5 and non-sphericity correction=1 (Faul, Erdfelder, Lang, & Buchner, 2007). Based on attrition rate of 50%, the ideal group size was 12, with 24 people enrolled in the study. The number of participants per group was calculated at 6, with a power of 81% (Faul et al., 2007). The G*Power Calculator was also used to determine sample size with 3 covariates, using the same parameters above. The recommended total sample size was 24, with actual power at 82%. Considering practical limitations of clinic size and possible attrition rates, covariates may significantly under power the study (35%).

In addition, we hypothesized a chart number per PT for inclusion in the analysis based on pilot data. We planned for an estimate of 18 charts at initial evaluation and discharge per therapist for inclusion. Over a two-month time period, we estimated using pilot data that clinicians would have an estimated caseload of 24 patients. If 75% of those patients are eligible to use the standardized assessment, 18 charts at initial evaluation and discharge should have been included. Of those 18 charts, 25% of the patients were evaluated and/or discharged by the same therapists (matched). We aimed for a total of 5 matched charts per therapist. This estimate was based on pilot study. Over a two-month time frame, therapists evaluated between 2-22 patients and discharged 8-20 patients. Approximately 25% of charts were excluded from analysis as patients were not eligible to measure gait speed at initial evaluation and discharge, and approximately 25% of charts were matched as the same therapists evaluated and discharged the patient. The chart audit inclusion criteria were not met because there were several time points the PT's did not evaluate and discharge a patient. We therefore could not analyze the data as planned.

3.6.2 Sample Size for Patient Focus Group

The patient focus group was exploratory. Merriam (2009) recommended focus groups include about six to ten participants, because this was exploratory, the anticipated sample was between 3 to 5 participants per focus group. We had 3 patients in the only focus group.

3.7 Randomization and Blinding

Randomization occurred by JED using a coin after study sites were selected and the first focus group/EOV was completed. Physical therapists/supervisors were blinded to study hypotheses. Blinding by cluster and outcome did not take place because participants were highly involved in the research process and goal setting. The analyst was not blinded to groups.

3.8 Statistical Methods

3.8.1 Baseline Equivalency

Group equivalency of physical therapists at baseline was planned to be analyzed using the following variables: age, gender, years of experience, educational level will be analyzed using either an unpaired t-test or Mann-Whitney U test. Continuous data (age, years of experience, use of standardized assessments) was planned to be analyzed using an unpaired t-test if assumptions of normality were met and Levene's test of homogeneity was not significant. Level of significance was set at .1. A Mann-Whitney U test was planned to be used for ordinal data and if data were not normal. Variables on which groups differ at baseline was planned to considered for inclusion in the final models as covariates. Unfortunately, groups were not equivalent at baseline and due to lack of number of charts, transformations were not performed.

3.8.2 Barrier assessment

Questionnaire data were analyzed descriptively to guide intervention development. The baseline focus group were transcribed, coded deductively using the CFIR codebook. Member checking, notes, and peer debriefing were used for triangulation.

3.8.3 Aim/ Hypothesis 1 Analysis

Aim 1: Determine if a theoretically informed multi-modal tailored 4 month KT intervention designed and implemented by a knowledge broker would increase (primary outcome) and sustain (secondary outcome) the use of a selected standardized assessment by physical therapists who work on the orthopedic teams in acute inpatient rehabilitation hospitals as compared to a KT intervention designed, but not implemented by the knowledge broker. (Chapter 6)

Hypothesis1a: Physical therapists documented and self-reported use of a selected standardized assessment would significantly increase immediately following the theoretical informed, multi-modal tailored intervention designed and implemented by a KB to greater extent as compared to the active control group.

Hypothesis1b: Physical therapists documented and self-reported use of a selected standardized assessment would be retained to a significantly greater extent at 6 months following the theoretical informed, multi-modal tailored intervention designed and implemented by a KB compared to the active control group.

Documented Use

Proportions of documented use of the selected standardized assessment at initial evaluation and discharge were calculated at baseline, immediately post intervention, and 6 months' post intervention and averaged by group (cluster). Data were not analyzed using the pre-planned within-between analysis, repeated measures ANOVA, (repeated measures, general linear model) with time and group as the factors as they did not the following assumptions: groups were not equivalent at baseline and there was a limited number of chart documented by PTs at given time points over the course of the study. There were plans to transform the dependent variables to meet parametric standards if needed, but this was not executed. Another option was to explore statistical procedures that model non-Gaussian distributions, but this was also not executed. Level of significance was proposed to be set at .05. Documented use was ultimately analyzed descriptively.

Self-Reported Use

Behavior change after the intervention was measured by the Goal Attainment Scale, was planned to be analyzed using the Friedman's test because the data are ordinal. The Friedman's test was planned to be used for within group analysis only. Comparisons between groups were reported descriptively. Level of significance was proposed to be set at .05.

Consideration of Confounders

Potential confounders were evaluated, but could not be controlled due to limited sample size. Confounders included: age, level of education, and years in practice.

3.8.4 Aim/ Hypothesis 2 Analysis

Aim 2: Explore and compare both groups of physical therapist's satisfaction and concerns with each KT intervention on standardized assessment use

Hypothesis 2: The physical therapists in the KB designed and implemented KT intervention group would express greater satisfaction with the KT intervention and identify fewer barriers for implementing the standardized assessment in practice as compared to the active control group immediately after and retained at 6-month follow-up

Post intervention and follow-up focus groups

Each focus group was recorded and transcribed. After the focus group was transcribed, open coding occurred as notes, observations, and comments in the margins of potentially relevant information (Lincoln & Guba, 1985; Merriam, 2009). Similar notes, observations and comments were planned to be grouped together into categories or themes (Lincoln & Guba, 1985; Merriam, 2009). Appropriate categories were associated with TDF domains. Categories were planned to be compared across groups. Experiences were determined by satisfaction with the intervention, perceived facilitators for changing their behavior and barriers that remain. The outline of the focus group can be found in Chapter 6. Several steps were taken to establish trustworthiness of the qualitative data collection that were outlined above (3.5.3).

Planned coding using the above strategy was not conducted as the realist evaluation ultimately conducted. Coding occurred deductively using the CFIR framework and codebook across all meetings rather than inductive coding at the post-intervention and follow-up focus groups only. CFIR domains were then entered into Context and Mechanisms for the realist evaluation. More details on the coding strategy are found above and in Chapter 6.

3.8.5 Aim/Hypothesis 3 Analysis

Aim 3: Explore and compare the patients' experience who were seen by the therapists in the different groups

Hypothesis 3: Patients who were treated by clinicians in the intervention group would demonstrate an understanding of the standardized assessment, why it's relevant to complete the test, and how the information gathered from the standardized assessment can be used to guide the plan of care.

Patient focus group

The patient focus group, was planned to compare the experiences of patients treated by therapists in the experimental and control groups. Due to recruitment issues only patients in the experimental group were including in either a focus group or individual interview. Each focus group and interview was recorded and transcribed. Open coding occurred through notes, observations, and comments in the margins of potentially relevant information of the transcribed focus group (Lincoln & Guba, 1985; Merriam, 2009). Similar notes, observations and comments were grouped together into categories or themes (Lincoln & Guba, 1985; Merriam, 2009). Categories were compared across interviews.

Establishing Trustworthiness of the Qualitative Data

Several steps were taken to establish trustworthiness of the qualitative data collection. Credibility was established through: member checking, peer debriefing, external audit, audit trail, and reflexive journaling.

3.9 Assumptions and Study Limitations

3.9.1 Methodical Assumptions

The study occurred in the natural social setting, where the participants are routinely evaluating patients. Therapists collaborate on a continual basis about patient care, eat lunch together, and discussed and made decisions about the project when the investigator was not present. This social process influenced the use of the selected standardized assessment. The social process served as both a support or threat. The focus group explored the social process and determined its' influence on the use of the selected patient standardized assessment.

Assumptions of focus groups were that participants answer questions honestly. The social dynamics of the group influenced responses of the participants during the focus group. Also, the researcher who was conducting the focus group was highly involved in the intervention which influenced the responses by the participants. A second investigator was present to reduce research bias.

3.9.3 Limitations

There were several limitations in this research that relate to random assignment, sample size, social and organizational threats, and use of indirect measures of behavior change. Random assignment occurred at the group level to prevent social threats between groups that may work within one setting. A limitation of random assignment completed at the group level was that it caused non-equivalent groups at baseline. There were plans to attempt to control for group differences in analysis which were not executed.

Sample size and power was a serious threat, as power is increased by number of clusters and number of participants within each cluster. For this study, sample size was calculated based on pilot data using a non-intervention control group. Number of clusters needed was not calculated due of the feasibility of the research the number of clusters was limited to two. This was a threat to validity of the research design. The number of participants per cluster was also limited based on the practical limitation of the clinic. Twelve participants per group was planned to allow for attrition, but group differences at baseline was not able to be controlled. Sample size, baseline equivalency, number of covariates, normality of data, charts available for audit were major limitations in this study.

There were many social threats to internal validity. Each group acted differently based on patients, participants, managers, and supervisors. Behavior change occurred at different rates because participants were active in the research. Participants in the control group implemented the action plan without help from the researcher, while the intervention group did not find clinical value in the selected measure. Due to the social threats, mixed methods analysis was selected to determine differences between groups and to explore and compare the group process and ultimately a realist evaluation was performed.

The documented use and self-reported use of standardized assessments are indirect methods of behavior change. Direct methods, such as observation or audio or visual recordings, to determine use of the standardized assessments are more valid because they occur in the natural setting and are more rigorous. Direct methods were not feasible for this research because of the time and cost. There is no recommended proxy method to measure behavior change in KT research. Questionnaires are typically used but are often not valid or reliable and clinicians often over-estimate their performance. Due to the limitations of proxy methods, two methods were selected measure behavior change to triangulate the data and enhance rigor.

The researcher was highly involved in the development and implementation of the intervention as well as led the focus groups to determine the outcome of the intervention which led to research bias. Ideally, focus groups are led by independent investigators to limit bias. This is a limitation of the focus group as method to measure the impact of the intervention on the participants. The focus group was prospective and influenced the intervention for the experimental group. Participants were encouraged to speak freely as it influenced the intervention. Another round of consent took place prior to the focus group to encourage the participants to speak freely. In addition, several methods were in place to establish credibility and trustworthiness of the focus group. A second investigator was present at all focus groups to decrease research bias.

One final limitation of the proposed research was that it only would be generalizable to the use of a knowledge broker who is highly involved in the setting where the intervention occurs. Knowledge brokers are unique in that they locally tailor interventions to the specific barriers faced by the clinic/clinicians. This research may not be generalizable to a generic broker or investigator who is not invested in clinic and clinicians and does not locally tailor interventions to target specific barriers. Additional limitations to the research can be found in chapters 6-8.

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Chapter IV

4.1 Manuscript Published in Physiotherapy Theory and Practice

TITLE PAGE

A knowledge translation intervention designed using audit and feedback and the Theoretical Domains Framework for physical therapists working in inpatient rehabilitation: A case report

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ABSTRACT

Background and Purpose: Little is known about the process of engaging key stakeholders to select and design a knowledge translation (KT) intervention to increase the use of an outcome measure using audit and feedback. The purpose of this case report was to describe the development of a KT intervention designed with organizational support to increase physical therapists' (PTs') use of a selected outcome measure in an inpatient sub-acute rehabilitation hospital.

Case Description: Eleven PTs who worked at a sub-acute rehabilitation hospital participated. After determining organizational support, a mixed methods barrier assessment including a chart audit, questionnaire, and a focus group with audit and feedback was used to select an outcome measure and design a locally tailored intervention. The intervention was mapped using the Theoretical Domains Framework (TDF). One investigator acted as knowledge broker and co-designed the intervention with clinician and supervisor support.

Outcomes: The four-meter walk test was selected through a group discussion facilitated by the knowledge broker. Support from the facility and input from the key stakeholders guided the design of a tailored KT intervention to increase use of gait speed. The intervention design included an interactive educational meeting, with documentation and environmental changes.

Discussion: Input from the clinicians on the educational meeting, documentation changes and placement of tracks, and support from the supervisor were used to design and locally adapt a KT intervention to change assessment practice among PTs in an inpatient sub-acute rehabilitation hospital. Implementation and evaluation of the intervention is underway.

TITLE

A knowledge translation intervention designed using audit and feedback and the Theoretical Domains Framework for physical therapists working in inpatient rehabilitation: A case report

BACKGROUND AND PURPOSE

Outcome measures are valid and reliable performance based or self-reported assessments that evaluate actual or perceived ability of an individual to carry out activities or participate in daily life (Jette et al, 2009). Use of outcome measures guides comprehensive patient management. They are used to determine need for therapy, patient progress, the outcome of an intervention, and communicate with the patient, family, and health care team. The physical therapy profession has called for the use of outcome measures to optimize practice for many years (Deutsch, 2004). In 2006, the Research Section of the American Physical Therapy Association developed the Evaluation Database to Guide Effectiveness (EDGE) Task Force with the goal of making recommendations for the use of outcome measures (Field-Fote, 2015). However, in the most comprehensive survey on use of outcome measures, physical therapists (PTs) reported they do not routinely use them (Jette et al, 2009). Since Jette's (2009) survey, there has been continued emphasis on routine and standardized assessment by PTs across settings with increased utilization reported, but gaps in regularity in use remain. In 2011, 90% of 369 PTs reported they regularly used outcome measures (greater than 60% of the time) to assess balance across practice settings (Sibley, Straus, Inness, Salbach and Jaglal, 2011). In 2013, 96% of 84 health professionals employed in stroke rehabilitation reported they used outcome measures, while only 47% of the health professionals reported they used outcome measures weekly (Burton, Tyson, and McGovern, 2013). To further address the need for standardized evaluation, knowledge translation synthesis tools such as the Rehabilitation Measure Database (www.rehabmeasures.org) (Moore, Raad, Ehrlich-Jones, and Heinemann, 2014), and PTNow (www.PTNow.org) were developed to make outcome measures more accessible and easier to implement.

Despite these efforts, there remain barriers to achieving routine use of outcome measures (Duncan and Murray, 2012). Lack of time and knowledge are the two most frequently reported barriers by health professionals (Duncan and Murray, 2012). Outcome measure use is also influenced by setting, organizational support, characteristics of the PT and the patient, and the outcome measure itself (Duncan and Murray, 2012). Considering these barriers and facilitators, knowledge translation (KT) interventions for physical therapists provide a structure to overcome the context specific barriers to using outcome measures.

KT interventions have been designed to increase the use of outcome measures in the pediatric (Russell et al, 2010; Schreiber and Dole, 2012; Schreiber, Marchetti, Racicot, and Kaminski, 2015), outpatient orthopedic (Abrams et al, 2006; Stevens and Beurskens, 2010), inpatient stroke rehabilitation settings (Van Peppen et al, 2009) and to measure reactive balance for patients at risk of falls (Sibley et al, 2016). KT interventions to overcome the barriers to using outcome measures have been designed without key stakeholder input (Schreiber and Dole, 2012; Schreiber, Marchetti, Racicot, and Kaminski, 2015; Van Peppen et al, 2009), or have been designed from the results from large scale surveys on the barriers to using outcome measures from a group of general clinicians (Sibley et al, 2016). Russell et al (2010) trained knowledge brokers, senior clinicians who worked in the facility, in KT strategies to design KT interventions they believed suited their practice. Stevens and Beurskans (2010) completed semi-structured interviews to determine the context specific barriers and tested their intervention on a small group of clinicians for feedback. In all studies, the outcome measures were pre-selected by the investigators, and organizational support and clinician input was not included in the intervention design (Abrams et al, 2006; Russell et al, 2010; Schreiber, Marchetti, Racicot, and Kaminski, 2015; Sibley et al, 2016; Stevens and Beurskens, 2010; Van Peppen et al, 2009).

Attaining support from the organization and clinicians to design the KT intervention may overcome barriers to use including organizational input and priority (Duncan and Murray, 2012; Swinkels, van Peppen, Wittink, Custers, and Beurskens, 2011). Russell et al (2010) found that following a KT intervention, PTs reported that supervisor support positively influenced their use of pediatric outcome measures, but the intervention was developed by the researchers without input from the supervisors. In addition, clinician engagement when designing a KT intervention can overcome barriers such as lack of support and lack of feedback between colleagues (Duncan and Murray, 2012; Swinkels, van Peppen, Wittink, Custers, and Beurskens, 2011). Clinician engagement in intervention design has been used in a variety of ways from training senior PTs in knowledge brokering strategies to facilitate behavior change (Russell et al, 2010), to meeting with clinicians for problem solving techniques (Perry, Zeleznik, and Breisinger, 2014), and using PTs in every step of design and implementation of the intervention (Tilson and Mickan, 2014). Audit and feedback may be a useful strategy that can engage clinicians and support the organization (Ivers et al, 2012). Charts are audited and feedback is provided to the clinicians on the outcome with the intent of changing behavior (Ivers et al, 2012). Audit and feedback completed by an external investigator can also be used to inform the organization about documentation behaviors of their clinicians.

The use of theories, models or theoretical frameworks to guide KT interventions has been recommended, yet their application to increasing use of outcome measures in the health professions is limited (Field, Booth, Ilott, and Gerrish, 2014; Hudon, Gervais, and Hunt, 2015). The Theoretical Domains Framework (TDF) (Michie et al, 2005) provides a method for assessing context specific barriers and facilitating factors in order to design interventions to overcome the barriers or enhance the facilitators (Cane, O'Connor, and Michie, 2012; Michie et al, 2005). The TDF was created through expert consensus to clarify and integrate multiple theories and to maximize the accessibility and usefulness of theories when developing behavior change interventions (Michie et al, 2005). The 14 domains of the TDF include: knowledge, skills, social/professional role and identity, beliefs about capabilities, optimism, beliefs about consequences, reinforcement, intentions, goals, memory, attention and decision process, environmental content and resources, social influences, emotion and behavioral regulation (Cane, O'Connor, and Michie, 2012). A complementary consensus matrix was created by four experts that linked 35 strategies for behavior change with 11 behavioral domains in the TDF (Michie et al, 2008). The TDF assists investigators to determine barriers and facilitators of behavior change (Michie et al, 2005, Cane, O'Connor, Michie, 2012), and the complementary consensus matrix links barriers and facilitators with behavior change strategies (Michie et al, 2008). The TDF has previously been used in the health professions to assess barriers and design KT interventions to care for patients with non-specific neck pain (Bussieres et al, 2015), enhance communication with patients with chronic low back pain (Matthews et al, 2015), increase clinical measurement of reactive balance (Sibley et al, 2016), and improve fall prevention referrals (Thomas and Mackintosh, 2014).

There is a gap in the literature describing facilitation by the research team to engage key stakeholders and build consensus to co-create an intervention to improve the use of outcome measures. In addition, to our knowledge, audit and feedback to design a KT intervention in health professional literature has not previously reported. This case report describes the development of a complex, theoretically based KT intervention using organizational support, clinician input, and audit and feedback to engage the clinicians to co-create a locally tailored intervention facilitated by the investigators and guided by the TDF.

CASE DESCRIPTION

Study Site and Participants

The study site was an independently operated inpatient sub-acute rehabilitation hospital whose supervisor, manager, and physical therapists were interested in increasing the use of outcome measures. The rehabilitation manager, a speech language pathologist, was interested in having the staff participate in the project and referred the study team to the PT supervisor. The PTs were assigned by the supervisor to evaluate and treat newly admitted patients. PTs treated adults primarily over the age of 61 (85%) and had a mixed caseload, with patient diagnoses including total joint replacements (50%), cardiopulmonary conditions (12%), gastrointestinal-genitourinary conditions (10%) (e.g. urinary tract infection and small bowel obstruction), orthopedic fractures and surgeries (10%), neurological conditions (5%) and other (13%) (e.g. altered mental status, fall, and cancer). The sub-acute rehabilitation hospital used paper charts and completed required evaluation forms which included the Functional Independence Measure (FIM™) (Keith, Granger, Hamilton, and Sherwin, 1987), daily notes, and discharge summaries. Eleven out of 13 full-time physical therapists who worked at the facility consented to participate (Table 1: Characteristics of Physical Therapists). The two full-time therapists who did not consent, did not participate in the focus group meetings and charts with their documentation were excluded. The supervisor planned to train the non-consenting PTs and per diem staff separately. This study was approved by the Rutgers University, State of New Jersey Institutional Review Board.

The primary investigator (WR) acted as a researcher and knowledge broker (KB) to facilitate the KT intervention (Bornbaum, Kornas, Peirson, and Rosella, 2015). The KB's role was to provide education and audit and feedback, collaborate with the clinicians to co-design the intervention, and evaluate the outcome (Glegg and Hoens, 2015). (WR) earned her Doctorate in Physical Therapy in 2006 and was a Neurologic Clinical Specialist with eight years of clinical experience in rehabilitation. WR was a clinical assistant professor at Sacred Heart University whose responsibilities included teaching outcome measures and a PhD student at Rutgers University with a focus on knowledge translation. WR did not know the setting or clinicians prior to the start of the intervention.

Intervention Design Overview

The investigators used a mixed methods barrier assessment to determine the perceived barriers and facilitators to using outcome measures and to guide intervention design. The intervention was designed in five key components: meetings with the supervisor and manager, chart audit, questionnaire completion, intervention mapping, and focus group with audit and feedback. The intervention occurred over a two-month timeframe (Figure 1: Study Outline). The site was identified through a discussion between the investigator, WR, and adjunct faculty members from Sacred Heart University. Based on conversations the adjunct faculty had with the site, they believed the site had PTs that were motivated to participate in research and use outcome measures. The investigators determined organizational interest and support through email exchanges and informational meetings with the manager and supervisor of the clinic. WR met with the supervisor and manager and provided a handout with the study timeline and goals. The investigators' goal was to select and implement an activity or participation level outcome measure upon which to base the intervention. Next, WR met with the interested participants and obtained informed consent. The time commitment for the PTs to participate in the study was a total of five hours and thirty minutes; 30 minutes to complete the questionnaire and five one-hour lunch time meetings. The investigators spent an additional 20 hours completing chart audits, searching the literature, and developing the intervention.

Chart Audits

WR conducted chart audits to determine the documented use of outcome measures three months prior to the start of the intervention. All charts were included in the retrospective audit. Data extracted included patient diagnosis, length of stay, assigned therapist, documented use of any activity or participation level outcome measure at initial evaluation and at discharge. One hundred and twenty-seven charts were included in the audit, and 64 of those charts had both the initial evaluation and discharge completed by consented participants. The facility documented using paper charts and mandated the use of one functional assessment, the FIM™, which was filed separately from the chart. All initial evaluations included strength (manual muscle testing) and sensation testing, range of motion using goniometry, observational gait analysis, functional mobility, and balance. Based on the retrospective audit, only one activity-based measure, The Elderly Mobility Scale (Smith, 1994) was documented in one chart (1.5%, n=1/64) at initial evaluation. Other impairment level tests that appeared to be standardized included the following: timed static stance was documented twice at initial evaluation (3%, n=2/64) and once at discharge (1.5%, n=1/64) and timed single limb stance was documented once at initial evaluation (1.5%, n=1/64) and three times at discharge (4.6%, n=3/64). See supplementary material for the handout provided to participants on results of the chart audit and questionnaire data (Appendix A: Barrier Assessment Handout).

Barrier Assessment Questionnaire

The investigators adapted a questionnaire from previous literature to determine barriers and facilitators to evidence based practice (EBP) (Jette et al, 2003; Salbach and Jaglal, 2010; Salbach et al, 2007) and use of outcome measures (Swinkels et al, 2011). The questionnaire was tested for face and content validity through a consensus panel of nine expert PTs and 13 end-users through greater than 80% agreement on a standardized scoring sheet. Expert PTs were defined as having peer-reviewed publications or national level presentations on EBP and/or outcome measures. Questions were modified, removed and added based on the validation process. The questionnaire was divided into two sections: (1) barriers and facilitators to EBP (Jette et al, 2003; Salbach & Jaglal, 2010; Salbach et al, 2007) and (2) barriers and facilitators to using outcome measures (Swinkels et al, 2011). The EBP section was included to determine the foundational EBP skills to guide intervention design. The EBP section had 35 questions in five domains: confidence (11 questions), behavior (10 questions), educational preparation (4 questions), availability of resources (9 questions) and barriers (1 question). The remaining domains were replicated from existing instruments specifically the Evidence Based Practice Confidence Scale (EPIC) (Salbach and Jaglal, 2010) and the Practitioner and Organizational Barriers to Evidence-Based Stroke Rehabilitation Questionnaire (Salbach et al, 2007).

The second section on barriers and facilitators to using outcome measures included 50 questions, covering eight of the 14 TDF constructs (knowledge, motivation and goals, beliefs about capabilities, skill, behavior, social/professional role and identity, environmental context and resources, and beliefs about consequences). Only eight constructs were represented in the questionnaire as it was adapted from another instrument (Swinkels et al, 2011), and experts reported it was complete during the validation process. Responses were rated on a five-point Likert scale, 1 being completely disagree to 5 being completely agree. Participants were also asked, in open comment fields, what factors may influence their use of outcome measures (Table 2: Comments from participants about what may increase their use of outcome measures), and what outcome measures they would like to use more frequently (Appendix A). Responses were tallied under each domain in the barrier and facilitators to using o questionnaire. The investigators determined that the domain was a barrier or facilitator if greater than 50% of the respondents agreed or disagreed with a question.

Based on the EBP questionnaire, PTs in the study overall agreed that they had previous education on EBP (64%-70%) (Appendix B: Evidence Based Practice Questionnaire Results). PTs had higher confidence in asking, searching, and evaluating the literature (75-95%), but had lower confidence with appraising and integrating research (33%-62%). Sixty-seven percent of the PTs used knowledge from continuing education courses to guide patient care but varied in frequency in other EBP behaviors (i.e. 60% did not conduct a literature search in the past eight weeks, 60% used a research article to answer a clinical question one to two time in the past eight weeks) (Appendix B). All the PTs were provided financial support to attend educational meetings, but lacked other resources to practice using evidence, such as time, access to journals and a resource person (Appendix B).

The results of the barriers and facilitators to using outcome measures questionnaire found that greater than 50% of the PTs experienced barriers to using outcome measures including: lack of knowledge, lack of skill, lack of confidence, lack of use and the documentation system. Greater than 50% of the PTs agreed that facilitators to using outcome measures included: participants (PTs) were motivated, had good social support from colleagues and that goal setting would be helpful to drive PT use of outcome measures. Other facilitators identified in the questionnaire included adequate space, access to outcome measures, healthcare policies, organizational support, and reimbursement (Appendix C: Barriers and Facilitator to Using Outcome Measures Questionnaire Results).

Intervention Mapping and Focus Group

The KB preliminarily designed the intervention by matching barriers and facilitators identified in the questionnaire to recommended strategies for behavior change using the TDF consensus matrix (Michie et al, 2008) (Table 3: Intervention Mapping and Design using the Theoretical Domains Framework). Recommended strategies were identified by the KB and preliminary discussed with the supervisor and later discussed with participants in the focus group. PTs also identified strategies in the open comment section of the questionnaire that were discussed.

The one-hour focus group with the clinicians and supervisor was used to both provide and collect data and design the intervention. Specifically, the purpose of the focus group was to: (1) provide audit and feedback from results of the chart audit and questionnaire, (2) confirm barriers and facilitators for outcome measure use through group consensus, (3) discuss efficacy of recommended intervention strategies identified in the TDF consensus matrix and by the clinicians, and (4) select an outcome measure to increase its use.

The KB provided a handout to the clinicians at the beginning of the focus group and reviewed it throughout (Appendix A). The handout was based on the results from the chart audit and questionnaire. The chart audit aggregated outcome measure use and provided a general overview of documentation including gaps where outcome measures could be documented. WR aggregated the questionnaire data and presented to the participants in an easy to read format. Graphs were added to increase visual appeal of the handout. The handout also included summaries of two outcome measures for the clinicians to select. The two outcome measures were selected based on the discussions with the PTs at the first meeting, discussions with the supervisor, responses in the questionnaire and psychometric properties of the measures.

Clinicians were given the opportunity to read, comment, and reflect on the summary findings throughout the focus group. The KB posed questions regarding feasibility of the proposed intervention strategies while reviewing the handout. For example, while the chart audits were being discussed, questions regarding documentation changes were posed to the group. Questions about rehearsal, social support and environmental changes were posed when that section of the questionnaire was reviewed. The comments in the open comment section were included on the handout and discussed. In the open comment section of the questionnaire, PTs also identified education on the measure, training, and documentation changes would be important to include in the intervention. Focus group questions were based on the TDF (Michie et al, 2005) (Table 4: Focus Group Questions). Two members of the research team (WR and JED) were present at the focus group. The focus group was recorded, transcribed, and data were coded into themes and compared to the TDF domains. To establish credibility, member checking was used to confirm interpretations and conclusions throughout the focus group. WR developed the themes and conclusions and peer review was completed by JED.

The PTs supported gradual implementation as a facilitation strategy. "I think that if we all decided on a couple of tests, that we thought would really work well and that was something that we were expecting, I think we would all do it" (P5). While another stated:

"If we choose maybe 3 or 4 (outcome measures), and if we end up putting them on our flow sheet or whatever it is then we would probably be more motivated to do it, and not be overwhelmed with like 10 different assessment tools, you know if we picked like 3 or 4 that we might think could be to our liking" (P9).

Positive social influences or peer support was also a supported strategy. "If we saw each other doing it and we were facilitating each other to do it, and it was a group mentality" (P3).

One participant commented on the lack of knowledge as a barrier and the need to include evidence in the intervention.

"I guess for it to be meaningful it has to be able to show to third party payers that you know, why that number or measure is important. I don't feel like I have a real grasp on that, I think that it is sort of a task, but I would love to get my hands on an article to see that" (P6).

One aim of the focus group was to achieve consensus on intervention strategies that were identified in the TDF and by the clinicians. As the strategies were discussed, the investigators asked the participants if they felt that a specific strategy would be helpful to include during the intervention. Clinicians nodded in consensus and disagreements were discussed.

Selecting an Outcome Measure

The investigators with the PT supervisor support suggested that two measures, a self-reported and a performance-based measure at the activity level, would be presented to the group. The investigators based their selection on measures that were valid and reliable for the patient population seen in inpatient rehabilitation. The four-meter walk test to measure gait speed was the performance-based outcome measure presented to the clinicians because gait speed was most frequently cited in the questionnaire, the facility had previously attempted to adopt it, and the size of the rehabilitation gym (Middleton, Fritz, and Lusardi, 2015). The *Patient Specific Functional Scale* (PSFS) (Stratford, Gill, Westaway, and Binkley, 1995) was also presented because the PTs wanted to choose a measure that could be used for patients who required assistance for functional mobility who may not be ambulating. The PSFS was recommended by the Geriatric Section of the American Physical Therapy Association on www.PTNow.org (American Physical Therapy Association, 2014). The investigators facilitated a group discussion at the end of the focus group to select a measure. The clinicians discussed several measures they would like to implement including gait speed, PSFS, the functional reach test (Duncan, Weiner, Chandler, and Studenski, 1990) and the Activity Measure for Post-Acute Care (AM-PAC™) (Haley et al, 2004). By the end of the focus group, the KB asked the participants to select one measure to design the intervention, and gait speed was selected through a vote and there was consensus.

OUTCOME

Plan for the Intervention

Based on comments provided in the open fields of the questionnaire and confirmation in focus group, the KB designed a preliminary intervention to implement the four-meter walk test. The KB tailored intervention based on clinician input and included education, handouts with documentation tips, a new documentation sheet and research articles. The educational session was adapted to include the participants input on the purpose of using the measure to educate patients and communicate with patients and third-party payers. The KB created a handout to support the educational session (Appendix D: Educational Session Handout). Full text articles listed on the handout were printed for the participants for future reference (Appendix D). The PTs were interested in documentation changes, and the KB created a blue documentation sheet that was added to the evaluation packets to prompt the participants to use gait speed (Appendix D). The KB presented the handouts to the supervisor for suggestions and approval.

The investigators included additional strategies recommended by the TDF matrix and confirmed by the participants in the focus group in the intervention (Table 3). These additional strategies included: practice, placement of tracks and stopwatches, and creating a group goal for outcome measure use. The investigators guided each strategy with supervisor support. The KB provided all necessary equipment. The supervisor participated and encouraged the PTs to practice assessing gait speed on each other, practice taking gait speed on patients, and providing feedback to each other. The PTs selected four ideal areas for the 4-meter tracks to be placed and the group placed them together. The supervisor hung multiple stopwatches on the wall with a laminated documentation sheets based on the PTs work flow. Prior to the focus group, the investigators asked the supervisor to guide the PTs to create a group goal of documenting gait speed. The supervisor believed a goal to use gait speed 50% of the time on appropriate patients at initial evaluation and at discharge would be ideal and determined that the test would be appropriate for patients who required minimum assistance or less from one person to ambulate and could ambulate greater than 20 feet (6.1meters). The therapists agreed with the goal through consensus during the focus group.

Determining the Outcome

The investigators will conduct chart audits to determine the change in documented use of gait speed following the intervention.   Clinicians will also complete a self-report measure to determine achievement of goal of 50% use following the intervention. Plans for a follow-up outreach visit from WR and focus group are in place to determine the impact of the intervention. A complementary paper is planned to report on the evaluation of this KT intervention.

DISCUSSION

Our pragmatic approach, which included obtaining key stakeholder buy-in, use of audit and feedback, determining the local barriers and facilitators for using outcome measures, and encouraging the clinicians to co-design the intervention, led to the development of a locally tailored theoretically informed intervention. Several levels within the organization were supportive of the initiative including the manager, supervisor and clinicians. The setting was unique because the clinic had a culture of readiness for change. The clinicians and supervisor engaged in every step of the intervention design.

The guidance from the KB supported the design of the intervention. The KB reported current use of outcomes measures and guided a discussion on the selection of an outcome measure, setting a goal for use of the outcome measure, and selection of strategies for implementation of the outcome measure. The KB also adapted the educational intervention, based on feedback from the key stakeholders, by synthesizing the literature, creating a resource handout, and creating documentation sheets.

There are a wide-range of high quality outcome measures for physical therapists to choose when examining patients, but KT interventions to increase the use of outcome measures are often designed without key stakeholder input. To our knowledge, this is the first study that describes using audit and feedback to engage the PTs and build consensus to design a KT intervention. Use of chart audit in the health professions can monitor behavior change (Schreiber and Dole, 2012; Van Peppen et al, 2009). The KT intervention was adapted based on chart audit results, questionnaire feedback from the PTs, and generated themes from the focus group with the key stakeholders. The handouts were adapted to include documentation tips and information to interpret gait speed. As an active participant, the supervisor also served as an onsite champion who supported and encouraged the PTs throughout the design of the intervention. The engagement of all participants aided in the selection of the outcome measure and intervention design by confirming the recommended strategies from the TDF consensus matrix.

The characteristics of the PTs in this setting also highlight the need for tailored KT interventions. Eighty-two percent (n=9) of the PT did not have their DPTs, only one PT had a Neuro-Developmental Treatment certification, and over 50% reported they lacked skills in selecting, administering, and interpreting outcome measures. PTs who have earned their doctorates and are have clinical specializations are more likely to use outcome measures (Duncan and Murray, 2012). Despite these barriers, the PTs were motivated and co-created an intervention based on their unique needs. The group identified strategies to overcome their barriers by adapting the intervention to include educational training to review the evidence and enhance interpretation and documentation of gait speed. We speculate that this process tailored the intervention to the context and a different intervention may have been designed if the PT characteristics differed.

The effectiveness of KT interventions has varied in the literature (Grimshaw et al, 2012), and a theoretically informed and locally tailored intervention to target specific barriers in the clinic is one approach that has been recommended to enhance the effectiveness of KT (Duncan and Murray, 2012). The TDF is the only validated framework to assess barriers and facilitators and develop KT interventions in the health professions. Use of the TDF to guide barrier assessment and intervention design has been primarily conducted with a group of general health care workers, without the input from the local clinicians (Bussieres et al, 2015; Matthews et al, 2015; Sibley et al, 2016; Thomas and Mackintosh, 2014). This is the first study, using the TDF that determined the barriers and designed an intervention with clinician engagement and supervisor support. The strategies recommended in the TDF consensus matrix were easily used by the investigators to guide intervention design.

The design of KT interventions is complex and there were some limitations. The creation of this behavior change intervention, although informed by theory, was based on an integration of multiple sources of information that required some judgement on the part of the investigators. The research team made decisions when creating the intervention using evidence, the TDF, and feedback from the participants to address the complex nature of behavior. In addition, the PTs previous experience with gait speed may have biased the investigators to encourage the participants to select that measure.

Development of the intervention was time consuming for the investigators decreasing the likelihood of it being reproduced without investigator support. The knowledge broker took 20 hours to complete chart audits, create the barrier assessment, analyze the data, and preliminarily design the intervention. There were attempts to reduce the amount of face-to-face time with the participants through the use of questionnaires to guide the focus group and additional meetings with the supervisor. In addition, the five one-hour meetings were only held during lunch time to encourage participation. Future research should investigate the amount of face-to-face time needed with the research team and participants to design and implement KT interventions.

Due to the complexity of KT and behavior change, one could argue that the intervention design was actually part of the intervention itself. At the informed consent meeting, the clinicians were engaged in a discussion regarding what measure to use and what barriers they needed to overcome. The group described socializing about the intervention when the investigators were not present. In addition, to help build consensus, the investigators attempted to schedule meetings when all the PTs could be present. If a PT missed a meeting, they would meet separately with the supervisor or investigators. The culture of the readiness for change of the facility and engagement from the clinicians outside of the formal meeting time will likely be favorable to the outcome.

CONCLUSION

This paper illustrates the use of audit and feedback, clinician engagement and organizational support underpinned by the Theoretical Domains Framework to guide barrier assessment and design a locally tailored KT intervention. By completing the mixed methods barrier assessment, the KT intervention was designed with input from the key stakeholders and organizational support. The intervention was created to reduce barriers and augment the facilitators identified. Research is in progress to evaluate the impact of the theory-based KT intervention.

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Table Legend:
Table 1: Characteristics of Physical Therapists

Table 2: Comments from participants about what may increase their use of outcome measures

Table 3: Intervention Mapping and Design using Theoretical Domains Framework

Table 4: Focus Group Questions: (TDF domains targeted noted in parentheses)

Figure Legend:
Figure 1: Study Outline

Supplementary material

Appendix A: Barrier Assessment Handout

Appendix B: Evidence Based Practice Questionnaire Results

Appendix C: Barriers and Facilitator to Using Outcome Measures Questionnaire Results

Appendix D: Educational Session Handout

Table 1: Characteristics of Physical Therapists

Table 1: Characteristics of Physical Therapists (n=11)

Characteristic	n(%) or mean ±sd (Range)
Age	43.3 ±13.1
Gender Female	 9 (85%)
Years of experience	21.7± 12.2 (1-44)
Years working at this facility	8 (5.6)

Highest Degree Bachelors Masters Doctorate	 5 (45%) 4 (36%) 2 (18%)
APTA member (Yes)	4 (36%)
Supervised PT students (Yes)	9 (82%)
Credentialed CI	3 (27%)
Certifications NDT	 1 (9%)
APTA: American Physical Therapy Association PT: Physical Therapy CI: Clinical instructor NDT: Neurodevelopment treatment	

Table 2: Comments from participants about what may increase their use of outcome measures

Table 2: Comments from participants about what may increase their use of outcome measures:

"Increased familiarity" (P1)

"Training" (P2)

"Increased training, decision tree for which ones to use when" (P3)

"Having more availability to standardized tests" (P4)

"Realizing that they consistently track changes in patient's functional status" (P6)

"Procedural forms and practice" (P8)

"Actually having space on the written evaluation and flow sheets to documents results" (P10)

"Meetings/continuing education/reviewing articles, time for the therapists to get together as a group and discuss assessment tools (pros/cons), new research for various patient population, etc." (P11)

"Would be nice to have paperwork (evaluation forms and flow sheets) that have space to document standardized assessments" (P11)

Table 3: Intervention Mapping and Design using Theoretical Domains Framework

Table 3: Intervention Mapping and Design using Theoretical Domains Framework

Barrier/Facilitators	TDF Term	Recommended TDF Strategies	Intervention Component
Lack of knowledge of suboptimal assessment behavior	Lack of knowledge	Provide information regarding behavior	Report of current outcome measure use from chart reviews[a]
Lack of confidence to change behavior	Belief about capabilities	-Self monitoring -Graded Tasks -Rehearsal of Relevant Skills -Social process of encouragement, pressure, support	-Rating goal achievement[a] -Starting with one skill [c] -Practice skill on each other[c] -Multiple participants in the study[c]
Positive Intention to improve assessment practice	Motivations and goals	-Goal Targeted behavior -Graded tasks -Information Regarding Behavior -Social Process	-Goal setting[a] -Starting with one skill [c] -Report of current use from chart review[a] -Multiple participants in the study[c]
Positive Attitude regarding outcome measures	Beliefs about consequences	-Self-monitoring -Information Regarding Behavior -Feedback	-Rating goal achievement[a] - Report of current use from chart review[a] -Process evaluated through focus group[c]
Good environmental resources	Environmental context & resources	Environmental Changes	-Add stop watches, documentation sheet and tracks in PT gym[a,b,c]

Positive Social Influences	Positive Social Influences	-Social process of encouragement -Modelling by others	-Practice skills[c] -Seeing other PTs use the OM[c]
Lack of Skill in selecting, administering and interpreting outcome measures	Lack of Skill	Goal Targeted Behavior Self-monitoring Monitoring Rewards; incentives Rehearsal of Relevant Skills Graded tasks Modeling and demonstration by others	-Set goals for outcome measure use[a] -Rating their goals achievement[a] -Report of current use from chart review[a] -Supervisor to create incentive[b,c] -Practice skill on each participants[c] -Practice skill with patients[c] -See others practice skills with other participants and patients[c]
Lack of Behavior Change	Action Planning	Prompts, triggers, cues	-Set goals for outcome measure use[a] -Environmental changes[b,c] -Add stop watches, documentation sheet and tracks in PT gym[a,b,c]
[a] indicates investigator facilitated [b] indicated organizational support from start [c] indicates PT identified through questionnaires and audit and feedback			

Table 4: Focus Group Questions

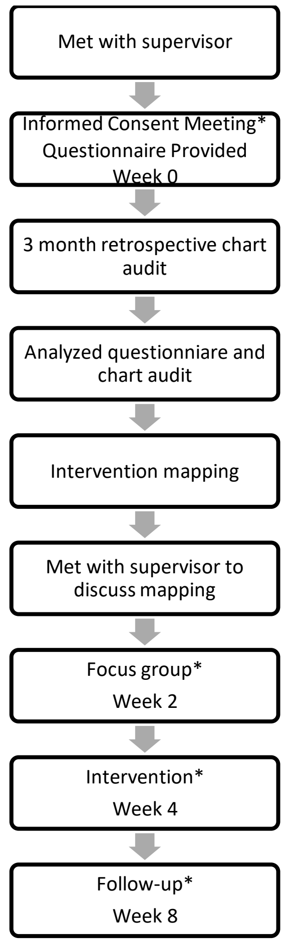
Table 4: Focus Group Questions: (TDF domains targeted noted in parenthesis)

Those who have used standardized assessments, tell me why you use them? (all) Those who don't use standardized assessments, tell me how we can increase your use? (all) What resources on site do you believe would assist you to use standardized assessment more consistently? (Probes on rehearsal, environmental contextual resources changes, social support) Would having a dedicated space on the evaluation form change your behavior of using standardized assessments? Explain why or why not. (environmental) Explain whether or not having a separate form to document may change your behavior? (environmental, context and resources)

Chapter 4 Figure 1

Figure 1: Study outline

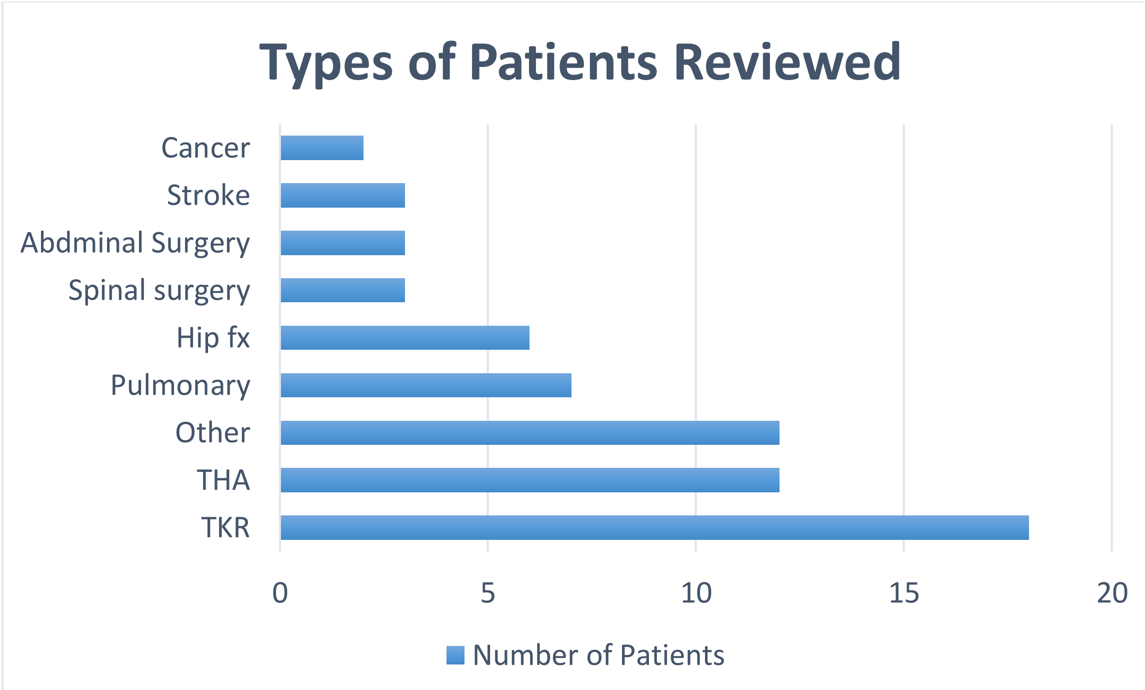
*indicates meetings with Physical Therapists (PTs)



Appendix A: Barrier Assessment Hand-Out

Chart Review:

Sixty-four charts reviewed from previous 3 months, included charts had initial evaluation and discharge completed by consenting therapists.



Abbreviations: fx= fracture, THA=total hip arthroplasty, TKR= Total knee replacement

Others included: multi-trauma, pelvic fx, shoulder replacement.

Length of stay: Range 2-91. Average 21. Shorter for TKA/ THA. Longer for more medical complexities (falls, multi-trauma, Chronic Obstructive Pulmonary Disorder, septicemia)

Documentation:

Free spaces to write gait speed or other balance measures.

No formal space for specific measures

Initial Exam:

Including Manual Muscle Tests, Range of Motion, observational gait analysis, functional mobility, balance, etc.

Lack of consistent use of standardized assessments at the activity and participation level.

Standardized assessment use:

Vitals

Overall 60.9% of the time

Rest and activity vitals: 35.9%

Pre or post activity vitals: 25%

Functional Independence Measure subscale:

Elderly Mobility Scale: 1%

Balance:

Initial

Timed static stance: 2%

Timed Single limb stance: 1%

Discharge

Timed stance: 1%

Timed single limb stance: 2%

Survey Data

Evidence Based Practice (EBP) Questionnaire:

Confidence

Higher scores on practical skills (deciding on appropriate course of action, asking pt about values, formulate a question)

Lower confidence on interpreting (t-tests, chi squared, and logistic regression)

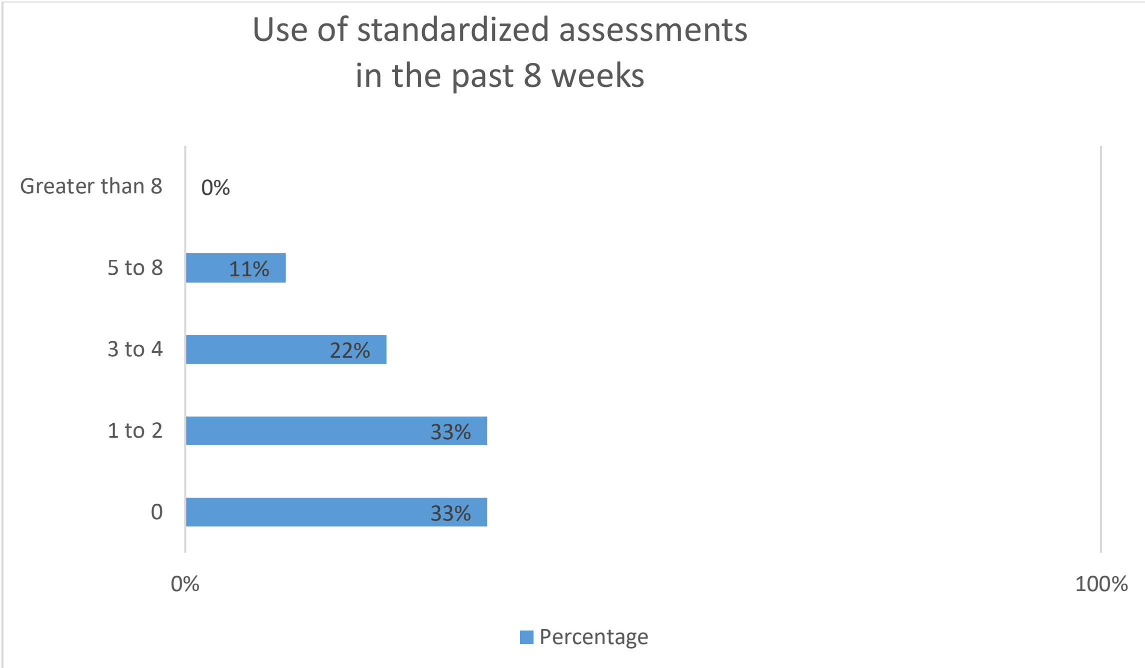
These finding agrees with literature on EBP and confidence (Salbach et al. 2010)

Behavior:

78% reports they applied what they learned at a course to patient care.

Variability with searching the literature.

66% reported they used at least one standardized assessment in the past 8 weeks



<u>Access to Resources</u>

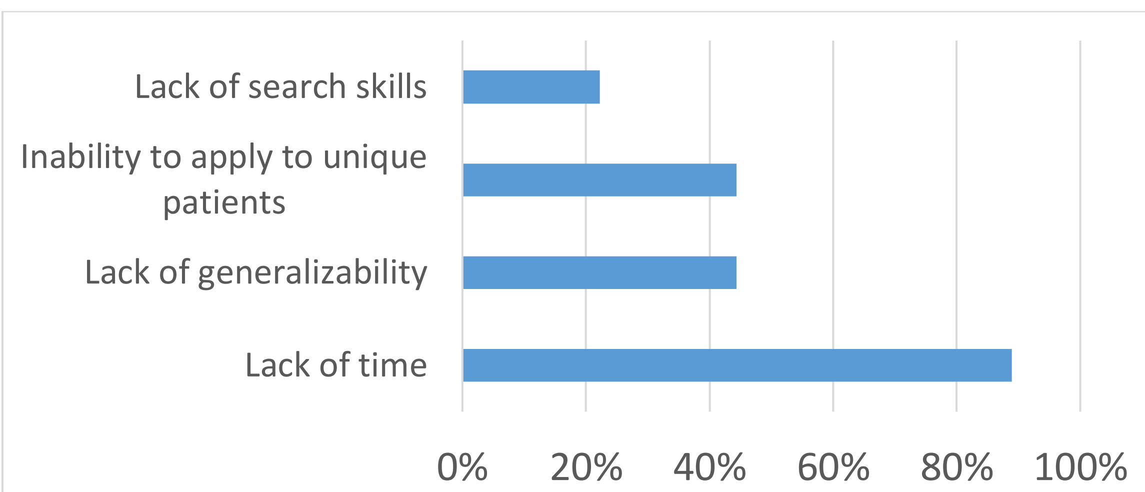
78% report having access to resources at home

Inconsistency between knowledge of access to evidence-based resources at work

<u>Educational Preparation</u>

Range of prep on EBP, analysis of literature and application of literature

<u>Barriers</u>:



Standardized Assessments Questionnaire:

Knowledge: range of knowledge of what is out there, choice, administering, interpreting, documenting

Attitude: Good

Confidence:

66% Reported lack of confidence choosing the best Standardized assessment

33% reported lack of confidence with Administering, 44% were neutral

33% reported lack of confidence with Interpreting, 44% were neutral

Skill:

55% reported lack of skill identify measures

55% reported lack of skill interpreting to patients

Behavior:

What percentage of the time during examination do you complete a standardized assessment?

Ranged from 0-100% of the time

Mode 10%.

Social Influences: Agreed support from co-workers and supervisors

Environment: Not a barrier as well, space

Barriers	Facilitators
Lack of time Lack of search skills Lack of generalizability Inability to apply research to individual patients with unique characteristics Lack of knowledge of what to choose	Positive attitude Co-worker and supervisor support Belief that it's not too time consuming to conduct Standardized assessments Belief that patients don't find it time consuming

Lack of confidence with choice and administration	Belief that patients are appropriate Belief that they are useful to communicate to the health care team Access to literature at home Adequate space

What factors may increase the use of outcome measures?

Training to increase familiarity

Space on documentation, Forms to document

Availability of measures, readily available for use

Therapists' discussion on use of Outcome Measures, research, etc.

Measures you reported you wanted to use more:

Gait speed

Walkie-talkie

TUG (Timed Up and Go)

Tinetti

Functional reach & Multi-directional functional reach

Berg Balance Scale

Questions/Comments after the focus group:

romneyw@sacredheart.edu

Patient-Specific Activity Scale

This questionnaire can be used to quantify activity limitations and measure functional outcome for patients.

Identify up to three activities, for each activity rate from 0 to 10 on your ability to perform the activity.

Patient-Specific Activity Scoring Scheme:

0	1	2	3	4	5	6	7	8	9	10
Unable to perform activity										Able to perform at the same level as before injury or problem

Sample Activities:

Get out of bed, Get into bed, Stand up, transfer to and from the toilet, Walk, go up the stairs, or get into the car

Activity #1:____

0	1	2	3	4	5	6	7	8	9	10
Unable to perform activity										Able to perform at the same level as before injury or problem

Activity #2:____

0	1	2	3	4	5	6	7	8	9	10
Unable to perform activity										Able to perform at the same level as

before injury
or problem

Activity #3:____
_____

0	1	2	3	4	5	6	7	8	9	10
Unable to perform activity										Able to perform at the same level as before injury or problem

Stratford, P., Gill, C., Westaway, M., Binkley, J. (1995). Assessing disability and change on individual patients: a report of a patient specific Measure. *Physiotherapy Canada*, 47, 258-263.

Gait Speed:

Valid and Reliable test to measure walking speed

Predicts fall risk, discharge placement, risk for hospitalization, and dependence for Activities of Daily Living (ADL's).

Patient Population

Includes patients that can ambulate at least 20 feet

Includes patients that require min assistance or below to ambulate

Includes patients that do not need assistance advancing lower extremity

Includes most patients with TKA, THA and general medical diagnoses

Administration

Patients ambulate along a 6-meter (m) track and time is measured for the intermediate 4 meters

Use a stop watch to time when the toes of the leading foot cross the one-meter mark and stop when the toes cross the five-meter mark

The patient is instructed to ambulate the full 6 meters, the one-meter warm-up and cool down is not measured.

To calculate speed, use meters per second: 4 meters/ x seconds

Patients can use an assistive device and have up to minimum physical assistance

0 m — **Start Walk**

1 m — **Start Timing**

5 m — **End Timing**

6 m — **End Walk**

GOAL ATTAINMENT SCALE

For appropriate patients*, we will measure:

Goal:		Gait speed at initial evaluation (within 1 day)	Gait speed at discharge
-2	Much Less than expected	0% of the time	0% of the time
-1	Less than expected	25% of the time	25% of the time
0	Expected	50% of the time	50% of the time
+1	Greater than expected	75% of the time	75% of the time
+2	Much greater than expected	100% of the time	100% of the time

Reference: Kiresuk, T.J., & Sherman, R. E. (1968). Goal attainment scaling: A general methods for evaluating comprehensive community mental health programs. *Community Mental Health Journal*, 4(6),443-453.

Appendix B: Evidence Based Practice Questionnaire Results

Education	Disagree[a]	Neutral	Agree[b]

I learned the foundations of EBP as part of my academic preparation.	4 (36%)	0 (0%)	7 (64%)
I have received formal training in search strategies for finding research relevant to my practice.	2 (18%)	2 (18%)	7 (64%)
I received formal training on how to critically appraise research articles.	3 (27%)	1 (9%)	7 (64%)
I received formal training on how to apply research evidence to a specific patient case.	2 (20%)	1 (10%)	7 (70%)

[a]Response categories of “strongly disagree and “disagree” were combined

[b]Response categories of “agree” and “strongly agree” were combined

EBP: Evidence Based Practice

Evidence Based Practice Barriers, Facilitators and Behaviors

Confidence: How confident are you in your ability to… 0%-100%	Mean	StDev
Identify a gap in your knowledge related to a patient or client situation	88%	9
Formulate a question to guide a literature search based on a gap in your knowledge?	78%	16
Effectively conduct an online literature search to address the question?	75%	18
Critically appraise the strengths and weaknesses of study methods?	62%	13
Critically appraise the measurement properties of standardized tests or assessment tools you are considering using in your practice?	55%	19
Interpret study results obtained using statistical tests such as t-tests or chi-square tests?	44%	21

Interpret study results obtained using statistical procedures such as linear or logistic regression?	33%	25
Determine if evidence from the research literature applies to your patient's or client's situation?	75%	9
Ask your patient or client about his/her needs, values and treatment preferences?	95%	8
Decide on an appropriate course of action based on integrating the research evidence, clinical judgment and patient or client preferences?	78%	12
Continually evaluate the effect of your course of action on your patient's or client's outcomes?	79%	14
TOTAL (/100)	70%	9
StDev: Standard Deviation		

Behavior: How often in the past 8 weeks have you? (n=10)	0	1-2	>2
Conducted a literature search to answer a clinical question (e.g. PubMed, OVID, google scholar, etc).	6 (60%)	2 (20%)	2 (20%)
Used individual research articles to answer a clinical question.	4 (40%)	6 (60%)	0 (0%)
Used clinical practice guidelines to answer a clinical question.	4 (40%	3 (30%)	3 (30%)
Used a systematic review to answer a clinical question.	6 (60%)	1 (10%)	3 (30%)
Used evidence-based internet resources (rehabmeasures.org, PTNow.org) to answer clinical questions.	5 (50%)	3 (30%)	2 (20%)
Used knowledge gained from continuing education courses or conferences to guide patient care.	1 (11%)	2 (22%)	6 (67%)
Used standardized assessment tools (outcome measures) to examine patients.	3 (30%)	4 (40%)	3 (30%)
Used evidence to guide the diagnosis of patients.			
Used evidence to guide the prognosis of patients.			

Used evidence to guide the treatment of patients.	5 (50%) 4 (40%) 2 (20%)	2 (20%) 1 (10%) 2 (20%)	3 (30%) 5 (50%) 6 (60%)

Resources: (n=11)	Yes	No	IDK
At my facility, I have access to professional journals in their paper form.	2 (18%)	9 (82%)	0 (0%)
At my facility, I can access relevant databases (e.g. PubMed, OVID, EBSCO).	6 (55%)	2 (18%)	3 (27%)
At my facility, I can access full text articles.	5 (45%)	4 (36%)	2 (18%)
At my facility, there is a resource person (e.g. clinical practice leader, librarian, research therapist) who can assist with implementing EBP.	3 (27%)	8 (73%)	0 (0%)
My facility has missions/goals/values regarding the use of evidence in practice.	5 (45%)	5 (45%)	1 (9%)
My facility provides protected time for me to conduct literature reviews and appraise the literature.	1 (9%)	10 (91%)	0 (0%)
My facility provides financial support to attend educational meetings and conferences.	11 (100%)	0 (0%)	0 (0%)
I have the access to relevant databases with full text articles on the internet at home or locations other than my facility.	9 (82%)	1 (9%)	1 (9%)
	Disagree[a]	Neutral	Agree[b]
I have colleagues who can mentor or facilitate my use of research findings in my practice.	1 (9%)	2 (18%)	8 (73%)
[a]Response categories of “strongly disagree and “disagree” were combined [b]Response categories of “agree” and “strongly agree” were combined			

Appendix C: Barriers and Facilitators to Using Outcome Measures Questionnaire Results

(n=11)*except where indicated

Domain Item	Disagree[a]	Neutral	Agree[b]
Knowledge			
I have sufficient knowledge of standardized outcome measures	5 (45%)	2 (18%)	4 (36%)
I know how to choose valid and reliable assessments (n=10)	4 (40%)	0 (0%)	6 (60%)
I know how to administer SOM (n=9)	4 (44%)	4 (44%)	1 (11%)
I know how to interpret SOM using MCID, MDC, etc. (n=10)	7 (70%)	0 (0%)	3 (30%)
I know how to document the results when using SOM (n=10)	3 (30%)	2 (20%)	5 (50%)
I would like to know more about SOM before using them	0 (0%)	0 (0%)	11 (100%)
Motivation and Goals			
Using SOM improves the quality of patient care (n=9)	0 (0%)	3 (33%)	6 (67%)
The use of SOM helps direct patient care	0 (0%)	3 (33%)	8 (73%)
Using SOM allows me to includes patient preferences	1 (9%)	9 (82%)	1 (9%)
The use of SOM fits my way of working in the clinic	1 (9%)	8 (73%)	2 (18%)
The use of SOM motivates my patients	1 (9%)	7 (64%)	3 (27%)
Using SOM is too time consuming	3 (27%)	3 (27%)	5 (45%)
In general, I avoid using SOM	2 (18%)	4 (36%)	5 (45%)
Confidence			
I feel confident I choosing the SOM for patient care	9 (82%)	1 (9%)	1 (9%)
I feel confident when administering SOM (n=10)	4 (40%)	4 (40%)	2 (20%)
I feel confident when interpreting SOM (n=10)	4 (40%)	4 (40%)	2 (20%)

I feel confident when documenting about the results of SOM (n=10)	3 (30%)	3 (30%)	4 (40%)
Skill			
I have sufficient skills identify SOM (n=10)	6 (60%)	1 (10%)	3 (30%)
I have sufficient skills obtaining SOM (n=9)	4 (44%)	0 (0%)	5 (56%)
I have sufficient skills administering SOM (n=10)	5 (50%)	2 (20%)	3 (30%)
I have sufficient skills interpreting SOM results to my patients (n=10)	6 (60%)	0 (0%)	4 (40%)
Behavior			
I use SOM to educate the patient and family (n=9)	6 (67%)	2 (22%)	1 (11%)
The use of SOM is always an integral part of my examination (n=10)	7 (70%)	1 (10%)	2 (20%)
I use SOM primarily of evaluative purposes (n=10)	2 (20%)	2 (20%)	6 (60%)
I use SOM primarily of prognostic purposes (n=9)	2 (22%)	5 (56%)	2 (22%)
I use SOM primarily of diagnostic purposes (n=9)	3 (27%)	2 (18%)	4 (36%)
I always follow the protocol when administering SOM (n=9)	2 (22%)	2 (22%)	5 (56%)
Social Influences			
Patients value the use of SOM to gain insight into their functioning	3 (27%)	4 (36%)	4 (36%)
Patients find the use of SOM too time consuming	2 (18%)	9 (82%)	0 (0%)
The kinds of patients I treat are not appropriate for the use of SOM	6 (55%)	3 (27%)	2 (18%)
My co-workers support the use of SOM	1 (9%)	3 (27%)	7 (63%)
My supervisor supports the use of SOM	0 (0%)	1 (9%)	10 (91%)
SOM are valuable when speaking about the patient to the team (n=10)	0 (0%)	3 (30%)	7 (70%)

Environmental Context and Resources			
I find using standardized assessments a problem because I do not have (physical) space in my practice.	5 (55%)	3 (27%)	3 (27%)
There are enough standardized assessment tools to use in my daily practice. (n=10)	4 (40%)	5 (50%)	1 (10%)
I don't have enough time to use standardized assessments. (n=10)	6 (60%)	1 (10%)	3 (30%)
I don't have the equipment I need to use standardized assessments. (n=10)	6 (60%)	4 (40%)	0 (0%)
The use of standardized assessments is required at the practice where I work. (n=10)	7 (70%)	1 (10%)	2 (20%)
I have access to the standardized assessments I want to use. (n=9)	2 (18%)	2 (18%)	5 (45%)
The use of standardized assessments is part of the organizational goals of our practice. (n=10)	3 (30%)	3 (30%)	4 (40%)
Health care policies support the use of standardized assessments. (n=10)	1 (10%)	3 (30%)	6 (60%)
Beliefs about Consequences			
I have increased my use of standardized assessments because of Medicare and Medicaid. (n=10)	5 (50%)	3 (30%)	2 (20%)
I have increased my use of standardized assessment because of other third-party payers. (n=10)	5 (50%)	3 (30%)	2 (20%)
The documentation system where I work supports the use of standardized assessments. (n=10)	6 (60%)	4 (40%)	0 (0%)
The documentation system where I work does not support the use of standardized assessments that I want to use. (n=10)	2 (20%)	5 (50%)	3 (30%)

Physical therapists who use standardized assessment should receive additional financial compensation	10 (91%)	1 (9%)	0 (0%)
Referrers want treatment results objectively evaluated.	1 (9%)	1 (9%)	9 (82%)
Using standardized assessments might strengthen negotiations with insurers.	0 (0%)	2 (18%)	9 (82%)

[a]Response categories of “strongly disagree and “disagree” were combined

[b]Response categories of “agree” and “strongly agree” were combined

SOM: Standardized Outcome Measures

MCID: Minimally Clinically Important Difference

MDC: Minimal Detectable Change

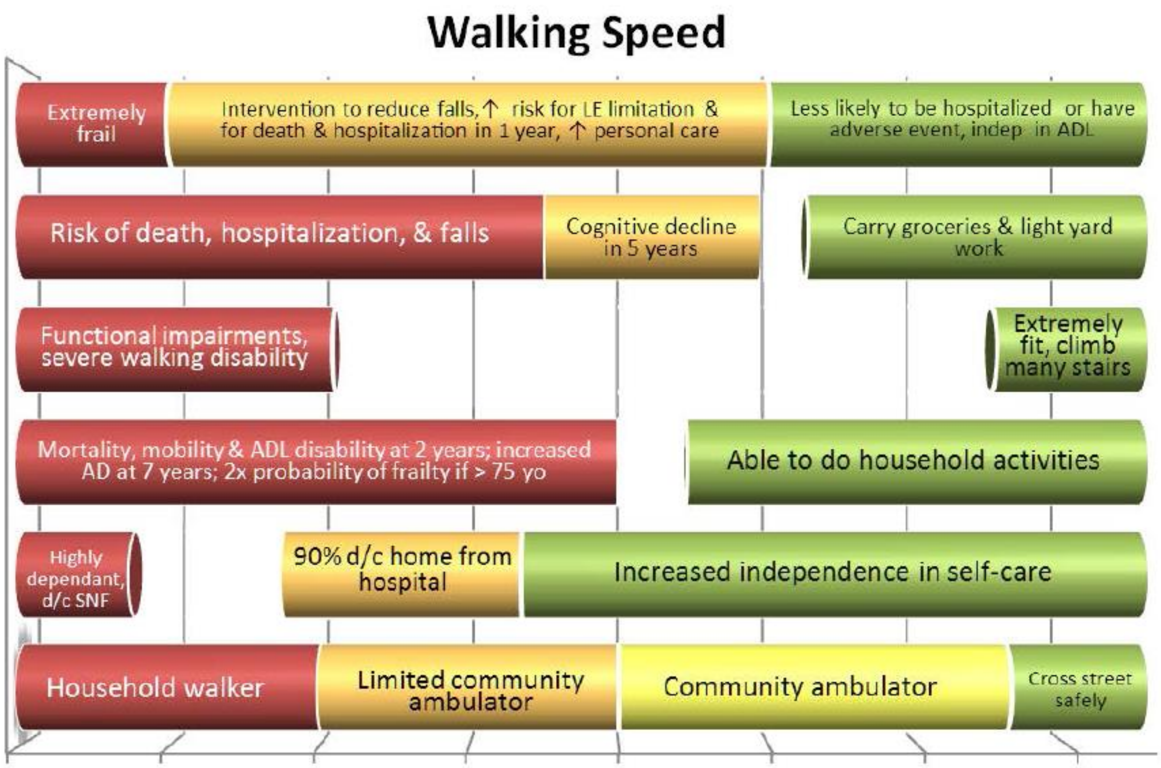
Patient Population

-Can ambulate at least 20 feet

-Requires min assist below to ambulate

-Does not need assistance advancing lower extremity

-Includes most patients with TKA, THA and general medical diagnoses



0 mph 0.2m/s 0.4m/s 0.6m/s 0.8m/s 1.0m/s 1.2m/s 1.4m/s

4MWT 20 sec 10 sec 6.7 sec 5 sec 4 sec 3.3 sec 2.9 sec

0 mph .45 mph 0.89 mph 1.34 mph 1.79 mph 2.2 mph 2.68 mph 3.13 mph

From A. Middleton, S.L. Fritz, and M. Lusardi, 2015, “Walking speed: The functional vital sign,” *Journal of Aging and Physical Activity* 23(2) (Champaign, IL: Human Kinetics), 314-322, as adapted by S. L. Fritz and Wendy Romney. Used with permission of Human Kinetics and S.L. Fritz.

Abrevations : TKA : Total Knee Arthoplasty, THA : Total Hip Arthoplasty

Documentation Tips:	
Exam:	Under examination, gait section: document gait speed: 4/____ OR NT secondary to: _______ Include: assistive device, orthotic, Level of assistance
Assessment:	Pt gait speed was less than 1.0 m/s which indicates increased likelihood for falls and pt will continue to benefit from skilled PT. Pt gait speed was less than .6m/s which indicates more likely to be re-hospitalized
Re-evaluation:	Pt presents with a gait speed of .34m/s which indicates she is a household ambulator, at an increased risk for falls and increased risk for re-hospitalization. Pt will continue to benefit from skilled PT to return to prior level of function (limited community ambulator). Pt continues to benefit from skilled PT with improvements in gait speed from .56m/s to .8m/s which is greater than the minimal detectable change (0.1m/s) (Lusardi, 2003). A change of > 0.1m/s is considered a minimal detectable change (MDC) (beyond measurement error) (Lusardi, et al., 2003)
Discharge:	Recommend discharge to home therapy secondary to gait speed upon discharge was .34m/s, indicating a household ambulator. Recommend to outpatient PT because gait speed was greater than .8m/s.
NT: Not tested, PT: Physical Therapy	

Definitions: (Perry, 1995)

<u>Community Ambulator: .8-1.2m/s</u>

Independent in all home and moderate community activities

Can accept uneven terrain

Can negotiate a crowded shopping center

Limited community ambulator: .4-.8m/s

Independent (without supervision) in either entering/exiting the home or managing curbs

can use some assistance in both local stores and un-crowded shopping centers

Household walker: < .4m/s

Relies on walking to some extent of home activities

Requires assistance for some walking activities, uses a wheelchair, or is unable to perform others.

If a wheelchair is needed for either bedroom or bathroom mobility, the other activity can be performed by Supervision only

Others:

<.6m/s more likely to be dependent for the ADL's and IADLs, more likely to be hospitalized.

A change of > 0.1m/s is considered a minimal detectable change (MDC) (beyond measurement error)(Lusardi, et al., 2003)

Important Values (Fritz & Lusardi, 2009)	
Normal walking speed	>1.2 m/s
Increased likelihood of falls	<1.0m/s
Community Ambulator	0.8-1.2m/s
More likely to be Dependent for ADLs and IADLs	< 0.6m/s
Limited Community Ambulator	.4-.8m/s
Household ambulator	<0.4m/s

Name: -

____

Record the time in seconds for the patient to ambulate the middle 4 meters. To find the velocity divide 4 by the number of seconds (m/s). For example, if a patient walks on average 8 seconds you have the following: 4/8= .5 m/s

Date:	Initial Evaluation or Day 1			Discharge
Trial 1 (sec)				
Trial 2 (sec)				
Trial 3 (sec)				
Average (sec)				
Velocity m/s 4/x sec				
Level of Assistance Assistive Device Bracing				

References:

Bohannon, R. W. (1997). Comfortable and maximum walking speed of adults aged 20-79 years: Reference values and determinants. *Age Ageing. 26*(1), 15-19.

Fritz, S. & Lusardi, M. (2009). White paper: walking speed: the sixth vital sign. *Journal of Geriatric Physical Therapy.* 32(2): 2-5.

Lusardi, M.M., Pellecchia, G.L. & Schulman, M. (2003). Functional performance in community living older adults. *Journal of Geriatric Physical Therapy.* 23, 3, 14.

Perry. J., Garrett, M., et al. (1995). Classification of walking handicap in the stroke population. *Stroke* 26(6), 982.

Steffen, T.M., Hacker, T.A., & Mollinger, L. (2002). Age and gender related test performance in community dwelling elderly people: six minute walk test, berg balance scale, timed up and go test and gait speeds. *Physical Therapy Journal.* 82, 128-137.

5.0 Chapter V. Manuscript Pilot Project

Submitted to Journal of Geriatric Physical Therapy

A Knowledge Translation Intervention Designed and Implemented by a Knowledge Broker Improved Documented Use of Gait Speed: A Mixed Method Study

ABSTRACT

Background and Purpose: Outcome measures are a valuable part of the physical therapy practice, yet there is a gap in routine outcome measurement use by physical therapists (PTs). There are many barriers to using outcome measure and knowledge brokers (KBs) are individuals who can collaborate with the PTs to facilitate outcome measure use. The purpose of this study was to determine if an intervention tailored by an external knowledge broker would overcome barriers and increase the use of gait speed by PTs working at a single inpatient rehabilitation hospital.

Methods: A mixed methods study was conducted with 11 PTs who worked in an inpatient rehabilitation hospital. With supervisor support, the PTs collaborated with a KB to design and implement a knowledge translation (KT) intervention to overcome barriers and increase confidence and use of gait speed. The 2-month intervention included education, documentation changes, printed material, audit and feedback, outreach visits, goal setting, and organizational support. Use of gait speed was primarily measured through chart audit. Focus groups at baseline, immediately following the intervention, and 9-month follow-up were used to determine barriers to using gait speed and perceptions of the intervention.

Results: Documentation of gait speed significantly improved from baseline (0%) to month-2 at initial evaluation (mean=66%, SD=30 %, $F=48.212$ $p<0.001$) and discharge (mean=65%, SD=30%, $F=51.941$, $p<0.001$) and at 6-month follow-up for initial evaluation (Mean= 63%, SD 21%) and discharge (mean=59%, SD 32%). 11 PTs in the focus group reported the KT strategies including documentation changes and social support helped facilitate their behavior change, but barriers to use remained such as lack of space and patient functional levels.

Discussion: The KB, with supervisor support, collaborated with the PTs, to tailor an intervention to address local barriers. The PTs significantly improved use of outcome measures following the intervention and reported the intervention facilitated outcome measure use although barriers to using gait speed remained.

Introduction

Standardized outcome measures are used to guide treatment, determine plan of care, document patient progress and communicate with providers, patients and payers, yet physical therapists (PTs) do not routinely use them.[1] Use of outcome measures varies across clinical setting, with home care therapists and outpatient therapists reporting the highest use (64.7% and 60.5%, respectively), and PTs who work in acute care, extended care facilities and inpatient rehabilitation reporting the lowest (16.4%, 23.1% and 30.8%).[1] National physical therapy associations have supported the use of outcome measures to optimize practice.[2,3] The American Physical Therapy Association developed the Evaluation of Database to Guide Effectiveness Task Forces to support outcome measure use, but despite these recommendations barriers to regular use still remain.[2] Health professionals frequently cite lack of time and knowledge of the outcome measure as barriers to using them.[4] However, the problem is more nuanced as many barriers are context dependent including therapist and patient characteristics, the practice environment, the organization, and the evidence itself.[4] Tailored knowledge translation (KT) interventions are needed to adapt knowledge to the local context and address context dependent barriers to facilitate behavior change.[4]

Knowledge brokers (KBs) are individuals who are trained in KT strategies and can facilitate the application of best practices such as the use of standardized outcome measures.[5,6] KBs collaborate with clinicians and policy makers with the intention to change practice.[6] They understand context dependent barriers and facilitators, allowing them to tailor KT interventions by enhancing facilitators and overcoming barriers to change practice. KBs have a working knowledge of the evidence and can adapt the knowledge in a way that's useful for the clinicians. KBs roles vary depending on the context and the evidence they are trying to implement.[7,8] Internal KBs are employed and embedded within the organization and external KBs are researchers or consultants contracted to work with the organization.[5]

While KT interventions to increase use of outcome measures by PTs have been implemented in pediatric,[7,9] outpatient orthopedic[10,11] and stroke rehabilitation settings,[12,13] only two groups have implemented KT interventions using KBs.[7,9] Russell et al[7] reported improvement of knowledge and use of four pediatric outcome measures following an intervention implemented by internal KBs. The internal KBs were senior PTs who were trained in KT and knowledge brokering strategies and were supported by an external KB who provided synthesized literature about use of the outcome measures. The roles of the internal KBs varied based on the individual KB and the clinical setting and included teaching staff about outcome measures in large groups, small groups, and one-on-one, performing a needs assessment, and reviewing policies and procedures to incorporate the measures into their setting.[14] Schreiber et al[9] described a KT intervention implemented by an internal KB that improved the knowledge and use of pediatric outcome measures. The KB worked part time in the clinic and knew the PTs well and was supported by administration for 4 hours per week to implement the project. The KB obtained organization support from formal and informal meetings and collaborated with the PTs to select outcome measures to implement.[9]

Little is known about an external KB that facilitates collaboration between the PTs and supervisors to co-design and implement a tailored intervention to improve the use of outcome measures for PTs who work in inpatient rehabilitation. The purpose of this study was to determine if an intervention, tailored by an external KB to address local barriers, co-created with knowledge users, the PTs, and supported by the supervisor, would overcome barriers, and increase confidence and use of gait speed, measured by the four-meter walk test, by PTs who worked at an inpatient sub-acute rehabilitation hospital. We hypothesized the percentage of documented use of gait speed at initial evaluation and discharge for ambulatory patients would be significantly greater during the intervention period compared to the pre-intervention period and that the tailored intervention would overcome barriers to use.

METHODS

A mixed methods study was conducted with four one-hour meetings over a period of two months. Chart audits were conducted retrospectively for 3 months and at 0-2, 2-4, 4-6, 6-8 month intervals. Focus group meetings were conducted at month 0, month 2 and month 9.

The primary investigator (WR) acted as a researcher and knowledge broker (KB) to facilitate the KT intervention.[5] WR was a Doctorate in Physical Therapy and Neurologic Clinical Specialist with eight years of clinical experience in rehabilitation. WR was also a clinical assistant professor at Sacred Heart University teaching outcome measures and a PhD student at Rutgers University with a focus on knowledge translation. WR did not know the setting or PTs prior to the start of the intervention.

PTs who worked at a community based sub-acute inpatient rehabilitation hospital greater than 20 hours a week and could participate in lunch-time meetings were recruited to participate. Part time therapists were excluded from the study. Eleven out of 13 full time PTs (including one supervisor) consented to participate (Table 1). There were no withdrawals. All consented PTs worked 40 hours per week and treated between 5-10 patients per day. They treated a mixed caseload of patients over the age of 60 years (85%) with diagnoses including total joint replacements (50%), cardiopulmonary conditions (12%), gastrointestinal-genitourinary conditions (10%) fractures and orthopedic surgeries (10%), neurological conditions (5%) and other (13%) (e.g. altered mental status, fall, and cancer).

Between four and six months after the start of the intervention, the supervisor trained the PTs that did not meet the inclusion criteria or did not originally participate in the study. This group became the post-hoc control group and consisted of full time, part time, per diem, and traveling PTs. There are no detailed demographics on this group. The Institutional Review Board at Rutgers University approved the study protocol.

Following a mixed methods barrier assessment, the intervention was co-designed with the PTs, supervisor and the research team which included the KB. The design of the intervention was informed by the Theoretical Domains Framework (TDF)[15-17] and the Knowledge-to-Action Framework.[18] Details of the development intervention are described elsewhere,[19] and are summarized here. The mixed methods barriers assessment consisted of a chart audit, completion of a questionnaire, and focus group. The chart audit established the baseline use of outcome measures. The questionnaire determined barriers and facilitators to evidence-based practice (EBP) and using outcome measures. The focus group provided feedback on the chart audit and questionnaire data, confirmed the barriers and facilitators, selected an outcome measure for the intervention, and selected strategies to address the barriers and implement in the intervention.

The intervention was implemented during four-one hour, lunch meetings over two months (Table 2). A fifth follow-up meeting at month nine reported the results to the PTs. During the intervention period, the KB following strategies were applied: educational meetings, printed material, documentation changes, outreach visits, audit and feedback, environmental changes, organizational support, and goal setting. The intervention was adapted based on feedback from the PTs and presented to the supervisor for feasibility. The investigators were able to add a documentation sheet with instructions of how to calculate gait speed (Supplementary File 1). The PTs set a goal for documenting gait speed 50% of the time on appropriate patients at initial evaluation (IE) and discharge. The KB spent 10 hours creating the materials for the intervention. Audit and feedback was provided three times at baseline, month two and month nine.

In the final meeting (month 9), the results were reported back the PTs. A handout was prepared that included: the number of patients and a group percentage of documented use (Supplementary File 2). A certificate of completion with four continuing education hours was also presented to the PTs.

Data Collection

Outcomes were assessed using mixed methods including chart audit, the Goal Attainment Scale and focus groups. The primary outcome was change in frequency of evaluation of gait speed at IE and discharge. Charts were audited (30 hours) by WR. All charts were audited during the following intervals: baseline (3-month retrospective), 0-2 month, 2-4 months, 4-6 months and 6-8 months. Data extracted included patient diagnosis, patient functional level and IE and discharge, consented PTs name who documented IE and discharge, whether or not gait speed was documented, and gait speed. Charts were included if patients ambulated greater than 20 feet and required minimum assistance or less to ambulate. The charts were divided into the experimental group and the post-hoc control group. For the experimental group, each PTs name was recorded to determine individual differences for analysis, but names were not recorded for the control group. A flow diagram describes the chart audit process (Figure 1). Reliability was ensured by have the auditor re-audit a subset of 50 charts from the 0-2 month time interval. The second audit demonstrated 98% accuracy.

The Goal Attainment Scale (GAS) was used to measure the PTs self-reported use of gait speed from 0, 25,50,75 and 100% of the time at month 0 and month 2. The GAS was developed for adults with mental health conditions as a program evaluation tool that facilitates patient participation in the goal-setting process.[20] This scale has been previously applied in KT research in physical therapy to measure evidence-based treatment of children with CP and general EBP behaviors of PTs.[21,22] The PTs, with the guidance of the KB and supervisor, selected an expected goal for documentation of gait speed and later rated their performance on the goal. A 5-point scale (-2 less than to +2 more than expected) is used for scaling goals,[20] and zero is used as the perceived expected level. The increments should be equal between each point and were determined by the group. The group agreed upon a goal for using of gait speed on appropriate patients was 50% of the time at IE and 50% of the time at discharge.

During month two and month 9, focus groups determined the PTs satisfaction with the intervention. The focus groups were audio recorded and facilitated by WR. Questions included: How have you been using gait speed? What is working? What, if any, problems or barriers are there to using gait speed?

Data Analysis

For the experimental group, a proportion was calculated to determine the number of times gait speed was documented over the number of times gait speed should have been documented given the patient functional level for each PT. The proportions were calculated twice, once at IE and another at discharge. The proportions were averaged at each time frame at IE and discharge for the experimental group. Data were uploaded into SPSS v 24 for analysis.

A repeated measures analysis of variance (ANOVA) was used to determine if the change was significantly difference from baseline, during the intervention, month 0-2 and at the 6-8 month follow-up for IE and discharge, level of significance was set at .05. Medians were calculated on the Goal Attainment Scale for the experimental group and the Wilcoxon signed-rank test was used to determine change from month 0 to month 2.

All charts that were documented by PTs in the post hoc control group were analyzed separately from the experimental group. Data were analyzed descriptively by calculating percentages of frequency of documentation of gait speed over frequency of appropriate patient charts for the whole group at IE and discharge.

Focus groups for the experimental group were used for both data collection and intervention development and implementation. All focus groups were recorded, transcribed and coded for themes. Member checking occurred during focus group meetings at month 0, 2 and 9 as WR summarized preliminary findings and asked for the PTs to confirm or elaborate on these findings.[23,24] Peer debriefings also occurred between WR and JED after each focus group meeting.[23,24]

RESULTS

The repeated measures ANOVA found a significant difference between baseline, during the intervention (month 0-2), and follow-up (month 6-8) at IE ($F=23.036$, $p=0.002$) and at discharge ($F=29.769$, $p<0.001$). The significant difference was found from baseline to during the intervention (month 0-2) at IE (mean=66%, Standard Deviation (SD)=30%) ($F=48.212$, $p<0.001$) and at discharge (mean=65%, SD=30%) ($F=51.941$, $p<0.001$). Documentation at follow-up (month 6-8) for both IE (mean=63%, SD 21%) and discharge (mean=59%, SD=32%) was not significantly different from month 0-2 (IE, mean $F=.280$, $p=.611$, discharge, $F=.980$, $p=.348$)

(Figure 2). Each therapist had documented at IE and discharge at each time point during the audit months 0-2,2-4,4-6,6-8, and had documented in charts more at discharge than IE. (Table 3). The post-hoc control group had increased documentation of gait speed at 4-6 (IE 24% and discharge 35%) and 6-8 months (IE 25% and DC 47%) (Figure 3).

The median score on the GAS for all the PTs at post intervention at IE rose from -2 to 0 and at discharge from -2 to 1. There were significant differences from month 0 to month 2 in self-reported use of gait speed at IE (Z= -2.842, p=0.004), and discharge (Z=-2.448, p=.014). The PTs underrated their performance for IE (median GAS=0) as compared to documented use (73% of the time) (Table 4).

The PTs commented on what in the intervention had worked to increase the use of gait speed and what barriers remained. The themes that emerged to facilitate the use of gait speed included: the documentation sheet, peer support, and environmental cues.

One PT reported, “The blue piece of paper in the (evaluation) packet is good and is helpful as a reminder” (P5, 12 years of experience). While another stated, “I think having the formula there is helpful, because I have had times where I totally did it wrong” (P10, 22years of experience).

For social support, the PTs comments included, “I think the other thing that helps is that we are seeing each other doing it and it reminds us” (P8, 19 years of experience). “I have seen that all of us with stop watches in our hands more than we ever have before, so we are moving in the right direction” (P3, 20 years of experience).

Barriers to using gait speed were patient, therapist, and context related. One person commented on a patient related issue, “I was surprised as to how big a fluctuation there was, within the 3 trials" (P7, 7 years of experience). While another stated, "Sometimes it is a little impractical to get 3 (trials) in….so we sort of collectively decided that 2 was enough, the goal is 2, informally in the office we decided this" (P3).

Therapists were busy which made the gym (environment) busy.

> "What I am finding is that we are booked solid right now, …. so everyone is very busy, so it is a little harder when you are that busy because you don't have a moment to think… and the gym is so busy, so that middle way where we have those 2 lines, it is great that there is 2, but there is usually stuff in the way, or somebody comes walking in the middle of it, or a wheelchair is there, and same for the other two (tracks), it gives us more opportunities but still there is sometimes limiting, for me I have a lot of half hour patients so a half hour goes very fast, it is like oops, I walked and I didn't get it" (P3).

The PTs identified several steps they would like to implement to sustain use including the addition of new tracks in the therapy gym and the patient corridor and training all the staff on how to measure gait speed. One PT commented, "I wish we could have one out in the hallway that is a dead end near the elevator because that is rarely as crowded or used" (P3). Another stated, "I was thinking for me I know that if I am working a Sunday or Saturday, like in the afternoon, having something set upstairs would helpful" (P11, 6 years of experience). "In the dining room and/or rec room on the first floor, either or both, we could also just mark it on the wall" (P5). The supervisor agreed to adding the additional tracks.

The PTs responded well to the KBs facilitation strategies. One person commented, "It was obviously what we needed, but I do not think it was too much" (P3). "We needed a good motivator, and we needed someone to prod and give us a push" (P1, 1 year of experience). "I think we do well with the one (measure) at a time, get it adopted, and then move on" (P2, 24 years of experience). "I think that is realistic for us, get one down and move on" (P10).

In the final focus group meeting, month 9, nine PTs were presented with their results (Supplementary File 2). The PTs were enthusiastic that they met their group goal (documenting gait speed greater than 50%) and that the patients improved gait speed over the course of treatment. One PT commented, "by documenting gait speed, we were able to prove to the patient, third party payers and ourselves that the patients we evaluated are making progress in therapy" (P6, 19 years of experience). They all agreed that it was nice to see that the patients were improving on the graphs.

DISCUSSION

Consistent with the hypothesis, the KB, with support from the supervisor and research team, and in collaboration with the PTs, designed and implemented an intervention that significantly increased the documented and self-reported use of gait speed by the PTs. The PTs were satisfied with the intervention but reported barriers to using gait speed remained such as lack of space and patients' abilities. The post hoc control group improved their documentation of gait speed after being trained by the supervisor.

The PTs, in experimental group, achieved the group goal of documenting gait speed greater than 50% of the time and the documentation remained above 50% at 6-8 months following the start of the intervention. There was slight decrease in documentation of gait speed during the follow-up periods (2-4 months and 4-6 months) that then increased to near post-intervention levels at 6-8 months. We speculate the rise in use at month 6-8 occurred because of renewed awareness of the four-meter walk test as the post-hoc control group was being trained how to use gait speed and the KB was at the facility conducting chart audits. While not explicitly providing reminders or cues, the KB interacted with the PTs because the charts were stored in the PT office suite. Although this study did not have a formal plan to sustain the use of gait speed, the informal interactions may have served as reminders. More formal plans such as reminders or continuing education should be considered when planning KT interventions to sustain use over time.[25] Schreiber et al[9] used ongoing interactions with the KB, email reminders, and discussion boards to sustain the use of pediatric outcome measures and found the frequency of documentation continued to increase over an eight-month period.

Despite meeting the group goal, there was variability between PTs when using gait speed. Chart audits reviewed individual differences across time points varied from 0-100%. The PTs also reported variability in use on the GAS from 25% to 100%. Most of the PTs underestimated their performance on the GAS when compared to documented use. Typically, in self-reported surveys, health care professionals admit to over-estimating their behavior.[26] Variability between PTs may be explained by individual differences including degree, specialty certification, and years of experience,[4] and while some PTs were early adopters to using gait speed others may be slow to change their use and documentation practices.[27]

While PTs varied in their use, our positive significant findings using the GAS from baseline to post intervention differ from the literature in physical therapy. Schreiber et al[21] used the GAS to evaluate change of EBP behaviors of five PTs and found that only six of the thirteen goals were achieved. Campbell et al[22] completed a randomized controlled trial with 135 health professionals on evidence-based treatment of children with cerebral palsy and found that although the intervention group had positive changes, there were no significant differences within or between groups using the GAS.

We speculate some of the behavior change may be explained by the characteristics the of the KB. While internal KB's may have a better understanding of the organization,[7] in this study, the external KB developed a relationship with the individuals and team during the KT intervention through the administration of the questionnaires, chart audits and the focus groups. During the focus group, the PTs discussed they were successful at meeting their goal because the KB was a good motivator, was trusted, and set realistic expectations for adopting the measure. Dobbins et al[28] reported characteristics of an effective knowledge broker include motivator, expertise in research and clinical skills, good interpersonal skills, and team builder. Rivard et al[14] completed semi-structured interviews with 25 KBs and identified that the KB's enthusiasm engaged the PTs, their colleagues, and administrators in the KT process.

As the KB was external, the organizational support and facilitation by the supervisor were central to the success of the intervention. Organizational support has been previously found to facilitate outcome measure use in self-reported surveys.[4,7] In our study, the supervisor provided organizational support and acted as the local onsite champion by providing the research team with support for meetings, intervention development, and was also a participant in the study. She helped facilitate the documentation sheet that was added to all evaluation packets to prompt the PTs use gait speed. The supervisor worked with the group to problem solve any issues that occurred while the KB wasn't present. The supervisor also improved the long-term success of this project by training the post-hoc control group. Our findings agree with the literature that the support of the organization and a local onsite champion may contribute to success.[7,9,29,30] Future research should include formal assessments of organizational support, such as the Implementation Leadership Scale[31] or the Organizational Readiness for Implementing Change Scale,[32] to determine the organizations impact on behavior change as organizational support can influence clinician behavior.

Another reason for success may be explained by the PTs engagement when selecting the outcome measure and implementing the intervention.[14,33] Gait training is a task that is central to patients seen in a rehabilitation hospital and therefore gait speed was a simple and practical outcome measure to adopt. In addition, the facility had experience with the four-meter walk test and had previously tried to adopt it. The PTs placed the tracks and stop watches around the gym and were involved in overcoming the barriers they faced. They reported strategies to increase self-efficacy such as the starting with one measure (staged approach) and social support also facilitated behavior change.[17] They reported lack of time and space to conduct gait speed and patient pain and fatigue as barriers. In the follow-up focus group, the PTs with the KB, problem-solved solutions to the environmental barrier by discussing adding tracks in the lower trafficked area in the PT gym. In addition, the PTs found it difficult to complete three trials and reduced the number of trials to enhance clinical utility. Reduction of trials addressed barriers such as patient fatigue and pain issues and lack of time. PTs have had positive attitudes and enjoyed collaborating when designing the KT interventions,[34] but this is the first study in PT, to our knowledge that included them in overcoming barriers during implementation. Future research should explore the effect of clinician engagement and buy-in when designing and implementing KT interventions.

As contextual changes can facilitate the usage of outcome measures,[4] we believe another important factor to the success of this KT intervention is that documentation was easily adapted in this clinic. The PTs were prompted to use gait speed because blue documentation sheets were included in all evaluation packets. These new handouts were placed in charts without need for administrative clearance. The paper documentation system used in this free-standing clinic facilitated the documentation changes. Barriers to documentation changes in larger organizations may include long wait times for changes due to administrative clearance.

Limitations

This study has several limitations including sample size, a single study site, study design and feasibility for larger scale investigations. This study involved eleven PTs that worked in one small sub-acute rehabilitation hospital whose documentation was easily adaptable. The results may not be generalizable to larger inpatient rehabilitation hospitals with electronic medical records and multiple levels of management are needed to approve documentation changes. While we added a post-hoc control group during the intervention, the control group couldn't be quantitatively compared to the experimental group. Randomization and control at the organizational level are needed to compare active, multimodal KT interventions to determine which methods are most effective. Future studies should also compare frequency of visits or number of reminders needed for behavior change by the KB. Finally, the KB, who conducted the chart audits, had knowledge of the hypothesis and wasn't blinded to the group. Future research should determine the feasibility to having an investigator blinded while conducting chart audits. In this study, the charts were stored by the PT desks and informal interactions between the PTs and KB occurred while audits were taking place. These informal interactions may have had some positive influence on use of gait speed of the PTs, but these interactions were not formally measured.

The use of an external KB reduced the time burden on the organization, but the time invested in designing and implementing a tailored KT intervention may make large-scale studies less feasible. The research team met with the manager, supervisor and PTs on eight occasions. These meetings included: informal meeting with manager, informational meeting with supervisor, consent process with PTs, barrier assessment focus group, meeting with supervisor for feedback on the intervention, implementing the intervention with PTs, two-month focus group to evaluate outcomes, and final meeting to report gait speed measure to PTs. To reduce the demand on the PTs, they were required to attend five one-hour lunch meetings. The additional 30 hours spent by the KB conducing chart audits was because all charts were included in the chart auditing process. To reduce the time burden, the KB could have selected to review only a sample of charts from each therapist. Electronic charts with report building options may have also decreased amount of time conducting chart audits.

This two-month intervention was successful for the PTs as well as middle management. Future interventions may also intervene both at higher level management and the patient level. At the organizational level, higher level administration may reward PTs for achieving goals of outcome measures use. Organizationally, the use of outcome measures may help leaders estimate discharge planning needs and may have financial impact.[25] Patients may also benefit from education of gait speed and have higher satisfaction in physical therapy because of use of evidence-based evaluation strategies.[25]

CONCLUSION

To our knowledge this is the first study highlighting the use of an external KB to facilitate the use of an outcome measure with supervisor support and key stakeholder input. Our methods substantially improved clinician behavior of evaluating gait speed and sustained the use of 8 months. Future work should compare this integrated KT model using an external KB to other KT strategies.

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Table 4: Comparison of Goal Attainment Scale and Percentage of Charts Documented by Participant

Figure 1: Chart Audit Flow Diagram at Initial Evaluation and Discharge

Figure 2: Mean Documentation of Gait Speed for Physical Therapists at Initial Evaluation and Discharge

Figure 3: Post-Hoc Control Group Average Documentation of Gait Speed at Initial Evaluation and Discharge

Chapter 5 Table 1: Experimental Group Demographics

Table 1. Experimental Group Demographics (n=11)

Characteristic	n(%) or mean ±sd (Range)
Age	43.3 ±13.1
Gender Female	 9 (85%)
Years of experience	21.7± 12.2 (1-44)
Years working at this facility	8 (5.6)
Highest Degree Bachelors Masters Doctorate	 5 (45%) 4 (36%) 2 (18%)
APTA member (Yes)	4 (36%)
Supervised PT students (Yes)	9 (82%)
Credentialed CI	3 (27%)
Certifications	

NDT	1 (9%)
APTA: American Physical Therapy Association PT: Physical Therapy CI: Clinical instructor NDT: Neurodevelopment treatment	

Chapter 5 Table 2: Intervention Outline

Table 2: Intervention Outline

Meeting	Time Point	Purpose
1	Week 0 Baseline	-Introduced the study and obtained informed consent -Questionnaire on the barriers and facilitators to EBP and using outcome measure
2	Week 2	-Audit and feedback on chart audit and questionnaire data -Selected Four Meter Walk Test -Co-designed intervention strategies to implement the Four Meter Walk Test
3	Week 4	Implemented the intervention
4	Week 8 Post Intervention	Outreach visit – problem solve issues Audit and Feedback
5	Month 9	Follow-up meeting: Report on use of gait speed Audit and Feedback

Chapter 5 Table 3: Median Chart Audit Data

Table 3: Median chart audit data per time point for experimental group

	Initial evaluation	Discharge

0-2 Months	10 (5-10.5)	14 (10.5-17)
2-4 Months	6 (3.5-8.5)	9 (4.5-13)
4-6 Months	6 (4-8.5)	10 (7.5-19)
6-8 Months	3 (2-5)	7 (5.5-7)
Mdn: Median, IQR: Interquartile Range		

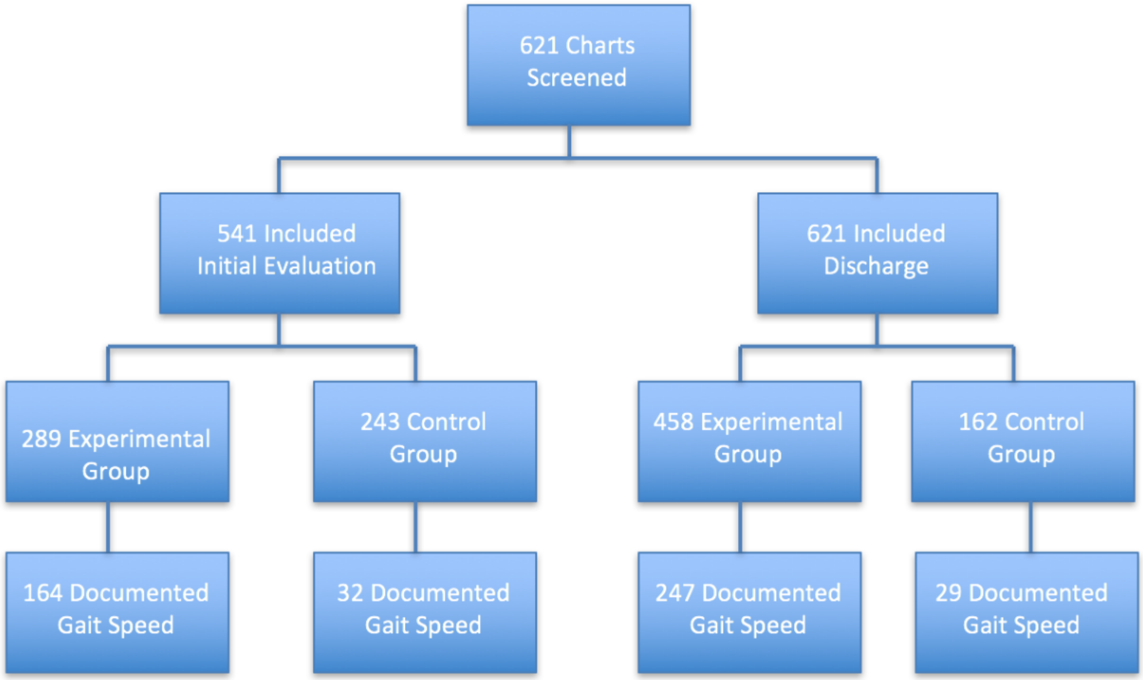
Chapter 5 Table 4: Comparison of Goal Attainment Scale and Percentage of Charts Documented

Table 4: Comparison of Goal Attainment Scale and Percentage of charts documented by participant (n=10)

	GAS at IE	Actual % at IE	GAS at DC	Actual % at DC
P1	75%	46%	75%	87%
P2	75%	100%	100%	75%
P3	25%	0%	25%	17%
P4	50%	43%	75%	75%
P5	75%	17%	75%	64%
P6	50%	67%	50%	50%
P7	50%	89%	100%	100%
P8	50%	55%	75%	100%
P10	75%	100%	50%	100%
P11	25%	57%	25%	44%
GAS: Goal Attainment Scale, IE: Initial Evaluation, DC: Discharge				

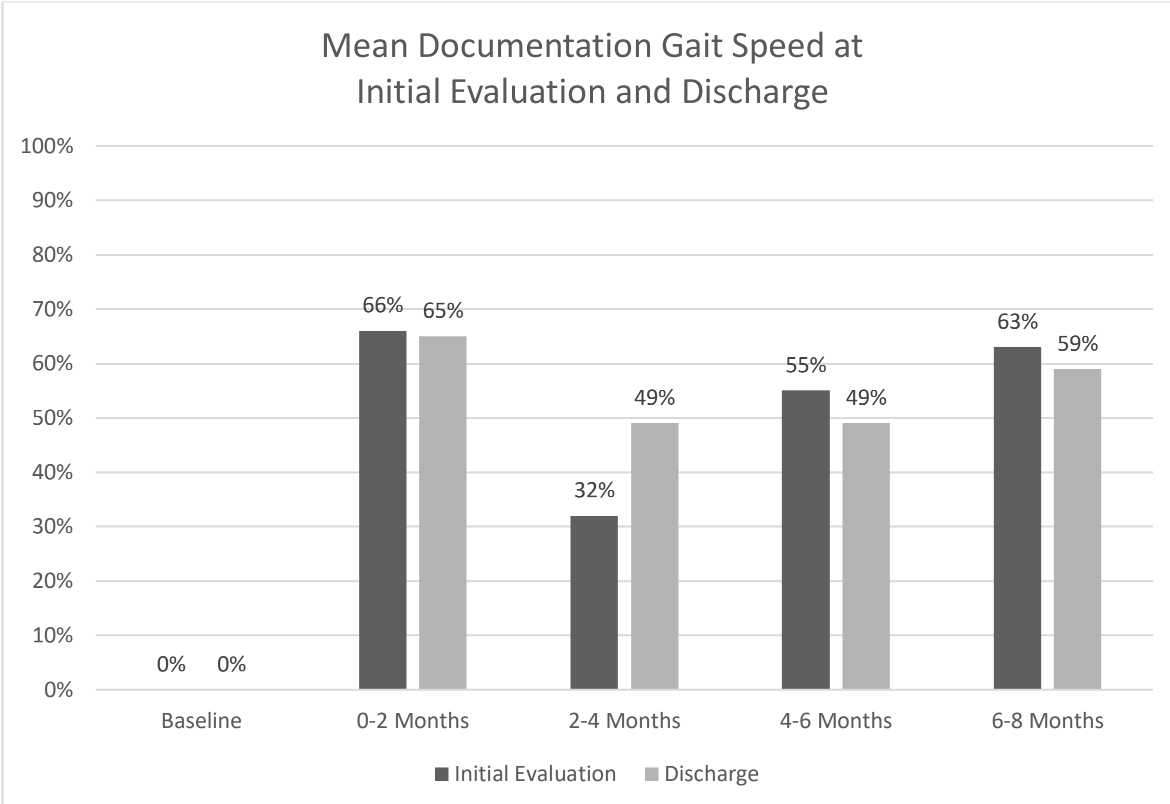
Chapter 5 Figure 1: Chart Audit Flow Diagram

Figure 1: Chart Audit Flow Diagram at Initial Evaluation and Discharge



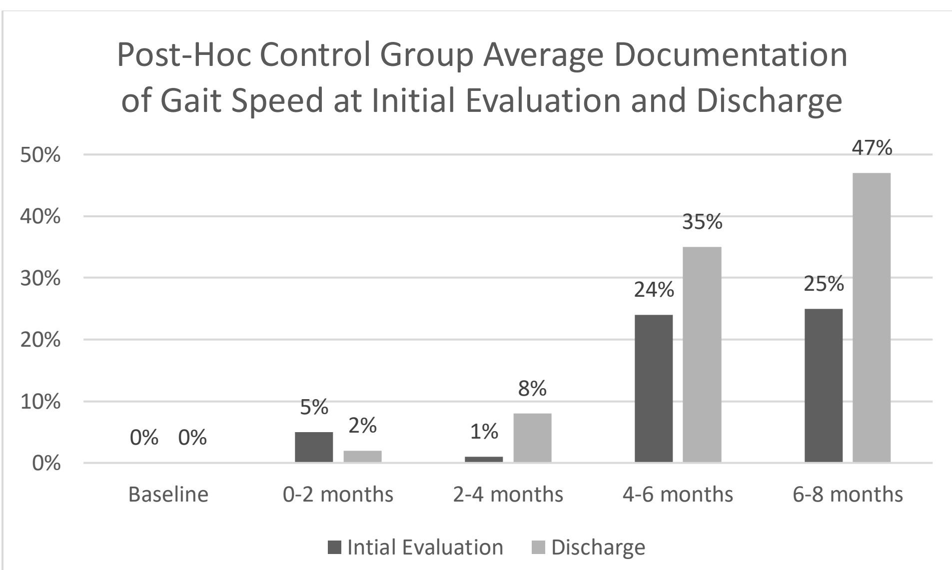
Chapter 5 Figure 2: Mean Documentation of Gait Speed

Figure 2: Mean Documentation of Gait Speed for Physical Therapists at Initial Evaluation and Discharge



Chapter 5 Figure 3: Post-Hoc Group Mean Documentation

Figure 3: Post-Hoc Control Group Average Documentation of Gait Speed at Initial Evaluation and Discharge



Supplementary File 1: Documentation Sheet

Name: ____

Record the time in seconds for the patient to ambulate the middle 4 meters. To find the velocity divide 4 by the number of seconds (m/s). For example: if a patient walks on average 8 seconds you have the following: 4/8= .5 m/s

Date:	IE or Day 1			Discharge
Trial 1 (sec)				
Trial 2 (sec)				
Trial 3 (sec)				
Average (sec)				
Velocity m/s 4/x sec				
Level of Assistance Assistive Device Bracing				

Important Values (Fritz & Lusardi, 2009)	
Normal walking speed	>1.2 m/s
Increased likelihood of falls	<1.0m/s
Community Ambulator	0.8-1.2m/s
More likely to be Dependent for ADLs and IADLs	< 0.6m/s
Limited Community Ambulator	.4-.8m/s
Household ambulator	<0.4m/s

Fritz, S. & Lusardi, M. (2009). White paper: walking speed: the sixth vital sign. *Journal of Geriatric Physical Therapy.* 32(2): 2-5.

6.0 Chapter 6: A Realist Evaluation of a knowledge translation intervention facilitated by a knowledge broker to increase the use of standardized outcome measures for physical therapist who work in inpatient rehabilitation

This Manuscript is planned for the journal Implementation Science. Formatting will be adjusted accordingly.

Background

Standardized outcome measures are valid and reliable self-reported or performance-based tools used in physical therapy and other disciplines to justify therapy and demonstrate patient progress [1]. The importance of using standardized outcome measures has been highlighted by national physical therapy associations and multiple resources have been developed to facilitate the adoption of outcome measures, such as the Rehabilitation Measures Database,™ PTNow.org and StrokEngine.ca [2-5]. Despite these efforts, there is a lack of routine measurement in physical therapy practice [1].

Knowledge translation (KT) studies are needed to determine the most effective ways to improve outcome measure use in physical therapy practice and overcome the context specific barriers and enhance facilitators to using outcome measures. KT is an iterative process of moving evidence into practice in order to improve health care outcomes [6]. KT research investigates approaches to determine effective strategies to change clinician behavior [6]. Knowledge brokering is one strategy used in KT to facilitate behavior [7, 8]. Knowledge brokers (KB) work with healthcare organizations to facilitate the implementation of preferred practices. KB have a working knowledge of the best evidence as well as clinical practice and can help create tailored interventions that overcome context specific barriers to implementing recommended practices [8-10]. KB have been used to facilitate the use of outcome measures in pediatric and rehabilitation settings with success, but higher quality studies are needed to determine the effectiveness of KB as a strategy for advancing clinical practice [11-13] (Romney, in review). Other KT strategies, such as education and audit and feedback, have been used to improve the use of outcome measures by allied health professionals, but there is often a lack of use of theoretical frameworks, control groups for comparison, description of intervention design, and long-term follow-up which makes it difficult to determine which strategies are most effective [14]. We completed a mixed methods pilot study that provided a detailed description of the use of the Theoretical Domains Framework [15-17] and audit and feedback to design a KT intervention with implementation facilitated by a knowledge broker to increase the use a of selected outcome measure by physical therapists (PTs) who worked in a rehabilitation hospital [18]. The mixed methods design assisted in determining the amount of behavior change as well as the impact the KT intervention had on the PTs [19]. The eleven PTs significantly improved the documented use of the four-meter walk test from 0% to 66% during the intervention and sustained documented use to 63% at 6-month follow-up, but barriers to using gait speed remained (Romney, in review). The pilot study was successful, but gaps in knowledge remained about the amount of implementation support by the KB that was needed across time [14].

In order to develop and test KT interventions that are most effective, the use of multiple theoretical frameworks has been recommended to guide the overall process, barrier assessment, intervention design, and evaluation [19]. Three frameworks were selected to guide the KT process described in this paper as each framework was developed by different theories and each framework worked in complementary ways to support different parts of the KT process. The Knowledge-to-Action (KTA) Framework was developed by planned action theories and guided the overall implementation process [6]. The KTA framework is the most widely used framework in physical therapy [6]. The Theoretical Domains Framework (TDF), developed by reviewing behavior change theories, was used to assess barriers and design the intervention [15-17]. The Consolidated Framework for Implementation Research (CFIR), designed by evaluating implementation theories, was used for data analysis [20]. The CFIR is ideal for the examination of individual and organizational contextual factors that are included in the framework and because constructs are rated on valence (positive, negative, mixed or no influence on the implementation efforts) and strength (1 or 2) of the effect on implementation outcome.

The knowledge translation-implementation process uses complex interventions to adapt to changes in the healthcare environment and to overcome the contextual barriers healthcare practitioners face. Traditional evaluation methods may fail to effectively evaluate complex interventions as they do not explain the details of why the intervention did or did not work [21]. The use of mixed methods assists with describing the outcome and the impact of KT interventions [19]. A Realist Evaluation, that uses the results from mixed methods, has been described as an evaluation technique that opens the "black box" of KT and attempts to explain the causal relationships between the intervention, context, and the outcome [21]. A Realist Analysis is a logic of inquiry that attempts to answer the question "what works, for whom, under what circumstances… and why?" [22, 23]. Realist Analyses identify mechanisms (M) or processes or structures designed to change human behavior through intervention strategies, the context (C) in which those mechanisms operate, and the outcomes (O) that are produced. First, a program theory, the theory used to develop the intervention should be selected to be tested. Next, hypotheses are formed through consideration of the context, mechanism and outcome (C-M-O configurations) and the hypotheses are tested [21]. After the study is conducted, the interaction between C-M-O are then reviewed through a rigorous consensus process and summarized. The final products are refined hypotheses within C-M-O configurations for future investigators to test.

This paper describes a Realist Evaluation, inspired by a Realist Analysis, of a complex KT intervention implemented at two rehabilitation hospitals within the same organization, where an external knowledge broker collaborated with PTs at each site to design and implement a KT intervention to improve the use of a selected outcome measure. The approach from the pilot study was scaled to answer the question: how much implementation support does an external knowledge broker need to provide to improve and sustain the use of selected outcome measures among PTs working in acute inpatient rehabilitation hospitals? The purpose of this mixed methods research study was to increase understanding of the effect of a KB to design and facilitate implementation of a tailored multimodal intervention on increasing outcome measure use among physical therapists on the orthopedic teams who work in acute inpatient rehabilitation settings.

Methods

Study Design

The mixed methods, two site cluster randomized controlled trial was conducted over a 10- month time period. Two acute rehabilitation hospital sites were randomly allocated to receive a 10-month tailored multi-modal KT intervention designed and implemented by a knowledge broker (fully supported implementation group) or a tailored multi-modal KT intervention designed but not implemented by the KB (partially supported implementation group) designed to increase physical therapists' use of a selected standardized outcome measure. Use of the outcome measure was evaluated through chart audit at baseline, and month 2, month 4 and months 8-10. Focus group were conducted with PTs at each site at months 1, 2, 3, 4, and 10. The quantitative and qualitative data were analyzed using the Realist Evaluation.

Insert Figure 1 Study Timeline

Setting and Participants:

A large organization in New Jersey was identified by the investigators for the research study because it had multiple acute rehabilitation hospitals. It was recruited through several meetings with the organizational leadership including the organizational: medical director, research coordinator, director of research, and the manager of rehabilitation services; and each hospital's rehabilitation supervisor. The organizational leadership recommended two acute rehabilitation hospitals with similar patients with orthopedic diagnoses. PT's who worked on the orthopedic teams were identified by the manager of rehabilitation services and each hospital supervisor for this project because they were using less outcome measures than other patient care teams that treated different patient diagnostic groups in the hospitals. Physical therapists who worked full time on the inpatient orthopedic teams in the acute rehabilitation hospital were eligible to participate.

After interest was identified at the hospitals, an information email was sent to the physical therapist's supervisors for recruitment of the PTs. The emails introduced the primary investigator, study purpose, benefits to participants, and anticipated time requirements. The supervisors at each site set-up recruitment meetings between the investigators and eligible PTs. Consent was obtained by interested PTs at the recruitment meetings. The study was approved by Rutgers University and Kessler Institute for Rehabilitation Institutional Review Boards.

Data collection

<u>Quantitative:</u> Electronic medical record audits were conducted by DZ over the course of the study from June 2016-August 2017 for the two sites. Audits were conducted at four time points: baseline, month 2, 4, and 8-10. The three-month retrospective chart audit was conducted to determine a baseline of outcome measure documentation by the PTs for patients with orthopedic conditions. These data were summarized and presented to the PTs at month one. At the month one meeting, after the outcome measure was selected, chart audit criteria for future audits were established by consensus by the participants. The fully supported implementation group selected patients with orthopedic diagnosis who could ambulate 50ft with no more than contact guard to minimum assistance and could use an assistive device. The partially supported implementation group selected patients with orthopedic diagnoses, who were contact guard assistance or better and could walk 30 feet with or without an assistive device. Charts audited at months 2, 4, and 8-10 were included if the patient was admitted to inpatient rehabilitation for an orthopedic condition, seen within three days of admission or within 2 days of discharge by participating therapists and met the established criteria. The following data were extracted: date, patient and treating therapist, orthopedic diagnosis and use of outcome measure at admission and discharge. The patient and therapist names were de-identified and coded.

The goal attainment scale (GAS) was used at month 2, month 4 and month 10 to determine the self-reported use of the selected outcome measures. The GAS is a criterion referenced scale with 5 points, from much less than expected (-2) to much more than expected (+2), with zero (0) representing the expected or anticipated goal [31]. The PTs identified and agreed upon a goal for outcome measure use at initial evaluation and discharge in order to rate themselves on the scale throughout the study. PTs for the fully supported implementation group selected 75% at initial evaluation and discharge, while in the partially supported implementation group selected 50% at initial evaluation and 60% at discharge. A score of zero (0) on the GAS at initial evaluation and discharge was assigned to the agreed upon goal.

Qualitative Data: Focus group meetings occurred at months 1-4 and month 10 for both groups. All meetings were audio recorded, including the meetings for the partially supported implementation group where the was not KB present (month 2 and 4). Semi-structured focus groups were used to collect data (Supplementary Material: Focus Group Questions). Questions on the focus group guide pertained to barriers, facilitators, reasons for use/non-use, patient education, and sustainability. Questions on the focus group guide were created using the TDF and KTA framework. The partially supported implementation group was provided with meeting outlines with semi-structured focus group guide questions for the two meetings the KB was not present. WR, JED and IW attended all focus meetings. Trustworthiness was established though reflexive journaling and briefing that occurred before each meeting and debriefing occurred after each meeting between WR and JED. Member checking was used during meetings as points were summarized by WR and participants were asked for feedback. Field notes were taken after each focus group meeting used for analysis. Meetings were used to both collect data and design and implement the intervention.

Intervention

The WIDER recommendations for behavior change interventions were used to guide reporting of this study [24]. The intervention consisted of a baseline assessment, four monthly one-hour meetings and a six-month follow-up (Figure 1: Study Timeline). Meetings were used both to implement the intervention and collect data. The PTs in the fully supported implementation group were supported with design and implementation of the intervention by the KB and met with the KB six times over the course of the study, baseline, month 1, 2, 3, 4 and month 10. The KB collaborated with the partially supported implementation group to design the intervention and provided outlines and food for meetings where the PTs self-implemented the intervention. The PTs in the partially supported group met with the KB four times over the course of the study, baseline, month 1, 3 and 10. The partially supported group were asked to meet independently at months 2 and 4 to self-implement the intervention.

The intervention was facilitated by an external knowledge broker who engaged the PTs to select an outcome measure they believed would be relevant to use to examine patients with orthopedic conditions seen in their respective rehabilitation hospitals. The KB earned her Doctorate in Physical Therapy and was a Neurologic Certified Specialist by the American Board of Physical Therapy Specialists, had 10 years of experience as a physical therapist working in inpatient rehabilitation, worked as a Clinical Assistant Professor and was PhD student with research focused on KT, knowledge brokering and outcome measure use using mixed methods. The intervention was designed and implemented following the KTA Framework [6].

After consent, the PTs were provided with a barrier assessment questionnaire that was used to identify the self-perception of barriers and facilitators to evidence-based practice and standardized outcome measures. The questionnaire was adapted from previous literature [25-28] and was tested for face and content validity by the investigators [18]. The questionnaire contained 85 questions with two sections: evidence-based practice and use of standardized outcome measures. The standardized assessment section was developed with eight of the 14 domains of the TDF [15-17] (Supplementary Material: Barriers and Facilitators Questionnaire). The questionnaire results were aggregated into barriers and facilitators and intervention strategies were mapped by the investigators using the TDF consensus matrix [17]

(Supplementary Material: Intervention mapping). A three-month retrospective chart audit was conducted to determine current documentation of outcome measures by PTs for patients with orthopedic conditions seen at the hospitals. The intervention was designed at the month one meeting where strategies identified in the consensus matrix were presented to the PTs at each site for feasibility [17]. At this meeting, a handout was provided to the PTs that the summarized chart audit and the barrier assessment questionnaire data, the barriers and facilitators were confirmed, the outcome measure was selected, and the intervention was designed (Supplementary Material: Barrier Assessment Handouts).

The intervention consisted of PT engagement to select a relevant standardized assessment they wanted to implement into practice, overcome barriers that were identified in meetings, education, audit and feedback, goal creation, engagement, handouts, reminders, and environmental changes including finding a dedicated place to document and perform the test. The fully supported implementation group selected the Timed Up and Go (TUG) test [29] as the standardized assessment they wanted to implement. The KB adapted resources on the TUG for the fully supported implementation group and facilitated implementation strategies such as handouts and reminders (Supplementary Material: Experimental Group Handout). The partially supported group selected the 10-meter walk test (10MWT) a test to measure gait speed [30]. The KB made recommendations for adaptation of the knowledge of the 10MWT and implementation strategies, but PTs self-implemented their intervention by reviewing the literature on the 10MWT, providing education to each other, creating hand-outs, and developing reminders (tracking sheet and reminders) and environmental changes (cones and string for a track). The KB asked the supervisors at each site to selected a local clinical liaison for the KB to contact on an as needed basis. There were no pre-set selection criteria of the local clinical liaison, but supervisors selected the liaisons based on experience and roles within the orthopedic teams. There were no formal plans for the local liaison to support implementation efforts other than a contact person. The local champion in the partially supported group rotated off the orthopedic unit at month 2 and a new champion was selected through participant interest and group consensus.

Hypothesis and CMO Configuration

Program Theory: As part the Realist Evaluation, we created an initial C-M-O configuration for each group by reviewing and hypothesizing outcomes based on the expected interaction between context using the TDF barrier assessment and the selected intervention strategies that were mapped with the TDF consensus matrix (Mechanisms) (Figure 2 and 3) [17]. Context refers to the social, economic, political, organizational, and participants in which the Mechanisms operate [22]. We identified organizational contextual factors and individual participant contextual factors that were included in the baseline TDF barrier assessment (Supplementary Material: Barrier and Facilitator Questionnaire). A Realist Analysis uses theory to define program theory, but this Realist Evaluation used the TDF, which was developed through evaluation of numerous motivation, action, and organizational behavior change theories to determine reasons for behavior change. In addition, Mechanisms were defined as the interventions mapped using the TDF consensus matrix rather than processes in which those interventions work.

Organizational Contextual factors included:

- PTs who worked for the same organization on the orthopedic teams in two acute rehabilitation hospitals

- Rehabilitation Manager (across hospitals)
- Local Hospital Supervisor (hospital specific)
- Same insurance policy coverage for patients in hospitals (Medicare, Medicaid, Third Party Payers)
- Positive supervisor and co-worker support (fully supported group and partially Supported group 100% agreement)
- Organizational Support (fully supported 86% agreement, partially Supported group 71% agreement)
- Need for environmental changes
    - Place to document (fully supported group: 57% disagreed that the documentation system supports the use of standardized assessment, partially supported group: 71% disagreed)

- **Individual PT's Contextual** factors at baseline included:
    - Positive knowledge (71-100% agreement across groups)
    - Positive confidence (57-100% agreement)
    - Mixed motivation (14% to 86% agreement)
    - Positive skills (86%- 100% agreement)
    - Positive behavior (86% agreement)
    - Need for additional education (Fully Supported Group 71% agreed they would like to know more about standardized outcome measures, partially supported 86% agreed)

The **Mechanisms** in the intervention included:

- implementation support by a KB

- audit and feedback
- goal creation
- dedicated space for documentation and perform test
- engagement
- values (knowledge, attitudes, beliefs)
- local clinical liaison
- education (outcome measure psychometrics, interpretation, documentation, and patient education)*
- handouts*
- synthesized resources*

  *provided by KB for fully supported group and self-implemented by partially supported group

The hypothesized **Outcomes** included:

- The fully supported implementation group:
  - Early adoption (month 2) of the selected outcome measure
  - Sustained use of the outcome measure (10 month)
- Partially supported implementation group,
  - Delayed adoption (month 4)
  - Sustained use 10-month time point.

Adoption was determined by each group through a selection of a goal for use. We also hypothesized that the fully supported group would have greater ease in overcoming barriers and be satisfied with the intervention greater than the partially supported group because of the implementation supported provided by the KB.

Insert Figure 2: Fully Supported Implementation Group Original C-M-O

Insert Figure 3: Partially Supported Implementation Group Original C-M-O

Data Analysis

Chart audit data were analyzed descriptively (frequencies and percentages). Percentages were determined at months 2, 4, and 8-10 by adding the number of patient charts in the given time period where the outcome measure was documented and dividing it by the number of patient charts that met the agreed upon criteria per therapist and then averaged by the group. Two percentages were calculated at a given time period, one percentage at initial evaluation and another for discharge. The planned analyses, factorial ANOVA or RM ANOVA were not executed because the data failed to meet the following assumptions: groups not equivalent at baseline and a limited number of charts documented by PTs at given time points over the course of the study. Results from the goal attainment scale were analyzed descriptively with medians as they were not normally distributed.

All focus groups were transcribed verbatim by a graduate research assistant using Express Scribe Transcription Software NCH® and an Infinity foot pedal. The transcriptions were copied into a Microsoft Word document transcriptions were checked for accuracy by WR. Conventional content analysis was conducted using an inductive approach with emergent codes into categories and themes [32-33]. Once the categories and themes were developed they were related to the TDF domains using a deductive approach [32-33]. The first focus group for the fully supported group was coded by WR in the following steps:

1. Coding: notes were written in margins of transcribed focus group that described the meaning of the quote

2. Categories: Similar codes with quotes were then brought together and reviewed to make categories
3. Themes: Similar categories were then made into themes.
4. Comparison of themes and categories to the TDF domains [32-33].

It was noted during the development of categories and comparison of the categories to the TDF domains that multiple contextual factors were coded, but did not relate the TDF domains. Therefore, an alternative framework (CFIR) was identified that included codes for context. WR reviewed categories and themes that were previously coded using the CFIR. WR and JED met to compare the codes and categories using the TDF and CFIR and decided to use the CFIR for analysis as CFIR included 37 constructs that covered both individual and organizational contextual factors as well as codes for the interventions strategies used in the KT process. The TDF does not include domains on intervention strategies. The investigators believed that coding the selected intervention strategies would guide the planned realist evaluation.

The coding approach was changed to an a priori context analysis (deductive approach) using the CFIR codebook [20]. All focus groups were entered into NVivo 11 for further analysis. Nodes were entered as codes into NVivo 11 following the 37 constructs (5 domains) in the CFIR codebook (http://www.cfirguide.org/tools.html) [34]. The valence and strength of each of the CFIR codes that were used were also rated. Valence was rated based on quotes being positive, negative, mixed or no influence on the implementation efforts Strength (1 or 2) was rated based on the number of times a code was used each a focus group (3 or less was a 1 and 4 or greater was rated a 2) or if there was consensus among participants (rated as a 2). The steps to coding were:

1. The first focus group for the fully supported group was coded and rated using the CFIR by one investigator (WR)
2. Codes and ratings were and discussed and confirmed with a second investigator (JED) who was present at all focus group meetings.
3. WR then coded and rated all focus groups for the fully supported implementation group and discussed and confirmed codes with JED.
4. IW (who was present at all focus group meetings) was then then brought into the coding process for discussion and confirmation with WR and JED.
5. Two additional investigators (JSP and NS) were then brought into the coding and rating process for discussion and confirmation with WR and JED.
6. This process was repeated for the partially supported implementation groups' focus groups. All investigators had prior experience with qualitative research but were novice users of the CFIR codebook.

Early on in the coding process we noticed that strength and valence of the CFIR codes differed within groups across time points. We therefore rated each CFIR Context (CFIR-C) and CFIR Mechanisms (CFIR-M) code at every focus group (Months 1, 2, 3, 4, and 10), modifying the valence as necessary. We also coded and rated meetings for the partially supported implementation group where the KB was not present because they followed an outline of questions provided by the KB and the meetings were audio recorded. All CFIR codes were then mapped into Contextual (CFIR-C) and Mechanistic (CFIR-M) factors for the Realist Evaluation (Table 1). Knowledge and Belief (CFIR-C) was coded under Context at month 1, as context referred to the previous experiences and perceptions program participants brought into the study. After month 1, Knowledge and Belief was coded to Mechanism (CFIR-M) as a Mechanism refers to changing of participants values, attitudes, knowledge and beliefs as a result of participating in the study [22]. A heat map was developed to demonstrate changes in the CFIR rating (strength and valence) across time. The rows indicated the CFIR codes, the columns represented the time points (months) when focus groups occurred and each square corresponded to a CFIR rating. We then compared the CFIR ratings across time points to the chart audit data.

Chapter 6 Table 1

Table 1: CFIR Coding Mapped to Context and Mechanism Factors for Realist Evaluation

<table>
<tr><th>Contextual Factors (CFIR-C)</th><th>Mechanisms (CFIR-M)</th></tr>
<tr><td>• Outer setting
  ○ External policy and incentives
• Inner Setting
  ○ Compatibility
  ○ Available Resources
  ○ Goals and Feedback
  ○ Relative Priority
• Characteristics of the Individuals (Month 1)
  ○ Knowledge and Beliefs</td><td>• Process
  ○ Planning
  ○ Engagement
• Characteristics of the Innovation
  ○ Evidence Strength and Quality
  ○ Complexity
• Characteristics of the Individuals (Month 2-10)
  ○ Knowledge and Beliefs</td></tr>
</table>

We used an iterative process and multiple investigators (WR, JED, IW, JSP, NS) to analyze data into the final revised C-M-O configurations for both group. The chart audit data were used primarily to describe the Outcome of the C-M-O, while focus group data and CFIR ratings were used triangulate the Outcome within the Context and the Mechanisms (Figure 4: Realist Evaluation). As the interaction of C-M-O changed across time, we used heat map to visualize the strength and valence of each of the CFIR codes across each focus group by site to determine the fluctuating influence of the Context and Mechanism on the Outcome. The CFIR coding and rating were reviewed together to see if there were any patterns in documented outcome measure use and Context or Mechanisms codes. For instance, we sought to identify the apparent changes in Outcomes with varying C-M configurations (noting that a C-M configuration change when the valiance of any of the Context or Mechanism characteristic changed). In addition, the strongest quotes from the participants across time points were extracted to support the major CFIR constructs coded in the Realist Evaluation.

Insert Figure 4: Realist Evaluation Data Analysis

Results

A total of 18 PTs consented to participate in the fully supported implementation (n=9) and partially supported implementation groups (n=9) (Table 2). The PTs at both sites treated patients with orthopedic conditions including lower extremity joint replacement (41%), lower extremity fracture (27%), and spinal surgery (31%) without neurologic involvement as verified by electronic medical record. Two PTs in the fully supported implementation group rotated off the orthopedic unit at month 2. One PT quit working at the hospital and one PT rotated off the unit after month one for the partially supported implementation group. The PTs who rotated off the unit continued to evaluate patients with orthopedic issues so their data were included in the analyses. All meetings were scheduled with the supervisors in advance to attempt to avoid any organizational conflicts. There were 6-9 PTs at every meeting, as days off, patient training, and other conflicts arose during meeting times. The KB asked participants to discuss the meeting(s) with any missing participants including providing any handouts, but no formal follow-ups were planned. In addition, although there were no formal plans for the local liaison to support implementation efforts other than a contact person, the local liaison at the fully supported implementation site worked as an onsite champion and sent monthly email reminders about the study and collaborated with the PTs to develop a tracking sheet.

Chapter 6 Table 2

Table 2: Characteristics of Physical Therapists

	Full Support (n=9)	Partial Support (n=8)
Characteristic	n(%) or mean ±sd (Range)	n(%) or mean ±sd (Range)
Age	31.8±6.6 (27-49)	28±4.5 (25-35)
Gender		
Female	6 (67%)	8 (100%)
Years of experience	6.8± 7.8 (2-27)	3.4±5.5 (0-14)
Years working at this facility	6.6±7.1 (2-25)	2.4±5.2 (0-14 years)
Highest Degree		
Bachelors	1 (11%)	0 (0%)
Masters	1 (11%)	1 (12.5%)
Doctorate	7 (77%)	7 (87.5%)
APTA member (Yes)	5 (55.6%)	3 (37.5%)
Supervised PT students (Yes)	8 (91%)	3 (43%)
Credentialed CI	4/7 (57.1%)	2/7 (28.6%)
Certifications	4 (44.4%)	0 (0%)
NCS	3 (33.3%)	

GCS	1 (11.1%)	
APTA: American Physical Therapy Association PT: Physical Therapy CI: Clinical instructor NCS: Neurological Certified Specialist GCS: Geriatric Certified Specialist		

Step 1: Documented Outcomes Across Time Points

For both groups, chart audit data revealed that between 12-18 patients were appropriate to measure the selected measure at initial evaluation, and between 16-31 patients were appropriate to measure the selected measure at discharge at each time point (Tables 3 & 4). The number of appropriate patients to document the selected outcome measure per therapist ranged from 0-8, and at several time points some of the therapists did not evaluate or discharge a patient where the TUG or gait speed could have been documented. Chart audit data from both groups also revealed that the PTs had documented the selected outcome measures more at initial evaluation than at discharge. For the fully supported implementation group, documentation at initial evaluation rose from 0% to 58.3% at month 2, but then declined at month 4 to 17.6% and 11.8% at month 8-10 (Table 3 & 4). For the partially supported implementation group, documentation at initial evaluation rose from 0% to 46% at month 2 and continued to rise to 50% at month 4, only to decline at month 8-10 to 2.8%. Documentation at discharge was much less but followed similar patterns for both groups.

Chapter 6 Table 3

Table 3: Fully Supported Group Charts Available for Audit

	Baseline	Month 2	Month 4	Month 8-10

	IE	DC	Initial Evaluation	Discharge	Initial Evaluation	DC	Initial Evaluation	Discharge
# of charts per participating PTs/# of PTs participating	9/9	8/9	5/9	9/9	7/9	6/9	6/9	8/9
# of charts with ortho dx	76	79	26	26	31	31	60	60
Final chart count*	76[a]	79[a]	12	16	17	21	17	37
Range of patient charts per PTs	4-16	0-14	0-4	0-3	0-5	0-6	0-8	0-10
TUG used	0	1	7	4	3	2	2	1
%	0%	1%	58.3%	25%	17.6%	9.5%	11.8%	2.7%

*Charts that remained at exclusion of patients not appropriate and therapists not consented

[a]Charts were not excluded for baseline measurement

Chapter 6 Table 4

Table 4: Partially Supported Implementation Group Charts available for Audit

	Baseline		Month 2		Month 4		Month 8-10	
	IE	DC	Initial Evaluation	Discharge	Initial Evaluation	Discharge	Initial Evaluation	Discharge
# of charts per participating PTs/# of PTs participating	9	9	6/8	7/8	6/8	7/8	7/8	7/8
# of charts with ortho dx	81	100	39	39	45	45	92	92
Final chart count*	81[a]	81[a]	13	31	18	21	35	52
Range of patient charts per PT	0-18	2-26	0-2	0-3	0-8	0-8	0-8	0-14
Gait speed used	0	0	6	6	9	7	1	0
%	0%	0%	46%	19.4%	50%	33%	2.8%	0%

		*Charts that remained at exclusion of patients not appropriate and therapists not consented [a]Charts were not excluded for baseline measurement

Goal Attainment Scale (GAS):

The PTs in both groups self-reported that they did not achieve their group goal over the course of the study, which was 75% at initial evaluation and discharge for the fully supported implementation and 50% for initial evaluation and 60% for discharge for the partially supported implementation group. The fully supported implementation group reported they used the TUG less than expected (Median: -1) to much less than expected (Median: -2) at initial evaluation and discharge (initial evaluation/discharge), Month 2: -1/-2, Month 4: -1/-1, Month 10: -1.5/-2. They reported higher use at initial evaluation than discharge which matches their documented use, but the GAS median scores do not match the fully supported implementation groups' actual rise in documented use which was highest at month 2 as compared to month 4 reported on the GAS. The fully supported group was provided with the opportunity to revise their goal after receiving chart audit feedback at month 2, but they were excited with their results, despite not achieving the goal and there was consensus to keep the goal the same. The partially supported group, reported using gait speed much less than expected at month 2 (Median -2), less than expected (Median: -1) at month 4, and much less than expected at 10 (Median: -2) for both initial evaluation and discharge, which more accurately reflected their change in documented use. The partially supported group came close to their goal for initial evaluation at month 2 (46%) and achieved their group goal for use (50%) at initial evaluation at month 4 despite scoring less than expected (-1) on the GAS.

Step 2: CFIR CODING and RATING of Focus Group Data

CFIR codes and ratings were mapped across time points for each group and placed into Contextual Factors (CFIR-C) and Mechanisms (CFIR-M) for the Realist Evaluation (Table 1). CFIR-C codes related to Outer Setting [External Policy and Incentives], Inner Setting [Compatibility, Available Resources, Goals and Feedback, and Relative Priority] and Characteristics of the Individuals [Knowledge and Beliefs] were moved into Context to describe the characteristics of the PT's, the organization, and external policies. The CFIR-M constructs related to Mechanisms, or interventions strategies to improve knowledge, motivation and behavior and ultimately aimed at influencing the outcome, included Process [Planning, Engagement] and the Characteristics of the Intervention/Innovation [Evidence Strength and Quality, Complexity].

Early on for both group, most Contextual factors and Mechanisms coded on the CFIR had positive valences (Figure 5 & 6). Starting at month 3, for the fully supported implementation group, Context factors changed from positive to negative [External Policy, Compatibility, and Relative Priority] or strongly negative [Knowledge and Belief, month 4)]. Mechanisms for the fully supported implementation group also changed at month 3 to 10 from positive to no influence across time [Planning, Engagement, Evidence Strength and Quality]. For the partially supported implementation group, early strong positive ratings were seen for both Context [Knowledge and Belief] and Mechanism [Planning, Engagement, Evidence Strength and Quality]. Unlike the fully supported group, two codes [Complexity and Available Resources] were negatively rated at the start and throughout the course of the study. At month 3, for the partially supported implementation group positive Context ratings moved to negative [External Policy and Incentives, and Compatibility] and positive Mechanisms moved to negative [Engagement-External Agent] or no influence [Evidence Strength and Quality, Planning]. In addition, there were particular CFIR-M and CFIR-C codes that differed between the two groups. The fully supported implementation group had codes for Relative Priority and the partially supported implementation group had codes for Complexity, Available Resources and Goals and Feedback.

Step 3: Triangulation of Data

Triangulation of the data was completed by comparing the chart audit data to the focus group codes (CFIR-C and CRIF-M) using the heat map. This comparison was used to examine the influence and interplay between the Context and Mechanism and the Outcome. The triangulation was completed by group and by early and late implementation/sustainability.

Fully Supported Implementation Group

Early Implementation (Month 1-2)

There was an increase in documented use at month two that dropped at each subsequent time point for the fully supported implementation group (Figure 5). *This increase at Month 2 mapped with initial positive Context and Mechanisms CFIR coding (Figure 5).* At months 1 and 2, the CFIR Mechanisms: Planning, Engagement and Evidence Strength and Quality all had positive valences. PTs were engaged in selecting the outcome measure [Planning and Engagement] and had knowledge of the strong psychometric properties of the TUG to determine risk for falls [Evidence Strength and Quality]. The CFIR Context factors, at month 1 and 2, Compatibility and Knowledge and Belief also had positive valences. Compatibility, defined as the organizational match with the intervention, included high census, appropriate patients for the TUG and consented PT staff working on orthopedic unit [Compatibility]. One PT stated: "I think that that TUG would be good with all the people we have had lately. We have had so many falls. I looked at the caseload I picked up one day and almost every single person was here because they had a fall." (P4 (Participant 4), Month 1) [Compatibility and Engagement]. The PT's also believed that TUG could help guide treatment and show patient progress [Knowledge and Belief] represented by a positive valence. “We use the TUG as a recommendation as to this is why the patient needs to continue therapy. (P2, Month 2). While another stated:

> “I would definitely say [to a patient] if are seeing an improvement in the score to continue [with therapy]. You [the patient] still had some type of procedure or complication and you are not fully healed but you are making that improvement or stride that we want to see.” (P13, Month 2)

Figure 5: Fully Supported Implementation Group CFIR CODING

Late Implementation (Month 3-10)

However, during months 3, 4 and 10, there were changes in the CFIR Context and Mechanisms codes from positive to negative. *These changes mapped to a decrease in documented use from the chart audit at Months 4 and 10.* The fully supported implementation group faced changes as seen with negative ratings after Month 3 in CFIR Context factors including lack of relative priority from the organization [Relative Priority] and decreased compatibility within the organization [Compatibility]. One PT commented about the limited Relative Priority as the management didn’t require the measure scores to be presented at team meetings, similar to the Functional Independent Measure (FIM) [Relative Priority].

> “The information [score] does not matter that we present it to them [the physicians and insurance companies] because they do not take that information into account of the plan. They will say ‘are they walking 150ft at a supervision level?’ That is all they look for. They look for the FIM outcomes versus what all these other outcomes mean.” (P13, Month 10).

The PTs also found that they were having problems identifying patients who were appropriate to complete the measure since external payment changes, Medicare's Bundled Payment, went into effect during Month 7 [CFIR-C, External Policy and Incentives]. These External Policy changes changed the patient case mix and the organization started new programs (month 6) to address the changes to the patient case mix [CFIR-C, Compatibility]. "We also had a big shift over the past couple months of their patient clientele as well. So I think that also kind of like altered who was appropriate and who wasn't" (P1, Month 10).

The CFIR-Mechanisms also changed over time from positive valance to negative. The largest change in valence was in Knowledge and Belief from positive to strong negative. The PT's had decreased value in the TUG and reported that the assessment didn't guide clinical practice. The PTs also reported they had difficulty interpreting TUG scores to their patients [Knowledge and Belief]. One PT stated at the month 10 focus group, "I feel like it didn't help guide my treatment too much, so if it were something found really useful I would have remembered to use it more often." (P5, Month 10)

> "Yeah I feel like the 13.5 seconds [fall risk cut-off score] especially when using a walker is very difficult because making the turn with a walker you have to go a lot slower so sometimes the faster they go does not make them safe necessarily especially if you have certain weight bearing restrictions so I find sometimes that number is difficult to use." (P5, Month 4)

> "I don't feel like I used it as an education tool either. I felt that we had the [13.5 second] cutoff [which represented fall risk] and it was telling us this person is at risk for falls when we already knew that. Most of my people are at risk for falls already and it was so

strict of using one outcome measure for people that are here for different things." (P4, Month 10)

The PT's reported the influence of the external KB also decreased to no influence at month 4 as their estimation of the value of the TUG declined [Engagement-External Agent]. The initial excitement of being involved in a research project which had early positive codes for the Engagement-External Agent decreased as PTs found the TUG didn't guide practice [Knowledge and Belief]. The PTs stated about the External Agent and involvement in research: "I don't know if this is a bad thing to say, but it's almost like we were telling you what you wanted to hear" (P3, Month 10), while another "After the last meeting it was not good. We were like 'why are we doing this?' After we left a lot of us were like okay I guess what we will see what happens in August" (P3, Month 10).

> "I think our numbers would jump after we had a meeting because we were like 'oh shoot we have to do this for the research person' and then it would be full out this is not helping us right now." (P13, Month 10) [External Agent and Knowledge and Belief]

Partially Supported Implementation Group

Early Implementation (Month 1-4)

Compared to baseline, documented use of the 10MWT was higher at month 2 and 4, but dropped at month 10 for initial evaluation and discharge. At month 1 and 2, the partially supported group had strong positive CFIR-Context factors of Knowledge and Beliefs regarding the use of the 10MWT [Knowledge and Belief] and positive Compatibility as the PT's believed the patient case mix was suitable for the 10MWT [Compatibility] (Figure 6). The PTs also reported they were motivated to hear the audit and feedback data at month 2 [Goals and Feedback]. The CFIR Mechanisms, Planning and Engagement of the Key Stakeholders and External KB, as well as Evidence Strength and Quality were also positively rated. One PT stated: "If it doesn't have to be done on the first day, like maybe within the first three days or something, then we might be able to fit in more things. I feel like if it wasn't a 45 minute eval it would really help." (P3, Month 1) [Planning and Engagement of the Key Stakeholders]

When selecting a measure, the PT's spoke about evidence including: "I know when we were talking we wanted something that all the populations could do. The nice thing with the gait speed is that they have so many predictive variables, independence for ADLs, falls, so I think that is why I liked it." (P9, Month 1) [Evidence Strength and Quality]. Another PT stated about Evidence Strength and Quality:

> "I think another reason we should pick the 10 meter one is because that they are allowed to use an assistive device. And our patients definitely need the assistive device. By discharge maybe not, but at the eval they definitely do." (P3, Month 1)

Engagement of the Key Stakeholders mapped strongly positive as the PT's were responsible for implementation of the intervention and developed equipment, resources, and reminders to encourage use, whereas Engagement of the External Agent mapping started positive and decreased to no influence as the external KB did not provide the implementation support to this group and was not present at meetings for months 2 and 4. The PT's faced barriers throughout the course of the study associated with space and equipment [Available Resources] and reported difficulty remembering which patients and when to measure gait speed [Complexity]. "The space is a big factor, I don't know if that is what you are going for fit but on the first-floor gym if you are trying to do it in the gym, it is really tough. And in the hallways like people are back and forth going to the cafeteria or wherever so." (P4, Month 1)

The positive ratings Knowledge and Belief, Planning, Engagement, Evidence Strength and Quality outweighed the negative rating of Complexity, Compatibility, and Available Resources as evidenced by the PT's increased their documented use of the 10MWT at months 2 and 4.

Figure 6: Partially Supported Implementation Group Outcomes

Sustainability (Month 10)

There was a decrease in documented use of the 10MWT at the month 8-10 audit. *The decrease mapped to strongly negative among CFIR-Context codes Compatibility and External Policy at the month 10 focus group.* The group discussed continued changes with the patient case mix which led to difficulty finding appropriate patients to use the 10MWT [Compatibility]. "I just think that we have been getting a lot more complicated patients and they just might not be appropriate for the test itself." (P2, Month 10). The changes in Compatibility were mapped negatively starting at month 3, while the changes External Policy changes mapped strongly negative at month 10. Similar to the fully supported group, the External Policy changes from Medicare lead to changes to the Compatibility as the organization faced different patient case mixed, a decreased census and new program development. "We are getting more into that bundling, where patients are coming in and they have 5 days. Do you really want to take the time to do this test, when you could be working on something else that is probably going to benefit them more."(P2, Month 10)

> "Most of the patients we get are short stay. They need to be out within 5 days included admission day and discharge day. We are rushing around to try and get equipment in

> and if a patient is admitted on a Thursday, they are going home on Monday. The chances of that test happening is extremely slim because I'm trying to call the family and ask can they go home? So that is a lot on the ortho floor, but that is a lot of our knees [replacements] who would be appropriate. I have had a bunch of patients who are single knee [replacements], but within 3-5 days they are out. It is really difficult with the time constraint that we have." (P7, Month 10)

The PTs also continued to report their frustrations with the equipment and space needed to complete the test [Available Resources]. "I feel like going back to day 1, the equipment I feel like it comes down to that. If we had it right here and it was like easy access. Like walk on that line, okay we're done, get it over with. I feel like it would have been a lot easier." (P3, Month 10).

The CFIR-Mechanism Knowledge and Belief valence changed to mixed influence at month 10. The PTs reported they valued the information the test provided, but had difficulty interpreting the test results to their patients which led to a mixed rating [Knowledge and Belief]. "When I would explain to a couple of patients using the laminated form, some of them were just like okay, good information. They didn't, despite any way I tried to word it to try to make them excited about it (that they progressed from the beginning), they weren't really affected by the test or the explanation of it." (P7, Month 10).

> "I think it's harder for patients to translate– yes there is an improvement, but even if you tell them that are at low risk for falls, I don't think they can understand concept of an objective number. Or an objective number can quantify X. Being able to ambulate home safely, being able to decrease falls because they don't really think about it that way." (P5, Month 10)

The CFIR-Mechanism of the External Agent remained negative after month 3 as the external KB did not provide support [External Agent] or the audit and feedback the PT's requested [Goals and Feedback]. One PT stated: "Can you let us know how we've been doing? Because I wonder if we are documenting appropriately and if it is what she wants to be seeing." (P7, Month 4) The PT's also continued to discuss confusion of when to complete the test [Complexity].

> "I had difficulty especially with the three-day thing. Maybe the first day I am thinking are you appropriate, but on day three I forgot… it is very difficult to keep track of every patient day 1… this patient is appropriate today, but not three days ago" (P7, Month 10)

Step 4 Revised CMO:

The final steps in the Realist Evaluation were completed after reviewing the interaction between the Context and Mechanisms and the impact on the Outcome. The outcome, early partial adoption that declined in different time periods for each arm, clearly mapped to the CFIR-Context factors and CFIR-Mechanisms identified in the focus groups as evidence by the heat maps (Figure 5 and 6). However, the complexity of the longitudinal patterns indicated the need for revised and more nuanced C-M-O's. The original program theories (C-M-O configurations) were reviewed and revised in the final step of the Realist Evaluation. We identified two issues with the CFIR-Context factors originally evaluated in the barrier assessment:

1. The TDF did not evaluate all of the organizational contextual factors (CFIR-Inner and Outer Setting) coded in the focus groups [Relative Priority, Compatibility, and External Policy and Incentives],

2. Individual contextual factors (TDF-Knowledge, CFIR Knowledge and Belief) identified in the barrier assessment changed in valence and therefore salience with respect to outcome over time.

The Realist Evaluation highlighted the need to add additional organizational constructs to the barrier assessment that are not in the TDF and the need for continual assessment of external policy changes and organizational barriers. We therefore, removed the TDF domains from the revised C-M-O Configurations and replaced them with the CFIR constructs. We revised the C-M-O Configurations based on the outcomes of both groups at different time points (Table 5 & 6, Figure 7 & 8). In addition, the revised C-M-O configurations found that some CFIR-Context factors and CFIR-Mechanisms had direct influence on the Outcome, while in some cases, changes in the Context influenced participant CFIR-M Knowledge and Belief which negatively impacted the Outcome because there was no additional Mechanisms to address these changes. As clear in Figure 2, an unmediated effect of Context factors on Outcomes was not anticipated in the preliminary C-M-O. The figures were also changed to highlight the importance of the Context.

Fully supported implementation group:

The initial combination of positive CFIR-Context factors including Knowledge and Belief and Compatibility along with positive CFIR-Mechanisms Planning, Engagement of Key Stakeholders and External Agent (KB), and Evidence Strength and Quality facilitated the short-term (2-month) use of the selected outcome measure. However, sustainability of the shorted lived increased use was negatively affected by changes to CFIR-C External Policy which, in turn, limited patient Compatibility and decreased CFIR-M Knowledge and Belief and the impact of the innovation and limited use. Lack of Relative Priority of the innovation by the organization and

PT's belief of the limited use of the outcome measures [CFIR-M Knowledge and Belief] also limited use of the measure (Table 5 and Figure 7).

Chapter 6 Table 5

Table 5: Fully Supported Implementation Groups CMO's for increased and lack of use

Fully Supported Implementation Group		
Context	Mechanism	Outcome
Month 2		
Compatibility (+) Knowledge and Belief (+)	Planning (+) Engagement (Key stakeholders and external agent) (+) Evidence Strength and Quality (+)	Increased Use (Short Lived)
Month 4-10		
External Policy and Incentives (-) Compatibility (-)	Knowledge and belief (-)	Limited Use
Relative Priority (-)	Knowledge and belief (-)	Limited Use

Figure 7: Fully Supported Implementation Group Revised C-M-O Configuration

Partially supported implementation group:

Similar to the fully supported group, the interplay between positive CFIR-Context factors [Knowledge and Belief (month 1), Compatibility, and Goals and Feedback] and CFIR-Mechanisms [Knowledge and Belief (month 2, 4, 10), Planning, Engagement of Key Stakeholders and External Agent (KB), Evidence Strength and Quality] lead to increased use of the 10MWT at month 2 and

4. The positive influence of these combined CFIR-C and CIFR-M items (in particular, the strongly positive valence of the CFIR-M Planning, Engagement and Evidence Strength and Quality) was enough to overcome the countervailing negative valences of CFIR-M Complexity and lack of KB support (CFIR-M Engagement-External Agent) as well as the lack of available resources (CFIR-C Available Resources). Sustainability of both groups, was affected by changes to External Policy (at month 7) which limited patient Compatibility and influenced the pre-planned intervention and limited use seen in chart audits at months 8-10. Sustainability was also affected due to the consistent lack of resources (Space and Track) [Available Resources] to complete the test (Table 6 and Figure 8).

Chapter 6 Table 6

Table 6: Partially Supported Implementation Group Revised C-M-O Configuration

Context	Mechanism	Outcome
Month 2-4		
Compatibility (+) Knowledge and Belief (+) Goals and Feedback (+)	Planning (+) Engagement (Key stakeholders and external agent) (+) Evidence Strength and Quality (+) Knowledge and Belief (+)	Increased Use (Short Lived)
Month 10		
External Factors (-) Compatibility (-)	Knowledge and Belief (+/-)	Limited Use
Available Resources (-)	*No Planned Mechanism Per Study Design*	Limited Use

Figure 8: Partially Supported Implementation Group Revised C-M-O Configuration

Discussion

To our knowledge this is the first mixed methods Realist Evaluation completed on a KT intervention in physical therapy. The KT intervention was implemented by an external knowledge broker to change the use of a selected standardized outcome measure for physical therapists treating patients with orthopedic issues in two inpatient rehabilitation hospitals. Through the Realist Evaluation and CFIR heat map coding and rating, we found early use of the selected outcome measure at initial evaluation was seen with positive Contextual factors and Mechanisms related to Planning, Engagement, Knowledge and organizational Compatibility. Later, sustainability was negatively affected by External Policy changes which impacted the Compatibility between the KT intervention and the organization. We found the initial barrier assessment using the TDF lacked evaluation of several organizational contextual factors which lead to removal of the TDF in the final C-M-O Configurations. We also noted the need for internal organizational leadership implementation support as the effects of the organizational contextual changes may have been offset if these organizational level issues were taken into account at the beginning and throughout the KT study. The external KB should have worked with internal leadership to plan and adjust KT strategies as these organizational issues arose.

Our original hypothesis that PT engagement and facilitation by external KB would lead to early adoption of the selected outcome measure and this adoption would be sustained over six months for the fully supported group and later adoption of the selected measure and sustained was partially true and proved to be more complicated as there were multiple Contextual factors and Mechanisms interacting in both groups. The investigators attempted to reduce organizational contextual differences to compare KB support, but what we found was different individual and organizational Contextual factors impacted the adoption and sustainability each group making it difficult to compare the target mechanism (KB engagement). In short, the planned experimental design where potential confounders would be reasonably controlled turned out to be far too restrictive to capture the complexity of the interplay between Context and Mechanisms, especially during a time of substantial change in organizational policy.

We also hypothesized that more face-to-face meetings with the KB would improve the use of the outcome measure for fully supported implementation group to a greater degree than the partially supported implementation group, which was not true as the fully supported implementation group increased from baseline to month 2, but declined at month 4, and the partially supported implementation group continued to increased month 2 and month 4 and only declined at month 10. The fully supported group may have benefited from a partnership between the external KB and the organization to create Mechanisms that addressed issues with test selection [Knowledge and Belief] and organizational changes [Compatibility], but their early frustration with the implementation of their selected outcome measure quickly resulted in a flip in the valence of Knowledge and Belief which wasn't addressed with the increased face-to-face meetings with the KB. The partially supported implementation group continued to improve between month 2 and 4 despite having fewer face-to-face meetings with the external KB as the PTs were still engaged seen with positive ratings in implementing the intervention with scheduled meetings at month 2 and 4 with agendas and food [Engagement-Key Stakeholders] and the PTs continued to believe in the value of the 10MWT to identify fall risk and patient improvement in physical therapy [Knowledge and Belief].

Last, we hypothesized that the fully supported implementation group would have greater ease overcoming barriers than the partially supported implementation group because of the extra support by the KB. This was not supported. One of largest barriers for both groups were Compatibility and External Policy which would have only been able to be addressed by the KB if more implementation support was planned with the organization. In addition, the fully supported implementation group reported barriers with issues with value of the test [Knowledge and Belief] which were not able to be addressed by the KB due to the study design (selection and implementation of one outcome measure), whereas the partially supported implementation group faced barriers with space and equipment needs [Available Resources] which also was not addressed due to study design. The partially supported group was able to overcome the Available Resources barrier as they improved the use of gait speed at months 2 and 4 which was mapped to a positive Knowledge and Belief and Engagement of Key Stakeholders despite not having the extra KB support.

Through the Realist Evaluation, several key findings about the methodological design and need for tailored interventions versus randomization and control were highlighted. The investigators attempted to control the amount of implementation support for comparison. The same organization was used to reduce contextual differences among groups, but individual and organizational contextual differences were found that out weighted the compared intervention plan (mechanisms). The complexity of comparing and controlling KT interventions show that pragmatic or exploratory study designs may be better methodological designs for complex behavior change interventions.

The use of an external KB as a Mechanism to promote engagement the intervention was partially successful to increase adoption of the selected measures as documented use increased for initial evaluation, but use was below the target and relatively short lived. The PTs were engaged by the KB to select the outcome measure and implementation strategies which early showed promise for adoption for both groups. Planning and Engagement by the key stakeholders and the external KB have been previously found as facilitators for outcome measure use [35]. Both groups discussed that focus group meetings with the KB improved their use and the excitement of the research project. Both groups also discussed an observer/Hawthorne effect [36] which increased their early use, seen in month 10 quotes by the fully supported group [Knowledge and Belief/Engagement of External Agent] and month 4 partially supported group [Goals and Feedback]. Interestingly, the engagement to implement the intervention for the partially supported group increased enthusiasm, buy-in and use, despite less visits by the KB. Enthusiasm can enhance positive experiences and attitudes which improves actual behavior use [37]. Conversely, negative experiences can decrease the value of the KT intervention and decrease behavior change as seen with the fully supported group [38]. The KB should have developed the PT's capacity to building intervention strategies to enhance buy-in, overcome barriers, and facilitate problem solving and group process which may have ultimately improved adoption [38].

Interestingly, despite selecting the outcome measure, the fully supported implementation group found it did not inform clinical and that only selecting one outcome measure for the intervention was too restrictive [Knowledge and Belief]. As this is a barrier to outcome measure use, future meetings with the PTs may have resulted in the selection of a different outcome measure which may have subsequently changed use [35]. The CFIR-M strategy of Trialability should have been included in the KT intervention because with Trialability, the PTs could have tested the outcome measure on a small scale before full adoption [20]. This would have been beneficial to help the PTs determine which outcome measure was relevant to their patients and helped guide clinical practice. Both groups reported difficulty with interpreting the results to their patients despite 100% agreeing they had the skills to interpret results to patients on the barrier assessment questionnaire. PTs have previously reported difficulty with interpreting findings to patients [40] and more research is needed to determine effective ways to interpreting outcome measure results to patients in order to make shared decision about patient care [41].

Further review and consideration of the barrier assessment found that both groups did not believe that outcome measures motivate their patients or help patient direct care. The barrier assessment questionnaire was summarized and presented to the participants, but more time should have been spent during the barrier assessment focus group (Month 1) exploring specific barriers to help build and modify the intervention. In addition, understanding ahead of time that clinician's often over-estimate their strengths and under-estimate weakness should have been considered [42]. Solely relying on self-assessment through questionnaires and focus groups may not be enough to objectively assess each groups strengths and weaknesses. This was seen with the goals set on the Goal Attainment Scale compared to the documented use in the chart audit. The KB should have considered observational methods for barrier assessments as well.

The intervention used goals for adherence and audit and feedback as a strategy. The PTs selected their own goals for use and rated it using the Goal Attainment Scale. Goal setting is a strategy for adherence when using audit and feedback [43]. Interestingly, this strategy had different effects on both groups. The fully supported group was overly optimistic with the goal setting and never achieved it, while the partially supported group was more realistic, but wanted more information and more frequent audits. Audit and feedback was used as part of the mechanism, but there was a lack of organizational influence over the goal such as adherence on performance evaluation [Relative Priority and, Goals and Feedback]. The lack of Relative Priority by the organization for the fully supported group made the PT's question the usefulness of the TUG and the lack of Goals and Feedback for the partially supported group resulted in disappointment and negative ratings [Goals and Feedback and Engagement-External Agent]. The PTs may have increased adherence if the planned intervention included adherence on performance evaluations at the organizational level and had more frequent and specific audits [43].

Mid-range theories/Hypotheses

After comparison of the two groups regarding engagement/enthusiasm, trialability, barrier assessment, and audit and feedback, we developed some mid-range theories/hypotheses and corollaries for future researchers to test:

1. Even in the presence of mild organizational barriers, high stakeholder enthusiasm and commitment can result in sustainable organizational change, especially in situations where members of the managerial team support the implementation team.
    a. Corollary: sustained resistance to change from the organizational context can, in time, overcome and dampen the enthusiasm of implementation teams resulting in failed implementation efforts.
2. Implementation teams that identify *a set* of trialable solutions to the identified problem are more likely to be able to create sustainable organizational change

than implementation teams that identify only a single solution that it not easily trialable.

    a. Even under conditions of organizational change, a set of possible solutions provides a degree of flexibility to adapt to the organizational environment.

3. Implementation teams that rely only on a self-assessment of their skills at implementation are less likely to create sustainable organizational changes than implementation scenarios where an outside observer is able to work with the team to more objectively assess the team's strengths and weaknesses.
4. Implementation teams that receive regular (constructive) feedback on implementation efforts are more likely to create sustainable organizational change than implementation teams that do not receive such feedback.

FRAMEWORKS

The contribution of the three frameworks selected also lead to partial success as well as limitations found in this study. Multiple frameworks are needed to guide the KT process, barrier assessment, intervention development and evaluation to accurately understand the complexity of behavior change interventions [6, 19]. The investigators selected three frameworks to design, implement and analyze the data which will be reviewed.

The **KTA framework** guided the overall implementation process, but the study design should have included more iterative steps during the 6-month follow-up period to continue to assess barriers and tailor the intervention [6]. More formal sustainability approaches should have been included in the intervention design during the follow-up including training of local leaders [Engagement-Key stakeholders], ongoing support [Engagement- External Agent] or continued audit and feedback [Planning, Goals and Feedback] [403.

In addition, the KTA framework action cycle starts with identification of a problem. The investigators met with the management at the hospital to identify groups that were using a limited number of outcome measures to see if comparing two KT interventions would change outcome measure use. The management identified the inpatient orthopedic physical therapy teams as having limited use of outcome measures and the PT's on those teams were invited to participate in the research project. The PT's were engaged in the research project to select an outcome measure they believed could inform practice, but it was not verified by the investigators if the PT's believed lack of outcome measure use was a problem. The identification of a problem in KT research is typically recognized by the researchers or the organizational leadership [19], but the bottom-up approach used in the study design to get key stakeholders engaged to 'own' their evaluation practices did not match the using a top-down approach typically used when organizational leadership identifies the problem. Although organizational support was obtained and the organizational leadership guided identification of the problem, there was no organizational leadership formally involved to facilitate outcome measure use throughout the KT study. Lack of organizational involvement has been previously has been found as a barrier in KT and outcome measure research in allied health [35].

We used the **TDF** evaluate individual contextual factors at baseline and found multiple facilitators among the PTs including positive attitude, confidence/self-efficacy, motivation and skill. These constructs were mapped to strategies used to support the intervention design. PTs have been previously reported positive attitudes toward using outcome measures [25]. There have been three KT studies reported in physical therapy literature on outcome measure use that have identified baseline positive attitudes which remained positive after the KT interventions [44-46]. Interestingly, our study found baseline positive attitudes, but change in attitudes [Knowledge and Beliefs] throughout the KT intervention. The positive attitudes reported in previous studies were all measured through surveys, but our study used qualitative follow-up to determine more about the impact of the intervention on the key stakeholders. Clinicians tend to overestimate their abilities [47], strengths and use of outcome measures using questionnaires [47-48] so our qualitative approach may have explored Knowledge and Beliefs of the PTs in greater detail.

The TDF also assessed organizational factors including social influences [Implementation Climate] and environmental resources (space and time) [Available Resources]. Social support was a facilitator used to engage the PTs in the intervention, while environmental resources were only a barrier for the partially supported implementation group and couldn't be addressed because of the study design. These findings agree with a recent systematic review that a limitation of the KT strategies to improve use of outcome measures included strategies that were on the individual level and not at the level of the organization [14]. It was through the CFIR coding and the Realist Evaluation that we identified organizational factors that negatively coded including External Policy changes, Compatibility, and Relative Priority. These organizational factors and many other constructs included in the inner and outer setting of the CFIR should have been evaluated during the barrier assessment and may have altered the section of implementation strategies.

The **CFIR coding** assisted the analysis of factors over time that influenced the outcome. The heat map approach using the CFIR valance ratings across the course of the study allowed the investigators to determine the number of quotes and strength of the quotes to see if they changed over time or were constant. As the same organization owned both sites, contextual and implementation differences caused variable reasons for decreased use and sustainability. We were able to determine several contextual factors associated with the outcome using the CFIR for the Realist Evaluation. This changed our original CMO configuration to include CFIR constructs and make recommendations to evaluate organizational contextual factors and the need for development of interventions aimed at the organizational level. Future research should investigate the use of the CFIR for barrier assessment and intervention design as multiple constructs cover the complexity of KT interventions [20].

Limitations:

This Realist Evaluation analyzed two cases with a limited sample size as seen in large multi-site cluster randomized controlled trials. The design, implementation and analysis of two KT cases comparing implementation and the completion a Realist Evaluation was resource intensive, but the iterative process and with multiple investigators assured rigor of the evaluation. In addition, chart audits were completed by the organization and while training was provided, reliability could not be assured. Documented use at discharge was lower in both groups than at initial evaluation, but differences in use were not sufficiently explored in focus groups to explain why use was lower at discharge. Last, WR was novice user of the CFIR code book and had never completed a Realist Evaluation.

Chart audit data also revealed that the number of appropriate patients to complete the measure was low. PTs also rotated on and off the orthopedic teams based on census fluctuations throughout the 10 months which was indicated by the lack of patient charts per PT at a given time period. The PTs may have not able to get into a routine with using the outcome measure over time, lacked practice interpreting data to their patients and did not have sufficient use of the outcome measure to see if it guided practice due to these changes.

Last, as it is important to have valid and reliable measures to assess patient change in physical therapy, the planned KT intervention was aimed at the clinician only. This KT intervention did not assess the impact on the patient or the organization. More research is needed to determine patient value of using standardized assessments in physical therapy and the impact standardized assessment can place on the organization and healthcare system [34].

Our Realist Evaluation differed from a Realist Analysis in two ways:

1. A framework (TDF) was used to define program theory rather than individual theory. The aim of the KT project was to use the TDF to guide the barrier assessment and intervention development and therefore we did not determine each individual theory used to develop the domains of the TDF for the Realist Evaluation, but evaluated the domains of the TDF as a whole.

2. Mechanisms were defined as interventions, not as processes in which interventions work.

We defined Mechanisms as Interventions because frameworks, which highlighted the interventions not processes, were used to develop the intervention and analyze the outcome. The TDF consensus matrix was used to map barriers to recommended intervention strategies and the analysis of the interventions using the CFIR codebook rated the interventions' influence on the outcome. The focus on the intervention strategies in both the TDF and CFIR guided our decision to define the Mechanisms as Interventions rather than evaluating the processes in which the interventions work in a typical Realist Analysis.

Conclusion

A Realist Evaluation was conducted on a KT intervention that occurred at two sites and determined the mechanistic and contextual factors that lead to early partial adoption and decline over time of the selected outcome measures. The Realist Evaluation found that multiple contextual and mechanistic factors that into play at different time points that interacted and influence the outcome. The Realist Evaluation highlighted the need for a formal assessment of the organization and external health care policies to plan for any anticipated changes, and the inclusion of organizational leadership throughout the implementation process to build flexible interventions to adapt to the changing healthcare environment. In addition, the inclusion of trialability in order to select the correct outcome measure and more capacity building strategies to enhance enthusiasm and buy-in. Future KT projects should evaluate the outcomes of the KT intervention at the patient, clinician and organizational levels.

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Chapter 6 Figure 1

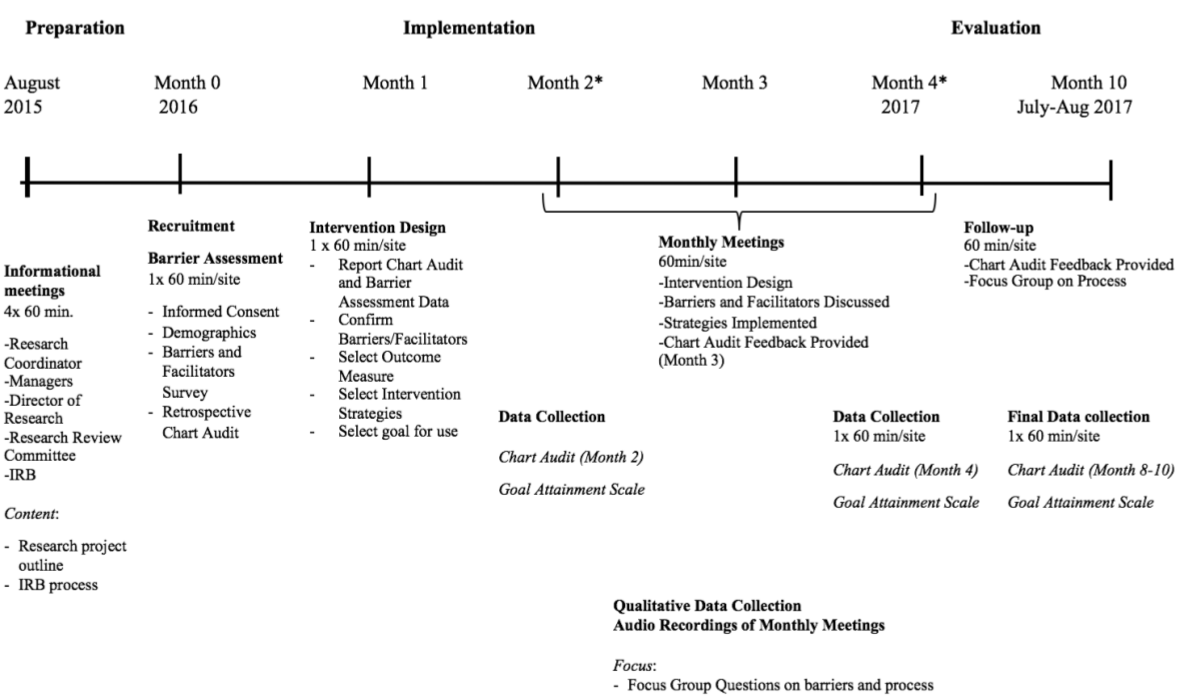
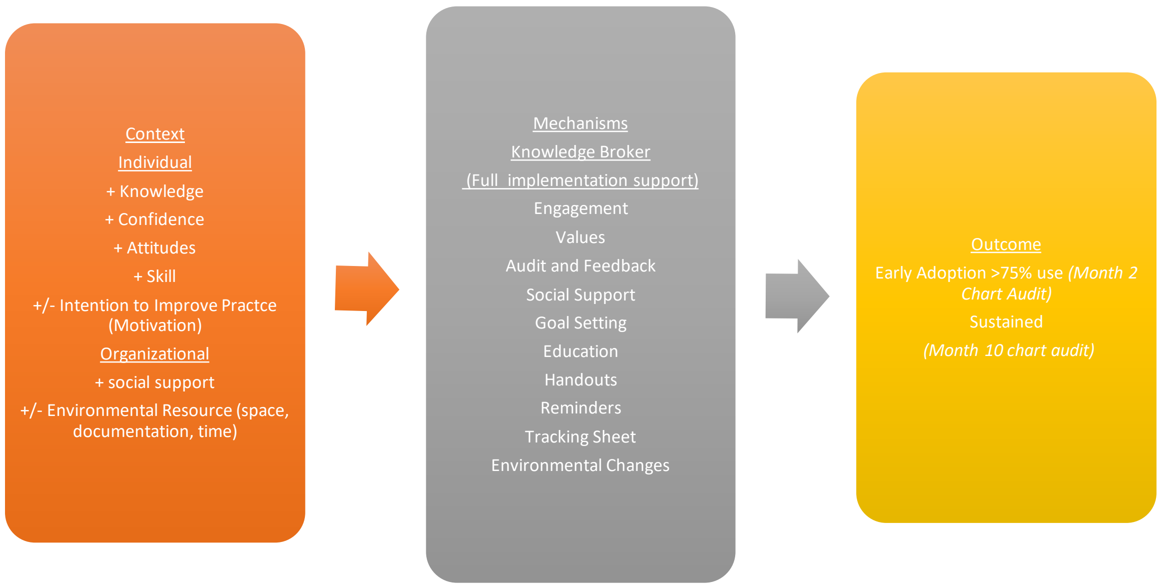


Table. 1 Study Timeline

*KB not present for active control group meetings

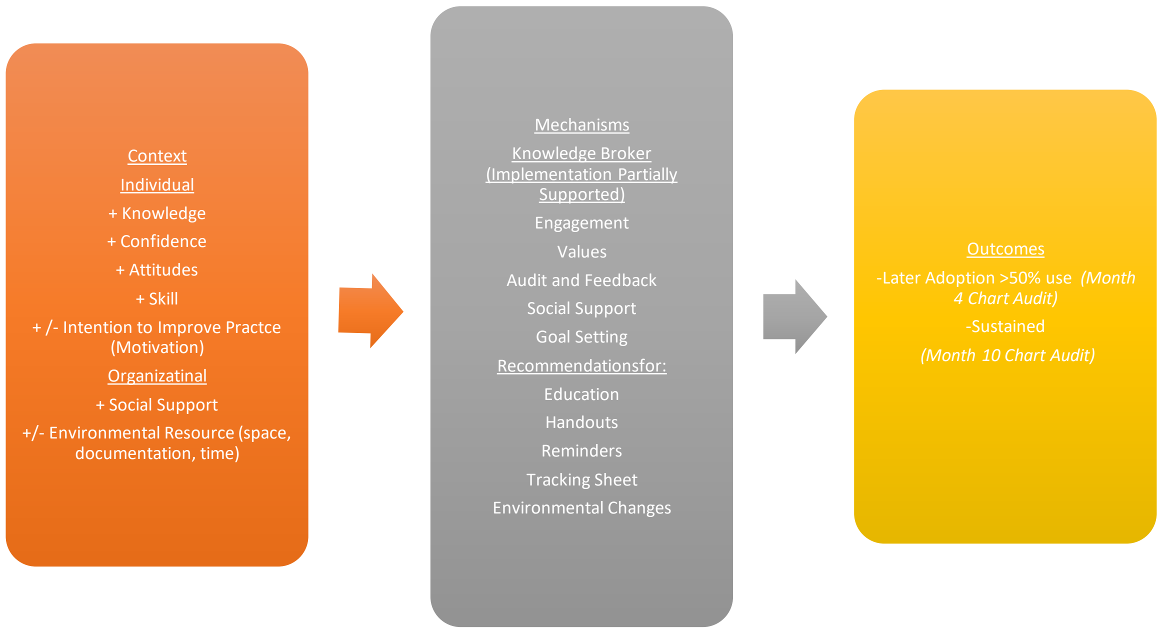
Chapter 6 Figure 2

Figure 2: Fully Supported Implementation Group Original C-M-O Configuration

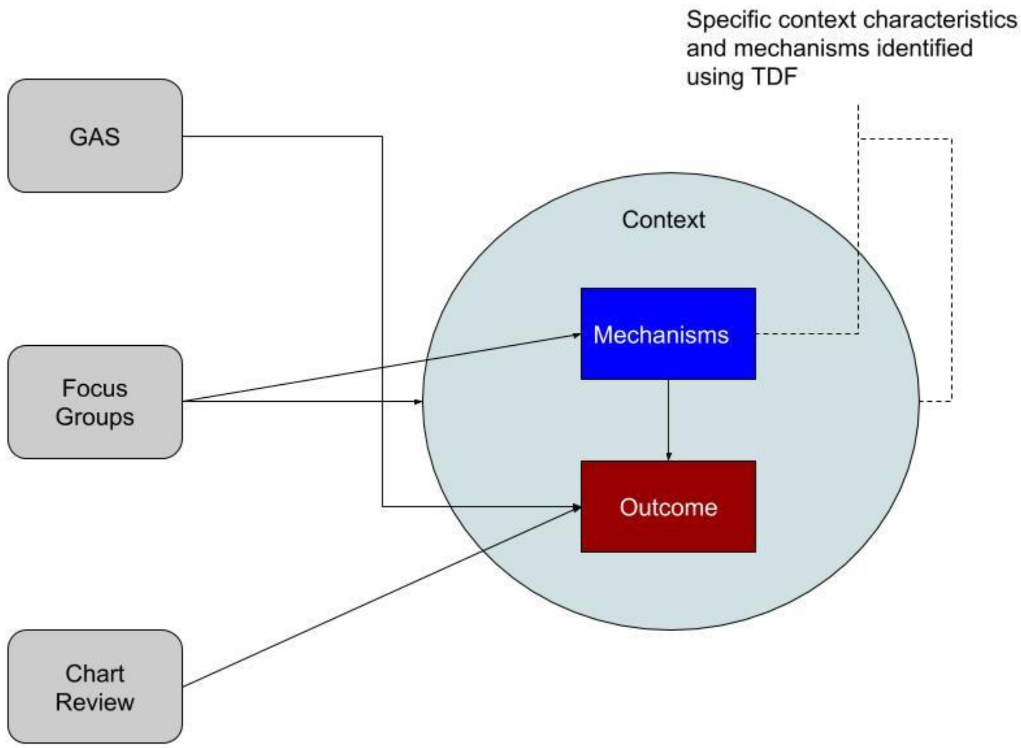


Chapter 6 Figure 3

Partially Supported Implementation Group Original C-M-O Configuration



Chapter 6 Figure 4

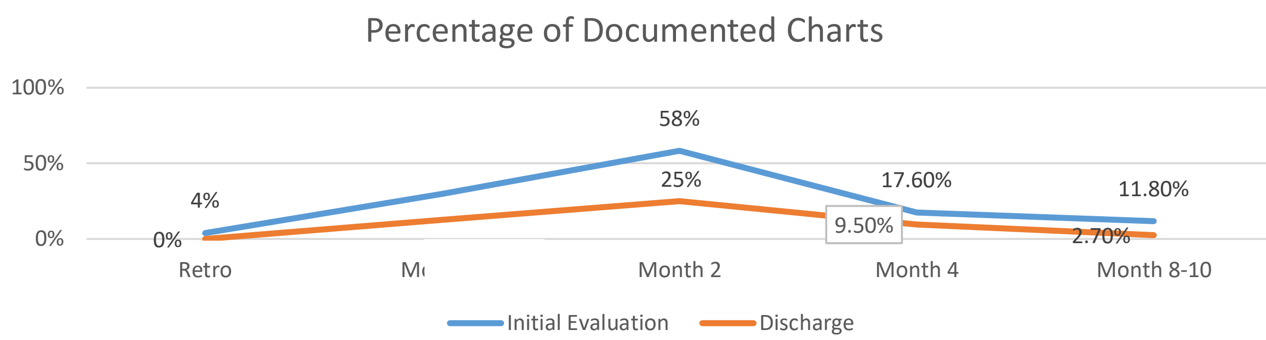


GAS: Goal attainment scale

TDF: Theoretical Domains Framework

Chapter 6 Figure 5

Figure 5: Fully Supported Implementation Group CFIR CODING



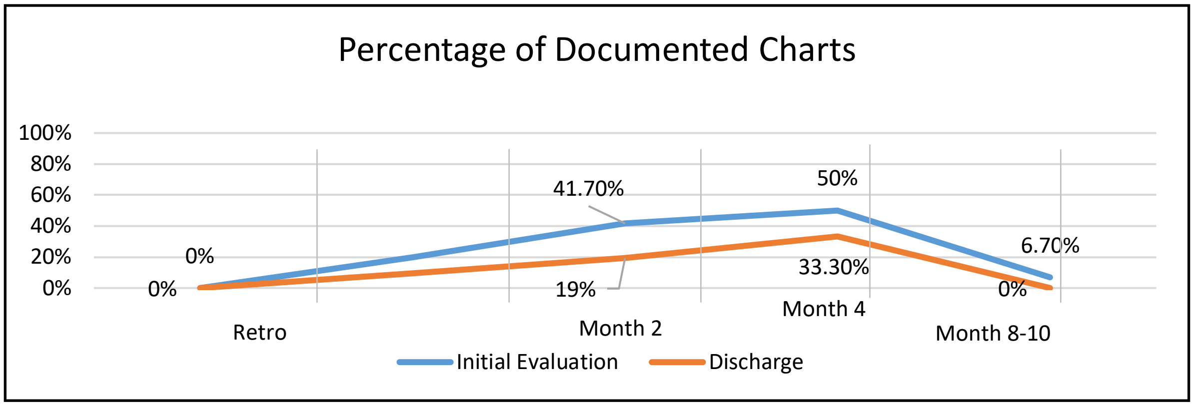
	Month 1	Month 2	Month 3	Month 4	Month 10
Mechanism					
Planning					
Engagement-Key Stakeholders					
Engagement-External Agent					
Evidence Strength and Quality					
Complexity					
Knowledge and Belief					
Context					
Knowledge and Belief					
External Policy and Incentives					
Compatibility					
Relative Priority					
Available Resources					
Goals and Feedback					

KEY: CFIR CODING

Strong Positive (2)	
Positive (1)	
Mixed	
Negative (1)	
Strong Negative (2)	
No Influence	

Chapter 6 Figure 6

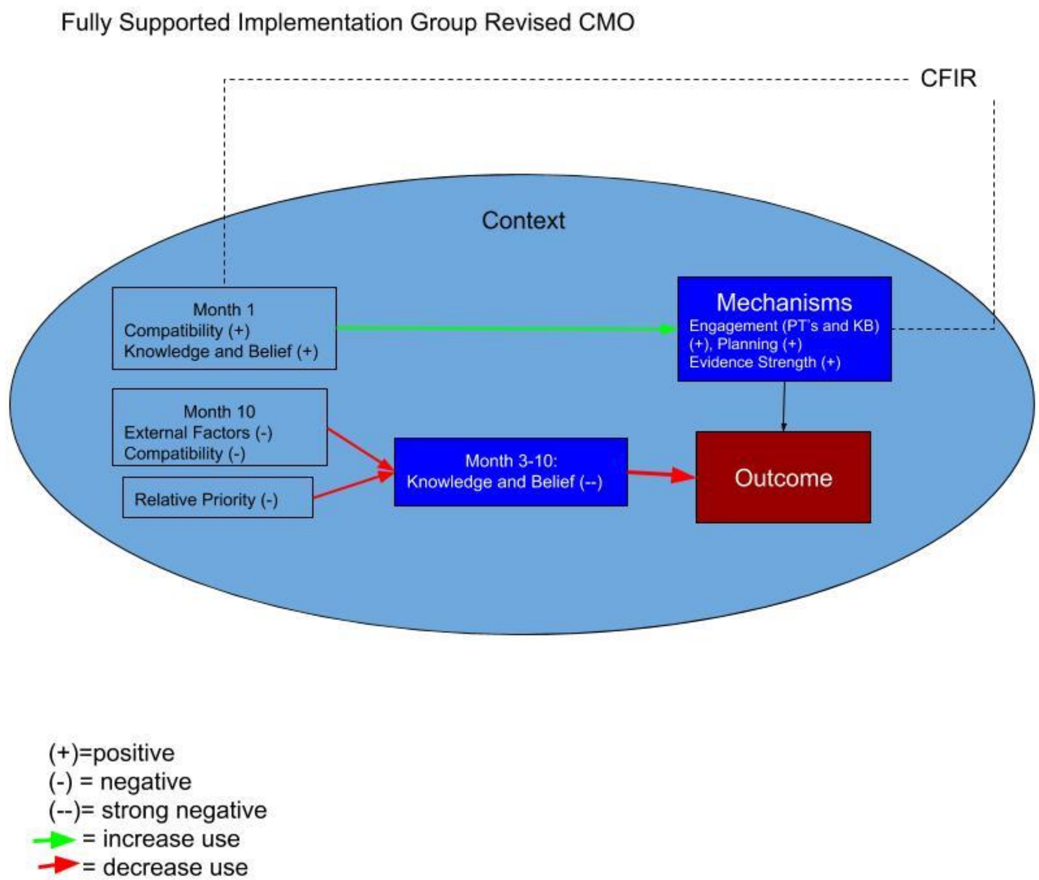
Figure 6: Partially Supported Implementation Group Outcomes



	Month 1	Month 2	Month 3	Month 4	Month 10
Mechanism					
Planning					
Engagement-Key Stakeholders					
Engagement-External Agent					
Evidence Strength and Quality					
Complexity					
Knowledge and Belief					
Context					
Knowledge and Belief					
External Policy and Incentives					
Compatibility					
Relative Priority					
Available Resources					
Goals and Feedback					

Chapter 6 Figure 7

Figure 7: Fully Supported Implementation Group Revised C-M-O Configuration



CMO: Context-Mechanism-Outcome

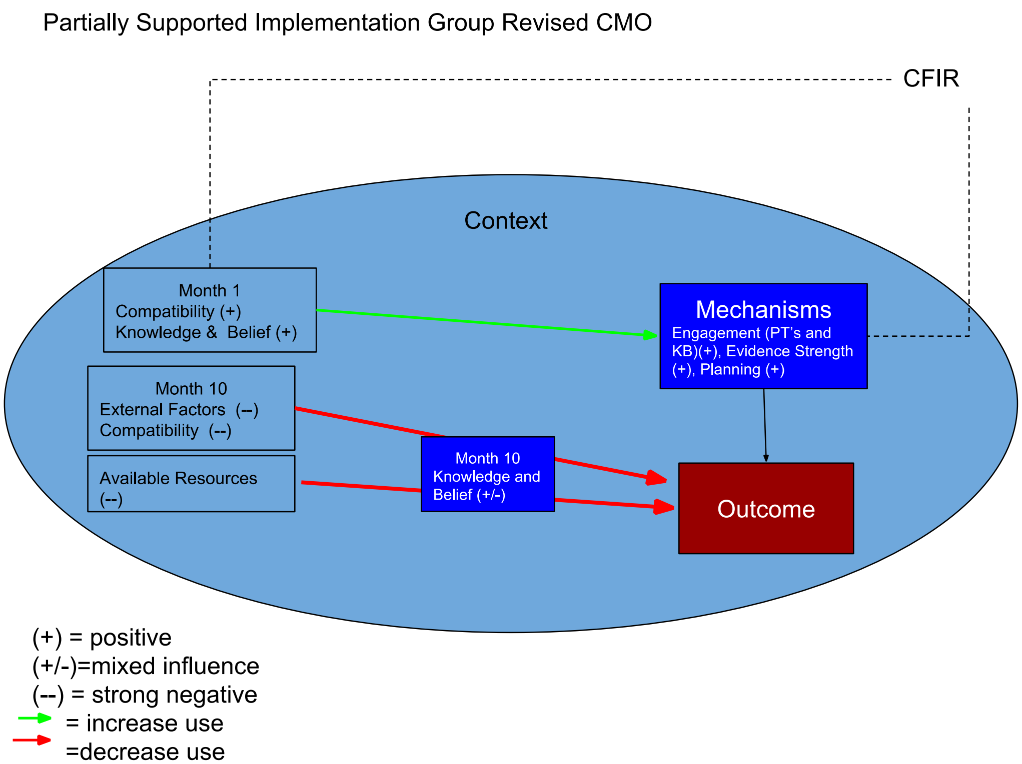
CFIR: Consolidated Framework for Implementation Research

PT's: Physical Therapist

KB: Knowledge Broker

Chapter 6 Figure 8

Figure 8: Partially Supported Implementation Group Revised C-M-O Configuration



CMO: Context-Mechanism-Outcome

CFIR: Consolidated Framework for Implementation Research

PT's: Physical Therapist

KB: Knowledge Broker

Supplementary Material: Focus Group Questions

Meeting	Focus Group questions
Month 1	For those who use measures, why do you used them? How do you select the outcome measures you use? How do you use outcome measures to educate your patients? How could we use support from other therapists to encourage the use of outcome measures? What environmental changes could provide reminders or clues to improve your use? How will you overcome space issues when using the selected measure? What factors may influence the use of outcome measure?
Month 2	What strategies do you want to include to increase your use of the OM? How can you use the measure to educate your patients?
Month 3	How are things going? What strategies increased you use? What barriers remain? How can you to continue to overcome the barriers? How can you increase or sustain your use of the measure for the next six months?
Month 4	How are things going? Are you using the OM? How can you increase or sustain your use of the measure for the next six months? How are you educating your patients? When are you educating? Do patients find learning about the outcome measure useful?

Month 10	What went well? What changed over time? Do you feel like you owned this approach? Are you confident in your ability to use the measure? Did you value the measure? Did the measure help with clinical decision making? Did using the measure change the way you spoke to your patients?

Supplementary Material: Barriers &Facilitators Questionnaire

Experimental

Education (n=7)	Disagree[a]	Neutral	Agree[b]
I learned the foundations of EBP as part of my academic preparation.	1 (14.3%)	1 (14.3%)	5 (71.4%)
I have received formal training in search strategies for finding research relevant to my practice.	1 (14.3%)	0 (0%)	6 (85.7%)
I received formal training on how to critically appraise research articles.	3 (42.9%)	0 (0%)	4 (57.1%)
I received formal training on how to apply research evidence to a specific patient case.	1 (14.3%)	0 (0%)	6 (85.7%)

[a]Response categories of “strongly disagree and “disagree” were combined

[b]Response categories of “agree” and “strongly agree” were combined

EBP: Evidence Based Practice

Partially Supported Implementation Group

Education (n=7)	Disagree[a]	Neutral	Agree[b]
I learned the foundations of EBP as part of my academic preparation.	0 (0%)	0 (0%)	7 (100%)
I have received formal training in search strategies for finding research relevant to my practice.	2 (28.6%)	0 (0%)	5 (71.4%)

I received formal training on how to critically appraise research articles.	1 (14.3%)	0 (0%)	6 (85.7%)
I received formal training on how to apply research evidence to a specific patient case.	1 (14.3%)	0 (0%)	6 (85.7%)
[a]Response categories of "strongly disagree and "disagree" were combined [b]Response categories of "agree" and "strongly agree" were combined EBP: Evidence Based Practice			

Evidence Based Practice Barriers, Facilitators and Behaviors

	Fully Supported	Partially Supported Group
Confidence: How confident are you in your ability to… 0%-100%	Mean (SD)	Mean (SD)
Identify a gap in your knowledge related to a patient or client situation	78.6% (14.6)	72.5% (25.5)
Formulate a question to guide a literature search based on a gap in your knowledge?	77.1% (10.3)	80.0% (10.7)
Effectively conduct an online literature search to address the question?	67.1% (22.1)	82.5% (12.8)
Critically appraise the strengths and weaknesses of study methods?	60% (20)	76.3% (5.2)
Critically appraise the measurement properties of standardized tests or assessment tools you are considering using in your practice?	64.3% (17.2)	76.3% (9.2)
Interpret study results obtained using statistical tests such as t-tests or chi-square tests?	40 (21.6)	57.5% (18.3)

Interpret study results obtained using statistical procedures such as linear or logistic regression?	42.9 (21.4)	55% (23.3)
Determine if evidence from the research literature applies to your patient's or client's situation?	75.7 (20.7)	85% (12.0)
Ask your patient or client about his/her needs, values and treatment preferences?	95.7 (5.3)	96.3% (7.4)
Decide on an appropriate course of action based on integrating the research evidence, clinical judgment and patient or client preferences?	85.7 (12.7)	86.3% (16.0)
Continually evaluate the effect of your course of action on your patient's or client's outcomes?	84.3 (11.3)	87.5% (8.9)
TOTAL (/100) StDev: Standard Deviation	70.1 (11.1)	77.7% (7.0)

Experimental (n=7)

Behavior: How often in the past 8 weeks have you?	0	1-2	>2
Conducted a literature search to answer a clinical question (e.g. PubMed, OVID, google scholar, etc). Used individual research articles to answer a clinical question. Used clinical practice guidelines to answer a clinical question. Used a systematic review to answer a clinical question. Used evidence based internet resources (rehabmeasures.org, PTNow.org) to answer clinical questions. Used knowledge gained from continuing education courses or conferences to guide patient care. (n=6) Used standardized assessment tools (outcome measures) to examine patients. Used evidence to guide the diagnosis of patients. Used evidence to guide the prognosis of patients. Used evidence to guide the treatment of patients.	4 (57.1%) 2 (28.6%) 2(28.6%) 5(71.4%) 1(14.3%) 0 (0%) 0 (0%) 0(0%) 0(0%)	2 (28.6%) 3 (42.9%) 1 (14.3%) 0 (0%) 1 (14.3%) 3 (50%) 0 (0%)	1 (14.3%) 2 (28.6%) 4 (57.1%) 2 (28.6%) 5 (71.4%) 3 (50%) 7 (100%)

	0(0%)	2 (28.6%)	5 (71.4%)
		2 (28.6%)	5 (71.4%)
		1 (14.3%)	6 (85.7%)

Partially Supported Implementation Group

(n=8)

Behavior: How often in the past 8 weeks have you?	0	1-2	>2
Conducted a literature search to answer a clinical question (e.g. PubMed, OVID, google scholar, etc).	2 (25%)	2 (25%)	4 (50%)
Used individual research articles to answer a clinical question.	2 (25%)	3 (37.5%)	3 (37.5%)
Used clinical practice guidelines to answer a clinical question.	2 (25%)	3(37.5%)	3 (37.5%)
Used a systematic review to answer a clinical question.	2 (25%)	4 (50%)	2 (25%)
Used evidence based internet resources (rehabmeasures.org, PTNow.org) to answer clinical questions. (n=7)	0 (0%)	5 (71.4%)	2 (28.6%)
Used knowledge gained from continuing education courses or conferences to guide patient care.	1 (12.5%)	3 (37.5%)	4 (50%)
Used standardized assessment tools (outcome measures) to examine patients.	0 (0%)	1 (12.5%)	7 (87.5%)
Used evidence to guide the diagnosis of patients. (n=7)	0 (0%)	3 (42.9%)	4 (57.1%)
Used evidence to guide the prognosis of patients.	0 (0%)	4 (50%)	4 (50%)
Used evidence to guide the treatment of patients.	0 (0%)	1 (12.5%)	7 (87.5%)

Experimental (n=7)

Resources:	Yes	No	IDK
At my facility, I have access to professional journals in their paper form.	5	0	2
At my facility, I can access relevant databases (e.g. PubMed, OVID, EBSCO).	6	0	1
At my facility, I can access full text articles.	6	0	1
At my facility, there is a resource person (e.g. clinical practice leader, librarian, research therapist) who can assist with implementing EBP.	6	0	1
	6	0	1
My facility has missions/goals/values regarding the use of evidence in practice.	5	0	2
My facility provides protected time for me to conduct literature reviews and appraise the literature.	0	7	0
My facility provides financial support to attend educational meetings and conferences.	7	0	0
I have the access to relevant databases with full text articles on the internet at home or locations other than my facility.	3	0	4
	Disagree[a]	Neutral	Agree[b]
I have colleagues who can mentor or facilitate my use of research findings in my practice.	0 (0%)	0 (0%)	7 (100%)
[a]Response categories of “strongly disagree and “disagree” were combined [b]Response categories of “agree” and “strongly agree” were combined			

Partially Supported Implementation Group (n=8)

Resources:	Yes	No	IDK
At my facility, I have access to professional journals in their paper form.	5 (62.5%)	1 (12.5%)	2 (25%)
At my facility, I can access relevant databases (e.g. PubMed, OVID, EBSCO).	8 (100%)	0 (0%)	0 (0%)

At my facility, I can access full text articles.	8 (100%)	0 (0%)	
At my facility, there is a resource person (e.g. clinical practice leader, librarian, research therapist) who can assist with implementing EBP.	7 (87.5%)	0 (0%)	0 (0%)
My facility has missions/goals/values regarding the use of evidence in practice. (n=7)	6 (85.7%)	0 (0%)	1 (12.5%)
My facility provides protected time for me to conduct literature reviews and appraise the literature.	1 (12.5%)	5 (62.5%)	1 (14.3%)
My facility provides financial support to attend educational meetings and conferences.	8 (100%)	0 (0%)	2 (25%)
I have the access to relevant databases with full text articles on the internet at home or locations other than my facility. (n=7)	7 (100%)	0 (0%)	0 (0%)
			0 (0%)
	Disagree[a]	Neutral	Agree[b]
I have colleagues who can mentor or facilitate my use of research findings in my practice.	0 (0%)	0 (0%)	8 (100%)
[a]Response categories of “strongly disagree and “disagree” were combined [b]Response categories of “agree” and “strongly agree” were combined			

Barriers and Facilitators to Using Outcome Measures Questionnaire Results

Fully Supported Implementation Group

Domain Item	Disagree[a]	Neutral	Agree[b]
Knowledge			
I have sufficient knowledge of standardized outcome measures	0 (0%)	0 (0%)	7 (100%)
I know how to choose valid and reliable assessments	0 (0%)	1 (14%)	6 (86%)
I know how to administer SOM	0 (0%)	0 (0%)	7 (100%)
I know how to interpret SOM using MCID, MDC, etc.	0 (0%)	1 (14%)	6 (86%)
	1 (14%)	0 (0%)	6 (86%)
	0 (0%)	2 (28%)	5 (71%)

I know how to document the results when using SOM			
I would like to know more about SOM before using them			
Motivation and Goals			
Using SOM improves the quality of patient care	0 (0%)	1 (14%)	6 (86%)
The use of SOM helps direct patient care	0 (0%)	1 (14%)	6 (86%)
Using SOM allows me to include patient preferences	1 (14%)	2 (28%)	4 (43%)
The use of SOM fits my way of working in the clinic	1 (14 %)	0 (0%)	6 (86%)
The use of SOM motivates my patients	3 (43%)	3 (43%)	1 (14%)
Using SOM is too time consuming	4 (57%)	3 (43%)	0 (0%)
In general, I avoid using SOM	7 (100%)	0 (0%)	0 (0%)
Confidence			
I feel confident I choose the best SOM for patient care	1 (7%)	2 (28%)	4 (43%)
I feel confident when administering SOM	0 (0%)	0 (0%)	7 (100%)
I feel confident when interpreting SOM	0 (0%)	2 (28%)	5 (71%)
I feel confident when documenting about the results of SOM	0 (0%)	1 (14%)	6 (86%)
Skill			
I have sufficient skills identify SOM	0 (0%)	0 (0%)	7 (100%)
I have sufficient skills obtaining SOM	0 (0%)	0 (0%)	7 (100%)
I have sufficient skills administering SOM	0 (0%)	0 (0%)	7 (100%)
I have sufficient skills interpreting SOM results to my patients	0 (0%)	1 (14%)	6 (86%)
Behavior			
I use SOM to educate the patient and family	1 (14%)	0 (0%)	6 (86%)
The use of SOM is always an integral part of my examination	0 (0%)	1 (14%)	6 (86%)

I use SOM primarily of evaluative purposes	1 (14%)	0 (0%)	6 (86%)
I use SOM primarily of prognostic purposes	0 (0%)	3 (43%)	4 (57%)
I use SOM primarily of diagnostic purposes	3 (43%)	1 (14%)	3 (43%)
I always follow the protocol when administering SOM	0 (0%)	0 (0%)	7 (100%)
Social Influences			
Patients value the use of SOM to gain insight into their functioning	2 (28%)	0 (0%)	5 (71%)
Patients find the use of SOM too time consuming	5 (71%)	1 (14%)	1 (14%)
The kinds of patients I treat are not appropriate for the use of SOM	5 (71%)	1 (14%)	1 (14%)
My co-workers support the use of SOM	0 (0%)	0 (0%)	7 (100%)
My supervisor supports the use of SOM	0 (0%)	0 (0%)	7 (100%)
SOM are valuable when speaking about the patient to the team	0 (0%)	1 (14%)	6 (86%)
Environmental Context and Resources			
I find using standardized assessments a problem because I do not have (physical) space in my practice.	5 (71%)	1 (14%)	1 (14%)
There are enough standardized assessment tools to use in my daily practice.	0 (0%)	1 (14%)	6 (86%)
I don't have enough time to use standardized assessments.	6 (86%)	1 (14%)	0 (0%)
I don't have the equipment I need to use standardized assessments.	6 (86%)	1 (14%)	0 (0%)
The use of standardized assessments is required at the practice where I work.	0 (0%)	1 (14%)	6 (86%)
I have access to the standardized assessments I want to use.	0 (0%)	1 (14%)	6 (86%)
The use of standardized assessments is part of the organizational goals of our practice.	1 (14%)	0 (0%)	6 (86%)
Health care policies support the use of standardized assessments.	0 (0%)	3 (43%)	4 (57%)

Beliefs about Consequences			
I have increased my use of standardized assessments because of Medicare and Medicaid.	4 (57%)	1 (14%)	2 (28%)
I have increased my use of standardized assessment because of other third party payers.	4 (57%)	1 (14%)	2 (28%)
The documentation system where I work supports the use of standardized assessments.	2 (28%)	2 (28%)	3 (43%)
The documentation system where I work does not support the use of standardized assessments that I want to use.	2 (28%)	2 (28%)	3 (43%)
Physical therapists who use standardized assessment should receive additional financial compensation	5 (71%) 0 (0%)	1 (14%) 1 (14%)	1 (14%) 6 (86%)
Referrers want treatment results objectively evaluated.	1 (14 %)	0 (0%)	6 (86%)
Using standardized assessments might strengthen negotiations with insurers.			
[a]Response categories of "strongly disagree and "disagree" were combined [b]Response categories of "agree" and "strongly agree" were combined SOM: Standardized Outcome Measures MCID: Minimally Clinically Important Difference MDC: Minimal Detectable Change			
Partially Supported Implementation Group Group			
Domain Item	Disagree[a]	Neutral	Agree[b]
Knowledge			
I have sufficient knowledge of standardized outcome measures	0 (0%) 0 (0%)	0 (0%) 1 (14%)	7 (100%) 6 (86%)
I know how to choose valid and reliable assessments	0 (0%)	0 (0%)	7 (100%)
I know how to administer SOM	0 (0%)	1 (14%)	6 (86%)

I know how to interpret SOM using MCID, MDC, etc.	0 (0%)	1 (14%)	6 (86%)
I know how to document the results when using SOM	0 (0%)	1 (14%)	6 (86%)
I would like to know more about SOM before using them			
Motivation and Goals			
Using SOM improves the quality of patient care	0 (0%)	1 (14%)	6 (86%)
The use of SOM helps direct patient care	2 (28%)	1 (14%)	5 (71%)
Using SOM allows me to include patient preferences	2 (28%)	3 (43%)	2 (28%)
The use of SOM fits my way of working in the clinic	1 (14 %)	3 (43%)	3 (43%)
The use of SOM motivates my patients	2 (28%)	2 (28%)	3 (14%)
Using SOM is too time consuming	2 (28%)	3 (43%)	2 (28%)
In general, I avoid using SOM	6 (86%)	0 (0%)	1 (14%)
Confidence			
I feel confident I choose the best SOM for patient care	0 (0%)	3 (43%)	4 (57%)
I feel confident when administering SOM	0 (0%)	0 (0%)	7 (100%)
I feel confident when interpreting SOM	0 (0%)	1 (14%)	6 (86%)
I feel confident when documenting about the results of SOM	1 (14%)	1 (14%)	5 (71%)
Skill			
I have sufficient skills identify SOM	0 (0%)	1 (14%)	6 (86%)
I have sufficient skills obtaining SOM	0 (0%)	0 (0%)	7 (100%)
I have sufficient skills administering SOM	0 (0%)	0 (0%)	7 (100%)
I have sufficient skills interpreting SOM results to my patients	0 (0%)	0 (0%)	7 (86%)
Behavior			
I use SOM to educate the patient and family	1 (14%)	4 (57%)	2 (28%)

The use of SOM is always an integral part of my examination	0 (0%)	1 (14%)	6 (86%)
I use SOM primarily of evaluative purposes	1 (14%)	2 (0%)	4 (57%)
I use SOM primarily of prognostic purposes (n=6)	2 (28%)	2 (28%)	2 (28%)
I use SOM primarily of diagnostic purposes	3 (43%)	4 (57%)	0 (0%)
I always follow the protocol when administering SOM (n=6)	1 (14%)	1 (14%)	4 (57%)
Social Influences			
Patients value the use of SOM to gain insight into their functioning	1 (14%)	4 (57%)	2 (28%)
Patients find the use of SOM too time consuming	2 (28%)	4 (57%)	1 (14%)
The kinds of patients I treat are not appropriate for the use of SOM	4 (57%)	2 (28%)	1 (14%)
My co-workers support the use of SOM	0 (0%)	0 (0%)	7 (100%)
My supervisor supports the use of SOM	0 (0%)	0 (0%)	7 (100%)
SOM are valuable when speaking about the patient to the team	1 (14%)	2 (28%)	4 (57%)
Environmental Context and Resources			
I find using standardized assessments a problem because I do not have (physical) space in my practice.	5 (71%)	1 (14%)	1 (14%)
There are enough standardized assessment tools to use in my daily practice.	4 (57%)	0 (0%)	3 (43%)
I don't have enough time to use standardized assessments.	4 (57%)	1 (14%)	3 (43%)
I don't have the equipment I need to use standardized assessments.	5 (71%)	2 (28%)	0 (0%)
The use of standardized assessments is required at the practice where I work.	0 (0%)	1 (14%)	6 (86%)
I have access to the standardized assessments I want to use. (n=6)	0 (0%)	3 (14%)	3 (43%)

The use of standardized assessments is part of the organizational goals of our practice.	0 (0%)	2 (28%)	5 (71%)
Health care policies support the use of standardized assessments.	0 (0%)	2 (28%)	5 (71%)
Beliefs about Consequences			
I have increased my use of standardized assessments because of Medicare and Medicaid.	1 (14%)	2 (14%)	4 (57%)
I have increased my use of standardized assessment because of other third party payers.	1 (14%)	4 (57%)	1 (14%)
The documentation system where I work supports the use of standardized assessments.	5 (71%)	2 (28%)	0 (0%)
The documentation system where I work does not support the use of standardized assessments that I want to use.	7 (100%)	0 (0%)	0 (0%)
Physical therapists who use standardized assessment should receive additional financial compensation	7 (100%)	0 (0%)	0 (0%)
Referrers want treatment results objectively evaluated.	0 (0%)	3 (14%)	6 (86%)
Using standardized assessments might strengthen negotiations with insurers.	0 (0%)	1 (14%)	6 (86%)

[a]Response categories of “strongly disagree and “disagree” were combined

[b]Response categories of “agree” and “strongly agree” were combined

SOM: Standardized Outcome Measures

MCID: Minimally Clinically Important Difference

MDC: Minimal Detectable Change

Supplementary Material: Fully Supported Implementation Group Intervention Mapping

Barrier/Facilitators	TDF Term	Recommended TDF Strategies	Intervention Component
Knowledge	Knowledge	Provide information regarding behavior	Report of current outcome measure use from chart reviews[a]
High confidence to change behavior	Belief about capabilities	-Self monitoring -Graded Tasks -Rehearsal of Relevant Skills -Social process of encouragement, pressure, support	-Rating goal achievement[a] -Including multiple participants in the study
Positive Intention to improve assessment practice	Motivations and goals	-Goal Targeted behavior -Graded tasks -Information Regarding Behavior -Social Process	-Goal setting[a] -Report of current use from chart review[a] -Multiple participants in the study

Positive Attitude regarding outcome measures	Beliefs about consequences	-Self-monitoring -Information Regarding Behavior -Feedback	-Rating goal achievement[a] - Report of current use from chart review[a] -Process evaluated through focus group[b]
Environmental resources	Environmental context & resources	Environmental Changes	-Dedicated space for TUG[b]
Positive Social Influences	Positive Social Influences	-Social process of encouragement -Modelling by others	-Seeing other PTs use the OM[b]
Adequate Skill in selecting, administering and interpreting outcome measures	Skill	Goal Targeted Behavior Self-monitoring Monitoring Rewards; incentives Rehearsal of Relevant Skills Graded tasks	-Set goals for outcome measure use[a] -Rating their goals achievement[a] -Report of current use from chart review[a] -See others use skills with patients[c]

		Modeling and demonstration by others	-Discussion on interpreting scores with PTs and patients
Decreased of Behavior Change	Action Planning	Prompts, triggers, cues	-Set goals for outcome measure use[a] -Environmental changes[b] - Tracking sheet, binders, emails[a,b]
[a] indicates investigator facilitated [b] indicates PT identified through questionnaires and audit and feedback			

Supplementary Material: Barrier Assessment Hand Out

Chart Review:

114 charts were reviewed from the last 3 months. Charts were reviewed from four RIC groups on e-rehab. Charts included patients with total joint replacements, spinal fusion/surgery, lower extremity fracture/surgery, and general debility. General debility ranged from pneumonia, cancer, UTI, sepsis, small bowel obstruction and generalized weakness.

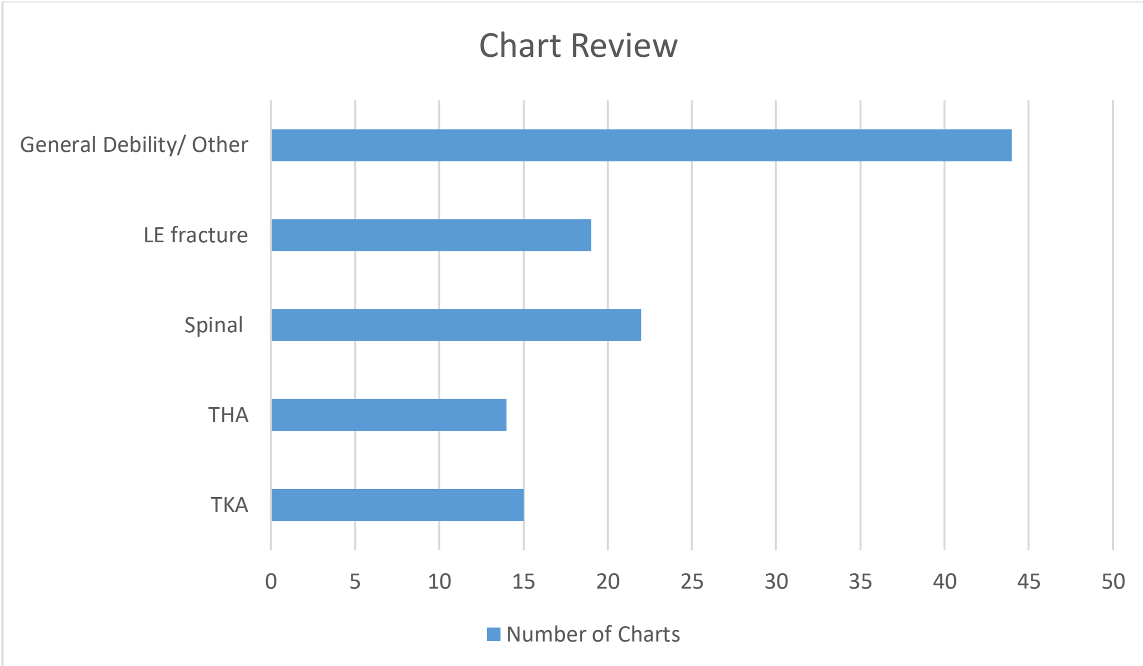


Chart Review:

- All charts included FIM, Quality Indicators, initial orientation log, and impairment and functional level measurements (ie. ROM, strength, balance, gait, functional mobility)
- Adequate space for documentation of additional outcome measures at initial evaluation, daily treatment notes and discharge summary
- Several measure documented, primarily for patients under general debility category. Berg was used twice for a patient spinal fusion; TUG was used once for a patient with TKR

Outcome Measure Used	Initial Eval up to day 6	Discharge

Berg	5	4
TUG	2	
10MWT	2	1
DGI	1	1
PSFS	1	
Hallpike-Dix	1	

<u>Survey Data</u>

EBP Questionnaire

<u>Confidence</u>

- Higher scores on practical skills (deciding on appropriate course of action, asking pt about values, formulate a question)
- Lower confidence on interpreting (t-tests, chi squared, and logistic regression)
- These finding agree with literature on PTs confidence with EBP (Salbach, et al. 2010)

<u>Behavior</u>

- 80% haven't conducted a literature search in the past 8 weeks

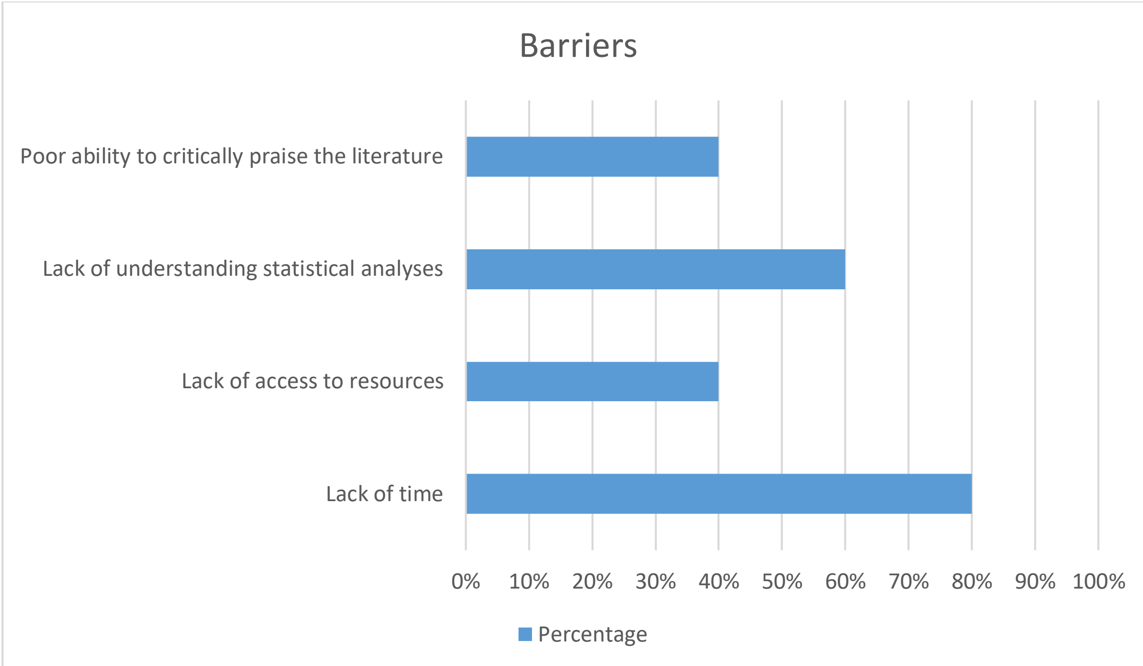
- Variability among group using articles, clinical practice guidelines and systematic reviews to answer clinical questions
- 80% are using evidence based internet resources to guide PT care (ie. rehabmeasures.org)
- 100% reported they are using information from courses/conferences to guide PT care
- 100% say they've used at least five standardized assessments in the past 8 weeks
- 100% say they use evidence to guide diagnosis, prognosis, and treatment

Access to Resources

- Facility supports EBP by providing access to databases, full text articles, a resource person, and financial support to attend continuing education
- 100% agree that colleagues support the use of EBP

Educational Preparation

- 100% trained in EBP principles
- 80% agree they have received training on search strategies, and apply the evidence to patient care
- 60% disagree they learned how to critically appraise articles



Standardized Assessment Questionnaire

Knowledge:

- Overall agreement on knowledge of selecting, administering, interpreting and documenting outcome measures.

Attitude:

- 80% agreed that using outcome measures improves patient care
- 100% disagreed that using outcome measures are too time consuming
- 80% agree that using outcome measures fits the way of working in the clinic

- 40% were neutral, 40% disagreed that using outcome measures motivates patients

Confidence

- Overall confidence with administering, interpreting and documenting outcome measures
- 60% were neutral or disagreed that they had confidence in choosing the best standardized assessments for patient care

Skill

- 100% agreed they have the skills to obtain, administer, and interpret outcome measures

Behavior

- 80% agreed they used outcome measures to educate the patient
- What percentage of time do you use outcome measures?
    - Ranged from 40-80%, Average 60%

Social Influences

- 80% agreed that patients value outcome measures
- 100% believed the patients they treat are appropriate for using outcome measures
- 100% believed their co-workers and supervisors supported the use of outcome measures

Environment

- 60% were neutral or disagreed that there is adequate space
- 100% disagreed that they don't have enough time
- 80% agree that using outcome measures is valued by the organization

- 40% agreed that the documentation system supports the use of outcome measures

Barriers	Facilitators
• Lack of time • Lack of understanding of statistical analyses • Inability to apply research findings to unique patient population • Lack of space • Documentation system	• Documentation of outcome measures in charts • Knowledge and training in EBP and outcome measures • Positive attitude • Skill using outcome measures • Belief that patients are appropriate • Access to literature • Support from co-workers and supervisors • Prior use with EBP internet resources

What factors may influence the use of outcome measures?

- Lack of applicable assessments for “non-normal” populations
- To reinforce clinical decisions
- Requirements from facility

Measures you reported you wanted to use more:

10MWT
DGI
6MWT
Berg
TUG
30 sec STS

For any questions, please contact Wendy at romneyw@sacredheart.edu or romneywe@shp.rutgers.edu.

203-365-4721

Supplementary Material: Month 1 Handout

Appropriate patients for Timed Up and Go:

- Ortho diagnoses (THR, TKA, hip fx, spinal surgery, general debility)
- PMH: falls or risk for falls
- Can ambulate 50ft within 3 days of admission
- Requires no more than CGA/min A for transfers or ambulation
- WBAT

- Can use assistive device

Goals for use:

- Admission (within 3 days) 75%
- Discharge 75%

Other info:

- Documentation sheet in binder
- Document in other treatment provided on evaluation
- Document in other intervention in daily notes
- Planned to put chair in hallway
- Cone

Supplementary Material: Experimental Group Handout

Timed Up & Go

Cut-Off Scores

Cut off Scores indicated risk of fall by population		
Population	**Cut-off Score (sec)**	**Author**
Community dwelling adults	>13.5	Shumway-Cook, 2000
Older stroke patients	>14	Andersson, 2006
Older adults attending falls clinic	>15	Whitney, 2005
Frail Elderly	>32.6	Thomas, 2005
LE amputees	>19	Dite, 2007
Parkinson's Disease	>11.5 >7.95	Nocera, 2013 Dibble, 2006
Hip Osteoarthritis	>10	Arnold, 2007
Vestibular Disorders	>11.1	Whitney, 2004

www.rehabmeasures.org

Community-Dwelling Elderly People with a variety of medical conditions (Podsiadlo & Richardson, 1991)

TUG Score (sec)	Functional Mobility Skills

< 20 sec	Independent for basic transfers
>30 sec	Dependent with transfers, needed help to enter/exit shower, do not go outside alone

Inpatients with Hip Fracture:

(Kristensen et al, 2007; n=79, 45 females, 34 males; mean age 81)

Cut-Off: >24 seconds was valid predictor of falls in people with hip fracture within the first 6 months after discharge

Norms:

Total Hip and Knee Arthroplasty

(Kennedy et al, 2005; n=150 patients, 69 THA, 81 TKA, mean age 63.7 (10.7) years)

	Pre-op, Mean (SD)	Post op <16 days, Mean (SD)	Post op, >20 days, Mean (SD)
TUG (sec)	9.8 (3.2)	24.7 (14.2)	10.3 (4.2)

SEM=1.07sec

MDC_{90}=2.49 sec

Community dwelling Adults

Bohannan. (2006). Reference values of the timed up and go test: A descriptive meta-analysis. Journal of Geriatric Physical Therapy, 29(2), 64-8.

Age Group	Time in Second (95% CI)
60-69 years	8.1 (7.1-9.0)
70-79 years	9.2 (8.2-10.2)
80-99 years	11.3 (10.0-12.7)

References:

Bohannan, R.W. (2006). Reference values of the timed up and go test: A descriptive meta-analysis. Journal of Geriatric Physical Therapy, 29(2), 64-8.

Brooks, D. Davis, A.M., Naglie, G. (2006). Validity of 3 physical performance measures in inpatient geriatric rehabilitation. *Archives of Physical Medicine and Rehabilitation, 87*, 105-10.

Kennedy, D.M., Stratford, P.W., Wessel, J., Gollish J.D., & Penney D. (2005). Assessing stability and change of four performance measures: a longitudinal study evaluating outcome following total hip and knee arthroplasty. *BMC Musculoskeletal Disorders, 6*(3).

Kristensen, M.T., Foss, N.B., Kehlet, H. Timed “up & go” test as a predictor of falls within 6 months after hip fracture surgery. *Physical Therapy Journal, 87*, 24-30.

Lusardi, M.M. (2004). Functional Performance in Community Living Older Adults. *Journal of Geriatric Physical Therapy*, 26(3), 14-22.

Podsiadlo, D., & Richardson, S. (1991). The timed “up & go”: A test of basic functional mobility for frail elderly persons. *Journal of the American Geriatrics Society*, 39, 142-148.

Steffan, T.M, Hacker, T.A, et al. (2002) Age- and gender related test performance in community dwelling elderly people: Six-minute walk test, Berg balance test, timed up and go, and gait speeds. *Physical Therapy Journal, (82)*8, 128-137.

Shumway-Cook, A., Brauer, S., & Woollacott, M. (2000). Predicting the probability for falls in community-dwelling older adults using the timed up & go test. *Physical Therapy*, 80(9), 896-903.

Yeung T.S.M, Wessel, J., Stratford, P., & MacDermid, J. (2008) The timed up and go test for use on an inpatient orthopaedic rehabilitation ward. *Journal of Orthopaedic & Sports Physical Therapy, 38*(7), 410-417.

7.0 Chapter 7

Physical therapists and patient experiences implementing the Timed Up and Go Test into an acute rehabilitation hospital: An descriptive qualitative study

In preparation for Physiotherapy Journal

Abstract:

Background and Purpose: A knowledge translation (KT) intervention was implemented with inpatient physical therapists (PTs) to increase the use of a standardized assessment tool to evaluate patients, the Timed up and Go (TUG). The TUG is a standardized tool that measures individual's balance while walking and can help determine risk for falls, functional independence, and progress in therapy. The purpose of this qualitative research study was to 1) explore PTs experiences and beliefs of using the TUG, 2) PTs beliefs of patient perceptions of being evaluated using standardized OM and treated while in inpatient rehabilitation and 3)

compare the beliefs of the PT with the experiences of their patients and 4) determine patient's experiences and perceptions of assessment practices while in physical therapy.

Methods: PTs who worked on the orthopedic teams in an inpatient rehabilitation hospital and involved in the larger KT study were interviewed in a focus group to determine their perceptions and values of the TUG and their beliefs of patient's experiences being evaluated in inpatient rehabilitation. Patients with orthopedic or medically complex issues who were evaluated and treated by the PT's were recruited to participate a focus group and a one-on-one interview to determine their experiences being evaluated in physical therapy. Semi-structured focus group guides were used. Data were audio recorded, transcribed and coded with a conventional content analysis.

Results: Six PT's participated in a focus group and four patients participated, three in a focus group and one in an individual interview. PT's reported they believed the TUG didn't help improve or guide clinical practice and that patient's value experiences in physical therapy over standardized assessments. Patient's discussed positive experiences in therapy and remembered observational assessments as compared to the use of standardized assessment tools. PT's and patient's valued the distance patients walked in therapy and functional independence.

Discussion: This descriptive, exploratory qualitative study compared PT's and patient's experiences being evaluated for balance and walking while in inpatient rehabilitation. Using a standardized assessment that is relevant to patients, so they can be involved in their treatment process and relevant to PT's to help PT's educate patients, make clinical decisions and justify care is an important part of patient care. Both PTs and patients emphasized distance walked and independence as priorities in physical therapy as compared to time measured while walking used in the TUG. Patients reported positive experiences in therapy which were likely due to positive patient-therapist relationships and communication. More research is needed comparing patient perceptions and outcomes as it relates to physical therapy care.

Background

Standardized outcome measures (OM) are valid and reliable tools used to determine patient level of function and progress in physical therapy (Jette, Halbert, Iverson, Miceli, & Shah, 2009). While standardized OM exist, physical therapists (PTs) face many barriers such as lack of time and knowledge to using them (Duncan & Murray, 2012). The Timed Up and Go (TUG) is a standardized outcome measure of balance and walking that times how long it takes for an individual to rise from a chair, walk 10 feet (9 meters) around a cone and return to the chair (Podsiadlo & Richardson, 1991). Scores on the TUG can be used to determine risk for falls (Shumway-Cook et al., 2000), functional independence (Podsiadlo & Richardson, 1991) and functional progress in rehabilitation (Kennedy, Stratford, Wessel, Gollish, & Penney, 2005; Yeung, Wessel, Stratford, & MacDermid, 2008). Shumway-Cook (2000) reported that community dwelling older adults with a time greater than 13.5 seconds have a high likelihood of falling.

Knowledge translation (KT) interventions have been developed to overcome barriers and improve the use of standardized OM, like the TUG in physical therapy practice (Moore et al., 2018; Romney, Salbach, Parrott, & Deutsch, in press; Russell et al., 2010; Schreiber, Marchetti, Racicot, & Kaminski, 2015; Swinkels et al., 2015; Van Peppen, Schuurmans, Stutterheim, Lindeman, & Van Meeteren, 2009). Several studies have shown that KT interventions can improve the use of standardized OM in physical therapy practice (Moore et al., 2018; Romney et al., in press; Russell et al., 2010; Schreiber et al., 2015; Swinkels et al., 2015; Van Peppen et al., 2009) however, most KT research on OM use in physical therapy is at the level of the clinician and little is known about patient experiences, perceptions and values of the use of standardized OM used by PTs.

Patient’s experiences, perceptions, values and outcomes in care improve with proper communication (Hall, Ferreira, Maher, Latimer, & Ferreira, 2010; Oliveira et al., 2012; Pinto et al., 2012). Clinicians must effectively communicate examination results including standardized OM and treatment options to inform patients to make decision about their care. The importance of communication has been highlighted in the patient centered care model which uses a collaborative approach to empower patients to be partners in their care (Mead & Bower, 2000; Morgan & Yoder, 2012). The shared decision making model adds to patient centered care by including information sharing and participation of both parties to make decision about the final treatment process (Charles, Gafni, & Whelan, 1997, 1999). Shared decision-making highlights the need to communicate about the process of therapy in addition to building a strong relationship.

As there is a lack of literature of both therapist’s and patient’s perspectives in physical therapy care, we were interested further exploring the PT’s and patient’s perspectives as it relates to use of standardized OM. We therefore conducted this qualitative research study nested within a mixed methods 2-site cluster randomized control trial KT study comparing the implementation support needed to overcome barriers of using a selected standardized OM. The 10-month KT study was conducted with two groups of PTs who worked at two acute rehabilitation hospitals within the same organization to determine barriers and facilitators for standardized assessment use, select a standardized OM, implement strategies to overcome barriers and monitor use with different levels of implementation support. This qualitative study was conducted with one group of PTs who selected the Timed Up and Go (TUG) (Podsiadlo & Richardson, 1991) to implement in practice with the use of a knowledge broker, education, audit and feedback, and reminders.

The PTs were provided a 60-minute educational session on information regarding psychometrics of the TUG including normative values, cut-off scores for fall risk and functional independence and minimal detectable changes scores with focus on patients in inpatient rehabilitation with orthopedic conditions (Supplementary Material: Group Handout). Discussion on how to interpret the findings to their patients occurred at three monthly meetings. At month 10, the PTs were asked in a focus group questions regarding their experiences and beliefs of using the TUG and their beliefs of patient perceptions of being evaluated and treated for walking while in inpatient rehabilitation. In addition, patients were interviewed to determine their experiences and perceptions of assessment practices while in physical therapy. Through these focus groups and interviews, the investigators aimed to 1) qualitatively explore PTs experiences and beliefs of using the TUG, 2) PTs beliefs of patient perceptions of being evaluated using standardized OM and treated while in inpatient rehabilitation and 3) compare the beliefs of the PT with the experiences of their patients, 4) determine patient experiences and perceptions of assessment practices while in physical therapy.

Methods

Design

The Consolidate Criteria for Reporting Qualitative studies (COREQ) was used to guide reporting of this study (Tong, Sainsbury, & Craig, 2007). This qualitative research study used focus groups with semi-structured focus group guides to determine PT's perceptions and beliefs of using the TUG as well as PT's beliefs of patient's experiences being evaluated and treated in inpatient rehabilitation. In addition, patients who were treated by the PTs involved in the KT study were interviewed (both in focus groups and one-on-one) using a semi-structured focus group guide to explore their perceptions and experiences in physical therapy while being treated at an inpatient rehabilitation hospital. This study was approved by Kessler Institute for Rehabilitation and Rutgers University Institutional Review Boards.

Participants

PTs who worked on the orthopedic teams at the rehabilitation hospital were recruited to participate in the KT study on the use of the TUG to evaluate patients with orthopedic and medically complex diagnoses in inpatient rehabilitation. The 10-month project included 9 physical therapists who selected the outcome measure to use in practice and collaborated with the investigators to create strategies to improve the evaluation practices using the TUG (CITE Realist evaluation). Patients with orthopedic or medically complex diagnoses at one acute rehabilitation hospital in New Jersey were recruited to participate. Participants were recruited if they were treated by one of nine physical therapists involved in the KT study. Patients were included if they had no cognitive deficits as reported by the primary PT, were treated by PTs involved in the KT study and signed an agreement to be contacted for research purposes in the admission paperwork at the hospital. Participants were excluded if they were still being treated by the PT involved in the study.

Patients were recruited by one PT involved in the KT study who screened for eligibility and distributed recruitment flyers. The recruitment flyers provided details about the study's purpose, eligibility, time requirements, potential benefits to participating, and contact information for the primary investigator. The PT asked interested patients for their contact information. The primary investigator contacted interested patients within one month after they were discharged home. Recruitment took place from February 2017–July 2017. Recruitment ended in July of 2017 because of the completion the larger KT study.

Six patients were recruited to participate while they were inpatients at the hospital. Four participated in interviews. The two patients who did not participate, agreed to be contacted while in the rehabilitation hospital, but did not answer the phone or return phone calls after discharge. Three participants were involved in a focus group (P1, P2, P3) and one participant was interviewed individually (P4).

PT Data Collection

The PTs who were involved in the KT study participated in a focus group at month 10 to determine their perceptions of patient experiences using the TUG and gait training while in physical therapy. A semi-structured focus group guide was used (Table 1). The focus group was audio recorded and transcribed. Questions 1 & 2 were asked to the PTs to explore the process and impact of the KT intervention. Questions 3-5 were added after the patient focus group interview based on preliminary findings from the patient focus group. Question 6 was asked to explore the PT perspectives of the patient experience's in therapy. Question 6 was discussed with the PTs at the end of the interview to decrease bias of the preceding questions. All questions were developed by the investigators. WR and JED conducted the focus group and IW was present as a representative from Kessler Institute for Rehabilitation. WR was a PhD student at Rutgers University and a clinical assistant professor as Sacred Heart University with research interest in KT and outcome measure utilization. WR had some prior experience conducting focus groups. JED was a professor at Rutgers University and PhD advisor to WR. JED is an experienced qualitative researcher. WR and JED did not know the PT's prior to the start of the KT study, but at the time of the month 10 interview, both knew the PT's for 11 months. The focus group was 50 minutes.

Chapter 7 Table 1

Table 1: Focus Group Questions

Focus Group Questions:

1. What are your perceptions of the TUG?
2. How did you educate your patients on the TUG?
3. What are patient's perceptions of using the Timed Up and Go or other standardized tests?
4. Do you think patients value standardized outcome measures?
5. What are patients' goals in physical therapy?
6. Why would patients emphasize distance with walking in physical therapy?

Patient Data Collection

A semi-structured focus group guide was used to collect patient data that was developed by the investigators (Table 2). The focus group and interviews were audio recorded and transcribed. Interviews took place at two weeks (P2, P4), three weeks (P1) and four weeks (P3) after the patients were discharged to home from the inpatient rehabilitation hospital. Patients were provided with the option to complete the interview over the phone if they were physically unable to travel to attend the focus group. Three out of four patients participated on the phone (P2, P3, P4). WR and JED conducted the focus group using a focus group guide. The focus group lasted 43 minutes. WR conducted the individual interview which was 23 minutes. WR and JED were not involved in the patients' rehabilitation and did not know that patients prior to interviews. Field notes were taken by WR and JED during the interviews. Focus group questions related to walking and use of the Timed Up and Go.

Chapter 7 Table 2

Table 2: Patient Focus Group Questions

Focus group questions included:

1. Describe your initial encounter with physical therapy

2. Do you remember any special tests that the PTs performed on you to measure your performance?

3. Do you remember the PTs measuring your walking in any way? Did they ever do a timed test with you?

4. Describe your overall experience with walking while you were there? How do you feel you progressed with your walking?

5. Did you (or the PTs) have a goal with your walking that you wanted to achieve while you were there?

Data Analysis

The interview and focus group were audio recorded and transcribed verbatim. The focus groups and interview were transcribed by a graduate research assistant using Express Scribe Transcription Software NCH® and an Infinity foot pedal. The transcriptions were copied into a Microsoft Word document and were checked for accuracy by WR. All participants were provided a unique ID number and de-identified in the transcription process. Data from questions 1 and 2 in the PT focus group were analyzed deductively using the Consolidated Framework for Implementation Research (CFIR) codebook in order to determine the outcome of the larger KT implementation project (Damschroder et al., 2009). One of the CFIR codes, knowledge and beliefs about the innovation, was included in this qualitative study as the PTs discussed their individual attitudes towards the use of the TUG. Coding of questions 1 and 2 occurred in three steps: 1) WR completed the initial coding using the CFIR codebook; 2) WR discussed and verified the codes with two additional investigators who were at the patient focus group (JED and IW); 3) Two additional investigators (JSP and NS) were brought into the coding process for verification as part of the larger project.

In addition, the PTs were asked specific questions at the 10-month focus group that related to their beliefs of the patient experience based on preliminary findings from the patient focus group. These questions were created by the investigators after the patient interviews were completed. Responses to the questions 3-6 were analyzed separately using conventional content analysis and quotes were organized by question [32] WR completed the initial coding, using open coding by writing words to describe the quotes in the margins. Similar codes with the quotes were then groups into categories and similar categories were grouped into themes [32] The categories and themes were reviewed, discussed and verified with JED. Themes discussed included: values and perceptions of patients using standardized assessments and distance walked in physical therapy. These themes were developed by question as well as number of quotes and agreement among PTs.

Data from the patient transcripts, field notes and reflective comments were analyzed using a conventional content analysis. Transcripts were read and reviewed, and reflective comments and open codes were written in margins. Similar codes with quotes were then grouped into categories (Merriam, 2009). One parent theme was developed from the categories titled: patient experiences, as it emerged from the patient focus group and interview. In addition, there were three sub-themes with several supporting categories that were developed from the theme. A narrative was used to describe each of the three sub-themes and quotes were used to support the categories under each sub-theme. WR completed initial coding of the patient focus group and discussed and verified the codes with JED. After verification, this process was completed with the patient interview. In addition, peer debriefing of the codes, categories and themes were completed by NS and JSP. The theme was developed by counting the number of quotes that supported the patient discussion on their experiences in rehabilitation. Sub-themes and categories were developed by counting quotes by the participants. A minimum of two quotes were needed by patients to develop a sub-theme or category due to the limited number of participants and lack of saturation.

Establishing Trustworthiness of the Data

Several other steps were taken to establish trustworthiness of the data including member checking, reflexivity, and an audit trial (Lincoln & Guba, 1985; Merriam, 2009). Member checking occurred informally during the interview as WR and JED synthesized the participants’ comments and asked the participants for confirmation or discussion. Reflexivity occurred between JED and WR met before and after each meeting through briefing and debriefing (Lincoln & Guba, 1985; Merriam, 2009). WR wrote a detailed description of each step of the study for the audit trial.

Results

Physical Therapists:

Six therapists who participated in the KT project participated in the focus group on patient perceptions. They were between 27 and 30 years old and all had earned their Doctorate in Physical Therapy (Table 3).

Chapter 7 Table 3

Table 3: Characteristics of the Physical Therapists

Participant ID	Characteristics Age, gender, degree, Year of experience, board certification
PT1	30 y/o, Female, DPT, 4 years of experience, no certification
PT4	30 y/o, Female, DPT, 3 years of experience, no certification
PT5	27 y/o, Female, DPT, 3 years of experience, no certification
PT6	29 y/o, Male, DPT, 2 years of experience, no certification
PT10	29 y/o, Female, DPT, 3 years of experience, no certification
PT13	30 y/o, Male, DPT, 6 years of experience, NCS
DPT: Doctorate of Physical Therapy, NCS: Neurological Certified Specialist	

Knowledge and beliefs about using the TUG

The PTs reported they had difficulty interpreting the findings for the TUG to their patients because as their patient's improved they were still at risk for falls, based on the 13.5 second cut-off score. They also discussed the addition of the TUG into their evaluations did not help guide patent education and treatment. The PT's reported they knew their patients were walking slowly and that they were at a risk of fall without the TUG score. They discussed the timing of the TUG test was not needed to confirm their beliefs that their patients were walking slowly to remain safe. (Table).

Table: Knowledge and Belief of the TUG

"I think the most difficult part was difficulty explaining the rationale of their score. Even though the patient had progressed, I'm telling them they still have this risk for falls. I found it the hardest for these patients who we were sending home at a modified independent level. It is kind of a paradox, here I am contradicting myself by saying, here you are at this increased risk for falls, but I am telling you that you are okay to live by yourself and go home by yourself. It was that fine line of justifying why they still needed more therapy. At the same time, it could also have been perceived as we are they sending me home unsafe because they are telling me I am at this risk for falls and I live alone, but because of this test." PT1

"Yeah I feel like the 13.5 seconds is especially when using a walker is very difficult because making the turn with a walker you have to go a lot slower so sometimes the faster they go does not make them safe necessarily especially if you have certain weight bearing restrictions so I find sometimes that number is difficult to use" PT5

"I feel like it didn't help guide my treatment too much. So, if it were something found really useful I would have remembered to use it more often." PT5

"I don't feel like I used it as an education tool either. I felt that we had the cutoff and it was telling us this person is at risk for falls when we already knew that. Most of my people are at risk for falls already and it was so strict of using one outcome measure for people that are here for different things" PT4

Value and Perceptions of patients of the TUG or other standardized assessments

The PTs believed patients varied on their ability to understand TUG scores and the value of standardized outcome measures. The PT's discussed that during 30 to 45 minute initial evaluations patients are asked to do multiple things (including discussion of diagnosis and medical history, performance of bed mobility, transfers, ambulation, and evaluation of strength, sensation, and balance) and that the addition of the TUG was just another test in the battery of testing. PTs stated:

> "I think there was a complaint factor especially for admission. Here we are asking them all these questions, we are doing all these assessments. Okay here we are going to go do this and sometimes the things that I found was by discharge when I was doing a discharge TUG and kind of go back to, do you remember from your initial evaluation you did this test and then that is usually when they look at me like, we did this test before?" PT1

> "I think a lot of them, did it because it was another test we told them to do. They did not look at it as like I'm timing you. I sometimes do not even say I'm timing the people. I would say just walk around the cone come back and sit back down. I would talk to them afterwards and say oh this shows you it took you that long to do it. It shows that you are increased risk for falling, but I think a lot of them wouldn't even process ultimately what we were doing at the point and time." PT 13

The PTs also reported that only certain patients who were motivated would value the TUG score. There was consensus that the patients wouldn't remember completing the TUG or being educated on their TUG scores. The PTs believed the patients valued their experiences while in physical therapy and not the time on a test. The PT's discussed that some patient's did not value timing or speed as they did not need to go fast.

> "I would say that they very few patients actually value the TUG. There are people who write down what they did in therapy that day and write down ROM they got after their

> bent their knee. The kinds who are more motivated, self-driven, ortho, elective types who are a little bit more into the statistics. The majority of them say I just want to go home." PT6

> "I think the patient's valued the time that we spent with them and the services that we provided, the outcomes that they got." PT6

> "One thing we get from a lot of people is, I know that I get it, is they say "I'm retired, I don't have to go anywhere fast.'" PT13

Distance walked in physical therapy:

The PTs were told that patients emphasized distance walked and independence while walking during physical therapy in inpatient rehabilitation and asked for their thoughts on the patient's perceptions. The PT's were not surprised the patients related their experiences with walking to distance and functional independence. Patients are in inpatient rehabilitation because they need physical assistance and may not be able to ambulate or can only ambulate short distances (typically less than 150ft). The PT's believed distance walked was easy for patients to understand and matched patient's goals of being able to ambulate short distances in and around their home. The PT's also discussed they emphasize distance walked in therapy. One PT stated: "Patients will say, "I want to be able to get in and out of the house, to and from the car, to and from here." (PT6). While others stated:

> "I think that is more realistic for people to use distance because people will be like 'I want to be able to walk and get my mail from the mailbox.' If you are walking 10 feet, that is not going to get you to the mailbox. We kind of using a distance thing, for their goals" PT4

> "I think we press distance because I think it is a quantitative thing that is a visual for a patient. You can't visualize time where a visual point A to point B you can see that, you can understand that. I think patients can appreciate that a lot more. They are like, "oh my God, I made it 100 feet away, I made it a full lap around this gym, I didn't need anybody with the chair." Time (using the TUG) is harder for somebody to quantify."
> PT13

PATIENTS

Four patients participated in the focus group and interview. The participant's mean age was 78 (range 65-89) and two of the four patients had the TUG documented in their charts (Table 4).

Chapter 7 Table 4

Table 4: Characteristics of Participants

	Age	Category of health condition	Discharge month	Interview Type and Date	TUG documented in chart
P1	65	Cardiac	Feb 2017	March 2017- In person, focus group	Not documented
P2	87	Respiratory Disorder	Feb 2017	March 2017- phone focus group	TUG at admission

P3	72	Major Multiple Trauma	Feb 2017	March 2017- phone focus group	Not documented
P4	89	Orthopedic	June 2017	June 2017- phone, individual interview	TUG at discharge

The major theme from patient interviews included patient experiences in rehabilitation with several subthemes: including overall experience, experience with assessment in physical therapy and experience while walking in rehabilitation. Several sub-categories emerged to support the sub-themes. Each sub-theme will be described narratively with supporting quotes under the categories.

Overall Experience:

The patients commented that all the staff were professional, polite and welcoming. Their overall experience while in inpatient rehabilitation was positive. Most participants reflected on their decreased functional mobility when describing their initial encounter in physical therapy. Two patients also reflected on seeing other patients improve in physical therapy which gave them hope that they would improve.

Professional Relationships:
"When I first got here they were very polite and everything and waiting for me with a wheelchair. They wheeled me to my room and everybody I saw that night was professional.

They greeted me with open arms…. Everybody is polite; they took good care of you. It was a great experience, really." P1

"I just had a wonderful experience every time I was down there. They were so polite and so professional and that just helped me so much. I have nothing else but praise for therapists. The young girls and the men." P2

Reflection and hope

"When you first go into that physical therapy room, you look around and see everybody doing what you can't do. It takes a little a while, but you look forward to getting out of that wheelchair and walking around." P1

"I remember the first time going into the exercise room or the therapy room and here I was sitting in the wheelchair, couldn't move and seeing all these people walking and I'm saying to myself, I'm never going to be able to that, I'm never going to be able to do that. And here I am, walking." P2

"When you go in the first time and you're unable to do anything and you see all these people progressing. They usually go day after day and you see how well they're doing. It gives you hope that you're going to get there." P3

Experience with Assessments in Physical Therapy:

The patients' varied in their experiences when describing any assessment including standardized or special tests performed by PTs. Two remembered their vitals being monitored closely in order to participate in therapy. Two described functional evaluation practices completed by the PTs by observing them walking, going up and down the stairs or getting into and out of the car. When given more detail about the TUG, three participants remembered a few details of the test, while only two participants had the test documented in the chart. Some remembered being tested but couldn't provide details of how the test was interpreted to them.

Vitals

"The biggest part was my blood pressure. My blood pressure would go up and anything time I did anything it went up and I had to wait a little in between doing the exercises until the blood pressure came down. Then we continued the therapy." P1

"They were always checking my blood pressure to see if it was up and then they would let me do more of therapy with them." P2

Observational Assessment Practices

"I did everything, the shower, sitting in a car, the kitchen, and they had me walking with a walker the second I was there which really surprised me." P2

“They watched me all the time. I had to walk with the walker and somebody walked along side of me. They had big things in the middle of the floor, that they laid patients on, and I had to walk around them. I had to go up and down stairs. I had to get in and out of the shower. I had to get in and out of the car, like if I was going to get in the car. There were different things they did with me.” P4

TUG

“I remember walking around a cone, then you turn around and came back. What was that about 20 feet? I think she told me it was something new and they were trying it out. You had to do it in a certain amount of time and I can’t remember the exact time. I did it once. Was it under a minute? …. You had to get down there and back in a certain time…I did it once and I came back and then we waited a little bit and I did it quicker the second time.” P1

“I just remember having something special that they want to test before, but I don’t know if they called it a name or anything…. I remember walking around the cone… I don’t remember them telling me what it was for. In groups and they kept taking people around the corner to the hallway to test people and I wondered they must be doing there. They didn’t tell me what it was and I don’t recall any timing.” P2

“Well the first time I didn’t do too well. The second time I did better. They said well you improved the second time.” P4

Experience Walking in Rehabilitation

The patients described different experiences when walking in therapy including using a walker, the distance they walked, and the education they received about walking. Each participant spoke about laps they walked around the gym as it related to distance. All participants had goals for walking.

Using a walker

"I didn't get the walker until I used it in the main room. I got a walker for my room to get up and go to the bathroom and come back. Maybe about three or four days into it. You couldn't get out of bed and to the walker by yourself they wouldn't let you, which was a bummer. I could have done that." P1

"I couldn't wait to get down there to walk with a walker. I could walk to the bathroom, but I couldn't walk to the cafeteria or anything. I think it was the second day and I was really surprised that they had me use the walker. Of course, they were holding on to me and right with me. It meant so much to get that walker the second day. To know that I could walk." P2

"I don't remember when I started walking. I remember it took me a while to learn how to get out of the chair and stand up. By the time I left I was walking with the walker. In my room I was only allowed to use the walker to go to the bathroom. I walked without the walker, I think once or twice." P3

"The first couple of days I was in the bed because I couldn't walk. My legs weren't working, I couldn't walk, and they had to get me mobile. They told me the different exercises they were going to give me and what I had to do, and I just did whatever they told me. By the time I left, I was walking with a walker." P4

Distance

"We went by laps. How many laps you can get around that bench in the middle. I figured that was 20x60. I was trying to count the tiles. The tiles are two feet." P1

"I guess with all of us, how many times you go around that table. First time, you're lucky you made a lap. The best I got was four." P1

"I could walk around the third time and I don't remember going around four times." P2

"It seemed like quite soon I was I able to go around the tables in the therapy room. Like four long tables together. They would ask if she could do a second lap and I would say yes and then I would say can I do it a third time? They would say yes, I could so I really started using the walker by the third day quite a bit in the therapy room and to the bathroom in my room. An aide was always with me when I went in the bathroom." P2

“I knew I was improving every day. I could tell the minute I got up with that walker and started walking around their room. I had to go around like 4 times and then they said, sit down and take a rest. I said, I could go again. He said, ‘okay smarty do one more.’ So I did 5 and he said, ‘now you take a rest.’ ” P4

Education

“Sometimes they would tell me I didn’t have to rush and to walk normal pace.” P2

“They taught me how to get up without the using the muscles to hurt my chest.” P2

“I had my ribs broken and my sternum broken from the accident. I wasn’t allowed to use my arms [to get up]. I couldn’t use my arms to put pressure on my chest.” P3

“They had to get my legs working. My legs weren’t working, I couldn’t walk, and they had to get me mobile. They told me the different exercises and what I had to do, and I just did whatever they told me.” P4

Goals

“My main goal was to walk. Get up out of bed myself. I’m still afraid to swing the golf club because I’m still a little unsteady.” P1

“I couldn’t wait to get down there to walk with a walker.” P2

“My goal was to walk. I wanted to walk. I wanted to go home.” P3

“I just made up my mind that I wanted to get out of that wheelchair. I didn’t want to stay in that wheelchair. I was determined. I wanted to get better so I can get out of there. I said not that I don’t love you, but I want out of here.” P4

Discussion

This small descriptive qualitative study involved interviewing PT’s on their perceptions and beliefs of using the TUG and compared those beliefs with patient’s experiences in physical therapy. Our original intent was to focus on the use of the TUG with patient’s, but our scope broadened to exploring patient’s experiences in physical therapy and assessment practices as there was a lack of patient’s recruited with the TUG recorded in their charts. The descriptive study found the PTs reported difficulty interpreting the test scores to their patients and the decreased utility of the test to help make clinical decisions as compared to the methods they were previously using. The PT’s believed patient’s would not remember the TUG test as it was incorporated with multiple other tests during their evaluations. The patients discussed positive experiences in rehabilitation, as they reported the PTs and other health care professionals were polite and encouraging. The patients reported using social support from other patients and the PTs for motivation. The patients reported on the use of vitals and observation of functional activities when asked about standardized OM used in physical therapy. The PT’s believed patients value their experiences in therapy over standardized testing. The patients discussed priorities for walking including the distance they walked and ambulating independently. Both the patients and the PTs valued the distance the patient ambulated while in therapy.

One purpose of the larger KT study was to work with the PT’s to select and implement an OM that they believed would be useful in clinical practice. The PT’s selected the TUG to implement as many of the patients seen in that setting had fallen, had difficult with transfers, and required the use of assistive devices to ambulate. The TUG has been proven to determine risk for falls, independence with functional mobility skills (Podsiadlo & Richardson, 1991) and progress in inpatient rehabilitation (Kennedy, Stratford, Wessel, Gollish, & Penney, 2005; Yeung, Wessel, Stratford, & MacDermid, 2008). The PTs were educated on the use of the test, but reported it lacked clinical usefulness for decision making. PT's previously used multiple tests and measures to make clinical decisions and justify care, so after the KT intervention, they found addition of the TUG didn't help guide their decision making. The PT's were provided with education and resources that specifically related to inpatient rehabilitation, including norm values and MDC's scores for patients seen in inpatient rehabilitation with orthopedic issues, but the PT's reported using the generalized fall risk score for community dwelling older adults. Continued training with the PTs on using the psychometrics of the TUG for patients in inpatient rehabilitation to reinforce and justify clinical decision making such as need for assistive device, assistance at home or continued therapy after discharge from the hospital may have improved value of the TUG. In addition, continued education on minimal detectible change scores and cut off scores with use of assistive devices for the TUG may have improved patient education. The PTs found difficulty explaining standardized OM results to the patients and additional training may have improved their ability to describe results to patients after they completed the test. It is not surprising that the patients interviewed did not recall details of the TUG or education on fall risk based on the PTs reported difficulty with interpretation and using the TUG and did not adopt it for use in practice. Other physical therapists have reported difficulty interpreting standardized OM to patients and families (O'Connor et al., 2017). In addition to accurate interpretation, the ability for patients to understand numbers presented to them may be a barrier to using standardized OM for shared decision making (Akl et al., 2011; Gigerenzer &

Edwards, 2003). More research exploring PTs ability to interpret test results and the ability of patients to understand the meaning of those results is needed when using standardized OM.

The patients in this small study reported positive experiences related to interpersonal relationships with the therapists and the process of therapy which agrees with the current literature (Hall et al., 2010; Hush et al., 2011; Kidd et al., 2011; Laerum, Indahl, & Skouen, 2006; Levack et al., 2016; Peiris et al., 2012). The PTs and patients matched in goals regarding ambulation distance. Their relationship was positive, but it appeared the PTs primarily decided the treatment plan and the patients agreed. One patient stated, “I did what I was told” while a PT stated, “I think a lot of them, did it because it was another test we told them to do.” The PTs primarily deciding on the plan of care has been previously described as a common approach used by PTs (Dierckx et al., 2013; Topp, Westenhofer, Scholl, & Hahlweg, 2018). Dierckx (2013) observed patients and physical therapist’s interactions to compare patient level of preference and therapist perception and found that patients have reported preferring sharing in the decision making, while PTs perceive patients prefer the PT makes the decision alone (Dierckx et al., 2013). In a 2017 survey of 357 German physiotherapists, 49.9% reported they have positive attitudes toward shared decision making, but most (67.8%) preferred to make decisions about patient care with little input from the patient (Topp et al., 2018). More research is needed to explore and further define the patient-therapist relationship to understand the use of shared decision making in examination and treatment planning.

The patients reported the PTs used observation of activities (observational assessment practices) and vitals as a key measures used in therapy to assess their function and walking distance. While observational assessments are key to PT examination and evaluation, standardized OM can be used to report changes in functional status in a valid and reliable way.

The focus on vitals, blood pressure and temperature, as key indicators for participation in therapy are important. Vitals are commonly used in all practice settings and easily understood by patients. The patients used blood pressure and temperature as indicators of whether or not they should participate in therapy, but other vitals including heart rate and rate of perceived exertion could easily be used to determine how hard the patient is working in therapy to prescribe the proper intensity of care.

Interestingly, the patients reported distance ambulated was another factor in measuring their improvement in therapy. They all reported walking around a "track" that was in the center of the therapy gym. While most patients didn't know the distance of the track, they knew the amount of laps they could complete. PTs agreed that distance was important and they reported they emphasize it in their care. The PTs may have considered a measure that utilizes distance (e.g. the 6MWT or 2MWT) when selecting which measure to implement for the KT intervention as distance was a major factor for both patients and PTs. In addition, the 6MWT has been shown to be valid and reliable for patients who require assistance, so it could be easily incorporated in the inpatient rehabilitation setting (Fulk, Echternach, Nof, & O'Sullivan, 2008).

The major limitation to this qualitative study was the limited sample size and lack of patients with the TUG documented in their charts which decreased saturation and generalizability of the findings. The goal was to recruit up to 16 patients who had the TUG measured on them at initial evaluation and discharge. After six months of recruiting, only six participants were recruited, four who participated and two had the TUG recorded in their charts. There were multiple recruitment issues including: patients had not signed hospital forms agreeing to be contacted for research purposes, training and availability of the PT who recruited patients, a low census, and PT perceptions of lack of clinical utility of the measure which lead to decease number of patients with the measure documented in their charts.

The limited patient sample size and limited functional ability to travel also altered the methods planned for this study. We had planned in-person focus groups at the facility to have group input and sharing of ideas. Two of the three patients in the focus group were physically unable to travel and the focus group was conducted over the phone and in-person. This mixed focus group limited group interaction and the investigators ability to read non-verbal expressions for the patients on the phone. The final patient was interviewed in a one-on-one phone interview because the recruitment period was ending and the patient was unable to travel. Due to the methodological issues faced by the investigators, the results of this study should be used with caution as the use of both a focus group and one-on-one interview as a method to collect and analyze data is not ideal.

Another limitation was that satisfaction and outcomes were not assessed. The positive experiences the patient's discussed could mean that they were satisfied, but the relationship between their positive experience and patient outcomes was not explored. Determining the role communication can play in patient outcomes is important to enhance patient care. Current research has found that patient outcomes are inconsistently associated with higher satisfaction (Hall et al., 2010; Hush et al., 2011; Levack et al., 2016). In the systematic review by Hush (2011), they reported that treatment outcomes inconsistently determined satisfaction (Hush et al., 2011). Hall (2010) conducted a systematic review on patients seen in rehabilitation and found good patient-therapist relationships have been shown to improve treatment outcomes including functional abilities like ambulation (Hall et al., 2010). Involving patents' in inpatient rehabilitation in goal setting, have been shown to positively influence outcomes related to quality of life, but did not influence physical outcomes (Levack et al., 2015). More research is needed to determine patient experiences, perceptions and values that positively influence outcomes in physical therapy.

As patients are becoming more knowledgeable health care consumers, PTs must understand their needs and values in order to find ways to improve patient autonomy and share in decision making. Further PTs education on communication and interpretation of standardized OM may be needed. The findings from this study lead to future research questions which include: How do PTs select standardized tests in consideration of patient’s goals? Do PTs know how to appropriately interpret and education their patients on OM results in order to make shared decisions? Do patients value the use of standardized OM to guide their care? And what influence does shared decision making have on patient outcomes in physical therapy practice?

Conclusion

Patients value the patient-therapist relationship when being evaluated and treated for walking and balance deficits in inpatient rehabilitation. Discussion of standardized OM results are a valid and reliable way to educate patients on improvement observed in therapy and to collaborate with patients about future treatment planning, but training may be needed on the selection of the proper test and interpretation of standardized OM results to patients. More work is needed to investigate patient and therapists value of using standardized OM in inpatient rehabilitation and the use of standardized OM in shared decision making.

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Supplementary Material: Group Handout

Timed Up & Go

Cut-Off Scores

Cut off Scores indicated risk of fall by population		
Population	**Cut-off Score (sec)**	**Author**
Community dwelling adults	>13.5	Shumway-Cook, 2000
Older stroke patients	>14	Andersson, 2006
Older adults attending falls clinic	>15	Whitney, 2005

Frail Elderly	>32.6	Thomas, 2005
LE amputees	>19	Dite, 2007
Parkinson's Disease	>11.5 >7.95	Nocera, 2013 Dibble, 2006
Hip Osteoarthritis	>10	Arnold, 2007
Vestibular Disorders	>11.1	Whitney, 2004

www.rehabmeasures.org

<u>Community-Dwelling Elderly People with a variety of medical conditions</u> (Podsiadlo & Richardson, 1991)

TUG Score (sec)	Functional Mobility Skills
< 20 sec	Independent for basic transfers
>30 sec	Dependent with transfers, needed help to enter/exit shower, do not go outside alone

<u>Inpatients with Hip Fracture:</u>

(Kristensen et al, 2007; n=79, 45 females, 34 males; mean age 81)

Cut-Off: >24 seconds was valid predictor of falls in people with hip fracture within the first 6 months after discharge

Norms:

Geriatric Rehabilitation:

(Brooks et al., 2006: n=52 subjects, 35 females, 17 males, admitted to geriatric rehabilitation program; mean age- 79.9 (7.7) years; means stay in rehab=1.4 (0.06) months)

Normative Data for Geriatric Rehabilitation				
	Admission		**Discharge**	
	Mean (SD)	**Range**	**Mean (SD)**	**Range**
TUG Score	31.9 (20.9)	8.6-117	21.2 (10.3)	7.7-51.4
FIM	86.6 (13.8)	54-120	109.5 (12.2)	62-124

(www.rehabmeasures.org)

Total Hip and Knee Arthroplasty

(Kennedy et al, 2005; n=150 patients, 69 THA, 81 TKA, mean age 63.7 (10.7) years)

	Pre-op, Mean (SD)	Post op <16 days, Mean (SD)	Post op, >20 days, Mean (SD)
TUG (sec)	9.8 (3.2)	24.7 (14.2)	10.3 (4.2)

SEM=1.07sec

MDC_{90}=2.49 sec

SEM= Standard Error of the Measure, Error within measurement

MDC=Minimal Detectable Change, Minimal change score beyond error

Orthopedic Rehabilitation

(Yeung et al., 2018; n=142 patients, 93 females, 49 male, 72 THR, 49 TKR, 21 Fx., mean age 64.9 (12.9) years.)

	Admission	Day 7-10	Discharge
TUG (sec)	63.4 (48.5)	34.7 (16.6)	22.7 (9.3)

SEM=10.2 sec

MDC_{90}=23.8 sec

Community dwelling Adults

Bohannan. (2006). Reference values of the timed up and go test: A descriptive meta-analysis.

Journal of Geriatric Physical Therapy, 29(2), 64-8.

Age Group	Time in Second (95% CI)
60-69 years	8.1 (7.1-9.0)
70-79 years	9.2 (8.2-10.2)
80-99 years	11.3 (10.0-12.7)

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Chapter 8:

Introduction

Outcome measures are valid and reliable performance based or self-reported assessments that evaluate actual or perceived ability of an individual to carry out activities or participate in daily life (Jette et al, 2009). The physical therapy profession has called for the use of outcome measures to optimize practice for many years (Deutsch, 2004). In 2006, the Research Section of the American Physical Therapy Association developed the Evaluation Database to Guide Effectiveness (EDGE) Task Force with the goal of making recommendations for the use of outcome measures (Field-Fote, 2015). However, in the most comprehensive survey on use of outcome measures, physical therapists (PTs) reported they do not routinely use them (Jette et al, 2009). Since Jette's (2009) survey, there has been continued emphasis on routine and standardized assessment by PTs across settings with increased utilization reported, but gaps in regularity in use remain (Burton, Tyson, & McGovern, 2013a; Sibley et al., 2011). To further address the need for standardized evaluation, knowledge translation synthesis tools such as the Rehabilitation Measure Database (www.rehabmeasures.org) (Moore, Raad, Ehrlich-Jones, and Heinemann, 2014), and PTNow (www.PTNow.org) were developed to make outcome measures more accessible and easier to implement.

Despite these efforts, there remain barriers to achieving routine use of outcome measures (Duncan and Murray, 2012). Lack of time and knowledge are the two most frequently reported barriers by health professionals (Duncan and Murray, 2012). Outcome measure use is also influenced by setting, organizational support, characteristics of the PT and the patient, and the outcome measure itself (Duncan and Murray, 2012). Considering these barriers and facilitators, knowledge translation (KT) studies are needed to determine the most effective ways to improve outcome measure use in physical therapy practice and overcome the context specific barriers and enhance facilitators to using outcome measures.

KT interventions have been designed to increase the use of outcome measures in the pediatric (Russell et al., 2010; Schreiber & Dole, 2012; Schreiber et al., 2015), outpatient orthopedic (Abrams et al., 2006; Stevens & Beurskens, 2010), inpatient stroke rehabilitation settings (Bland et al., 2013; Kall et al., 2016; Meerhoff et al., 2017; Van Peppen et al., 2009) and to measure reactive balance for patients at risk of falls (Sibley et al., 2016) with mixed success (Colquhoun et al., 2017). Knowledge brokering is one strategy used in KT to facilitate behavior change (Bornbaum et al., 2015; Glegg & Hoens, 2016). Knowledge brokers (KB) work with healthcare organizations to facilitate KT. KB have a working knowledge of the best evidence as well as clinical practice and can help create tailored interventions that overcome context specific barriers to implementing KT (Dobbins et al., 2009; Glegg & Hoens, 2016; Ward, House, & Hamer, 2009). KB have been used to implement outcome measures in pediatric and rehabilitation settings with success, but higher quality studies are needed to determine the effectiveness of KB as a strategy for KT (Rivard et al., 2010; Russell et al., 2010; Schreiber et al., 2015). Other KT strategies, such as education and audit and feedback, have been used to improve the use of outcome measures by allied health professionals, but there is often a lack of use of theoretical frameworks, control groups or case series for comparison, and description of intervention design which makes it difficult to determine which strategies are most effective (Colquhoun et al., 2017). Finally, KT interventions have primary been aimed at the clinicians, and outcomes should be assessed at the clinician, patient and organizational levels.

Dissertation Outcomes

The goals of this dissertation were to determine the immediate and longer-term effectiveness of a theoretically informed multi-modal tailored KT intervention designed and implemented by a knowledge broker as compared to a tailored intervention designed but not implemented by the KB on the use of a selected patient standardized assessment by PTs who work in rehabilitation. A secondary goal was to explore and compare the patients' experiences of being evaluated by the PTs involved in the KT study with the perceptions of those PTs.

STUDY ONE (Chapter 4 and 5):

In study one, we completed a quasi-experimental study that developed a complex, theoretically based KT intervention using organizational support, clinician input, and audit and feedback to engage the clinicians to co-create a locally tailored intervention facilitated by the investigators and guided by the Theoretical Domains Framework (Cane, O'Connor, & Michie, 2012; Michie et al., 2005; Michie et al., 2008). Eleven PTs who worked in one sub-acute rehabilitation hospital participated. After determining organizational support, we completed a mixed methods barrier assessment including a chart audit, questionnaire, and focus group with audit and feedback. The intervention was mapped using the Theoretical Domains Framework by the investigators (Michie et al., 2008).

The KT intervention was implemented by an external knowledge broker. The two-month KT intervention included education, documentation changes, printed material, audit and feedback, outreach visits, goal setting, and organizational support. Outcomes were primarily measured by chart audit to determine documented use of gait speed. In addition, focus groups at baseline, immediately following the intervention, and nine-month follow-up were used to determine barriers to using gait speed and perceptions of the intervention. Documentation of gait speed significantly improved from baseline (0%) to month-two at initial evaluation (mean=66%, SD=30%, F=48.212 p<0.001) and discharge (mean=65%, SD=30%, F=51.941, p<0.001) and at six-month follow-up for initial evaluation (Mean= 63%, SD 21%) and discharge (mean=59%, SD 32%). Eleven PTs in the focus group reported the KT strategies including documentation changes and social support helped facilitate their behavior change, but barriers to use remained such as lack of space and patient functional levels. A post hoc control/comparison group was added as the supervisor trained the non-consented and excluded PTs, which included part time, per diem and traveling PTs on the use of gait speed. Documentation of gait speed for the post hoc control group increased in months 4-6 (initial evaluation 24% and discharge 35%) and 6-8 (initial evaluation 25% and discharge 47%).

We discussed that the PTs significantly improved use of outcome measures following the intervention and reported the intervention facilitated outcome measure use although barriers to using gait speed remained. We also highlighted the impact the supervisor played, as she served as a local onsite champion and facilitated behavior change. We also discussed that some of the change may have occurred because of characteristics of the KB and relationship between the PTs and KB as well as the ease of documentation changes within the organization. The methods of study one were published in *Journal of Physiotherapy Theory and Practice* (Chapter 4). The outcome paper of study one is in review at the *Journal of Geriatric Physical Therapy* (Chapter 5).

STUDY TWO (Chapter 6)

In study two, we scaled our approach from study one to address gaps in the literature comparing two active groups, evaluating sustainability of the intervention, and using mixed methods for evaluation. We conducted a 10 month-mixed methods, randomized cluster trial at two acute rehabilitation hospitals within the same organization. We used an experimental and active control group to address a gap in the literature of an active comparison group (Colquhoun et al., 2017). We were also interested if the of number of times the KB interacted with each group (dosage) would play a role in the documented use of the outcome measure. The experimental group (fully supported implementation group) had support to design and implement the intervention and the active control group (partially supported implementation group) had support from the KB to design the intervention only. The KB met with the experimental group at baseline, month 1, 2, 3, 4, and month 10 and met with the active control group at baseline, month 1,3 and month 10. The active control group (partially supported implementation group) met separately at months 2 and 4 to self-implement the intervention strategies and were provided with a meeting outline by the KB.

Following the same methods from study one, we used the KTA Framework (Graham et al., 2006) to guide the overall process, the Theoretical Domains Framework (Cane et al., 2012; Michie et al., 2005) to guide barrier assessment and intervention design. Quantitative outcomes were evaluated through chart audit and Goal Attainment Scale (Kiresuk et al., 1994). We added the Consolidated Framework for Implementation Research (CFIR) for qualitative data analysis (Damschroder et al., 2009). The organizational leadership identified PTs from the orthopedic team to participate in the intervention as they were using the least amount of outcome measures compared to other teams in the organization. We conducted a mixed methods barrier assessment using chart audits, questionnaire and a focus group. Intervention strategies were mapped using the TDF and brought to the participants for feasibility. The participants selected an outcome measure to implement based on consensus. The experimental group selected the timed up and go (TUG) and the active control group selected the 10-meter walk test (10MWT).

The intervention for both groups included a goal development, engagement to select the outcome measure, selection of a location to perform the test and a location to document as well as audit and feedback. For the experimental group, the KB synthesized literature on the TUG and provided a handout and a quick reference sheet, started a binder and tracking sheet and guided the PTs to document in a consistent place. A local opinion leader for the experimental group updated the tracking sheet and sent out monthly reminder emails. The active control group was responsible for synthesizing the literature independently, printed out relevant articles, laminated charts, and discussed gait speed. They also created their own tracking sheet and purchased equipment for a removable track.

Chart audit for both groups revealed early partial adoption of the outcome measure which declined across time. At month 2, experimental groups documented use of the TUG, rose from 2% at baseline, to 58.2% at initial evaluation (IE) and 25% at discharge (DC) but dropped at month 4 to 17.6% and 9.5% and month 8-10 to 11.8% and 2.7% at IE and DC respectively. For the active control group, documented use of the 10MWT at month 2 chart audit rose from 4%

and 0% at baseline, to 46% and 19.4% and at month 4 use continued to rise to 50% and 33%, but dropped to 2.8% and 0% at IE and DC respectively. Chart audits also revealed a limited number of charts available for data analysis as well as a limited range in the number of available charts from 0-14 across time points by consented PTs. The pre-planned analyses including factorial ANOVA and RM ANOVA could not be conducted due to differences in baseline characteristics between groups, the limited number of charts, and decreased number of PTs ability to evaluate patients across time points.

Due to the issues with interpretation of quantitative data, problems with comparison of groups from scaling the approach, and the complexity of the intervention and changes seen in the organization, another method to evaluate the outcome was needed. A realist evaluation was selected and conducted to determine the relationship between the organization, intervention and outcome. A realist evaluation has been described as an evaluation technique that opens the “black box” of KT and attempts to explain the causal relationships between the intervention, context and outcome (Salter & Kothari, 2014). A realist analysis is a logic of inquiry that attempts to answer the question “what works, for whom, under what circumstances… and why?”(R. Pawson & Tilley, 1197; R. Pawson & Tilley, 2004). Realist analyses identify mechanisms (M) or processes in which intervention strategies work, the context (C) in which those mechanisms operate, and the outcomes (O) that are produced. First, a program theory or the theory used to with the selected intervention should be selected to be tested. Our program theory was the Theoretical Domains Framework. Next, hypotheses are formed through consideration of the context, mechanism and outcome (C-M-O configurations) and the hypotheses are tested (Salter & Kothari, 2014). After the study is conducted, the interaction between C-M-O are then reviewed through a rigorous consensus process and summarized. The final products are refined hypotheses within C-M-O configurations for future investigators to test.

“Our Realist Evaluation differed from a Realist Analysis in two ways:

1. A framework (TDF) was used to define program theory rather than individual theory. The aim of the KT project was to use the TDF to guide the barrier assessment and intervention development and therefore we did not determine each individual theory used to develop the domains of the TDF for the Realist Evaluation, but evaluated the domains of the TDF as a whole.

2. Mechanisms were defined as interventions, not as processes in which interventions work. We defined Mechanisms as Interventions because frameworks, which highlighted the interventions not processes, were used to develop the intervention and analyze the outcome. The TDF consensus matrix was used to map barriers to recommended intervention strategies and the analysis of the interventions using the CFIR codebook rated the interventions’ influence on the outcome. The focus on the intervention strategies in both the TDF and CFIR guided our decision to define the Mechanisms as Interventions rather than evaluating the processes in which the interventions work in a typical Realist Analysis.”

Before conducting the realist evaluation, all focus group data were coded using the Consolidated Framework for Implementation Research (CFIR) (Damschroder et al., 2009). The CFIR contains five major domains with 37 constructs including: intervention characteristics, outer setting, inner setting, characteristics of the individuals and process (Damschroder et al., 2009). The inner setting is defined as the structural and cultural context, while the outer setting is defined as economic, political and social environment in which the organization resides. Intervention characteristics includes the strength and quality of the evidence, the source of the innovation, and ability to adapt and trial the innovation. The process includes the planning and engaging of individuals involved in the implementation. Characteristics of the individuals includes attitudes, confidence and stage of behavior change (Damschroder et al., 2009). The CFIR was developed through identifying domains of several implementation theories and creating general domains that influence implementation research. The CFIR can be used to describe what works for whom, but it does not allow for causal associations among constructs (Damschroder et al., 2009). The CFIR works within a realist evaluation as all of the constructs can be coded into context and mechanism. Codes were moved into context and mechanism and analyzed using a realist evaluation to determine the interaction and causal relationships between mechanisms and contextual factors and their influence on the outcome. The CFIR was selected as framework for analysis because of the multiple contextual factors that could be coded using the CFIR code book(Team., 2014) http://www.cfirguide.org/tools.html. In addition, the CFIR constructs are also rated on valence (positive, negative, mixed or no influence) and strength (1 or 2) which was useful when identifying the causal relationships of the context and mechanism and the outcome (Damschroder et al., 2009).

The realist evaluation was conducted on the KT intervention and determined the mechanistic and contextual factors that lead to early adoption and decline over time of a selected outcome measure at both sites. Early positive contextual and mechanistic factors lead to early use of the outcome measure. The experimental group discussed reasons for non-use of the TUG because of decreased believe in the value of the test to inform clinical practice and evaluate patients (Knowledge and Belief). The early engagement by the partially supported group overcame barriers of available resources and complexity of the intervention. The active control group discussed issues with lack of space to complete the test (Available Resources) and patient case mix changing (Compatibility) as a result of the Bundled Payment for Care Improvement Initiative created by the Affordable Care Act (https://innovation.cms.gov/initiatives/bundled-payments) (External Policy Changes). The realist evaluation identified a lack of organizational contextual factors assessed during the barrier assessment that were coded by the CFIR and did not exist in the TDF. The realist evaluation found changes in contextual factors with lack of mechanisms directly impacted the outcome.

The revised CMO configurations replaced the TDF with the CFIR domains concluded:

- Early use will be seen with positive mechanisms (Planning, Engagement and Evidence Strength and Quality) and positive contextual factors (Knowledge and Belief, Compatibility),
- Decreased use will be seen with negative contextual factors including External Policy Changes which impacted Compatibility of the intervention and PT's knowledge and belief about the innovation

The Realist Evaluation found that multiple contextual and mechanistic factors that into play at different time points that interacted and influence the outcome. The Realist Evaluation highlighted the need for a formal assessment of the organization and external health care policies to plan for any anticipated changes, and the inclusion of organizational leadership throughout the implementation process to build flexible interventions to adapt to the changing healthcare environment. In addition, the inclusion of trialability in order to select the correct outcome measure to select, and more capacity building strategies to enhance enthusiasm and buy-in. Last, we attempted to control the amount of times the KB interacted with the PT's for comparison, but what we found is that randomization and control may not be the ideal study design for complex behavior change interventions.

STUDY THREE: Chapter 7

In study three, we explored the patient perceptions of being evaluated and treated for walking using the Timed Up and Go by physical therapists while in inpatient rehabilitation and compared those experiences with the beliefs of the PTs who treated them. Four patients were recruited in the six-month recruitment window. Due to recruitment issues, three patients participated in a focus group and one participated in an individual interview. Six PTs participated in a focus group meeting where questions were asked on their personal views of using standardized outcome measures as well as patient beliefs of outcome measures. Semi-structured interview questions were used to explore perceptions.

The patients reported using social support from other patients and the PTs for motivation. When asked about standardized assessments used in physical therapy, the patients reported on the use of vitals and observation of functional activities as compared the standardized assessments like the Timed Up and Go. The patients discussed priorities for walking including the distance they walked and ambulating independently. The PTs believed the patients would not remember the TUG. Both the patients and the PTs valued the distance the patient ambulated over the time they walked. The PTs also reported difficulty interpreting the test scores to the patient and the decreased utility of the test to help make clinical decisions.

Limitations, Considerations, and Comparisons

The first study had several limitations including small sample size, a single study site, lack of randomization and control which we attempted to address in study two. The feasibility of doing KT without investigator support was limited, in study one, as the development, implementation and analysis of the intervention was time consuming (40+ hours). We attempted to address some feasibility issues in study two by analyzing only a sub-set of charts as well as comparing dosage, or number of times, the KB needed to interact with the PTs. We aimed the intervention at the PTs and middle management in study one and we concluded that future interventions may also intervene both at higher level management and the patient level. We made suggestions to use an organizational readiness assessment, such as the Organizational Readiness for Implementing Change (Shea, Jacobs, Esserman, Bruce, & Weiner, 2014) or the Implementation Leadership Scale (Aarons, Ehrhart, & Farahnak, 2014; Aarons, Ehrhart, Torres, Finn, & Roesch, 2016) to help determine the fit between the KT intervention and the organization. Unfortunately, with the complexity of scaling the approach we were unable to assess organizational readiness in study two.

STUDY TWO Limitations

The major limitations in study two included some of the methodological decisions made which lead to difficulty with comparison. The lack of organizational leadership involvement in the study and changes in the contextual factors over time lead to inability to evaluate what was happening within the organization and lack of flexibility to address contextual issues as they developed. In study one, the supervisor as a participant and the KB's ability to complete chart audits allowed the KB to informally assess the KT intervention. More chart audits may have given us a better picture of what was happening with use. Some changes that occurred during the study which were difficult to address as we didn't know in advance included: patient case mix changed as a result of Medicare's Bundle Payment Program, PTs rotated teams, census fluctuation, PTs not involved in the study were evaluating the patients with orthopedic issues, and construction of one gym caused the PTs to rotate to different floors.

We attempted to address some of the issues seen in study one with lack control and randomization, but due to complexity of the organization and the study, the planned randomized controlled study became a case series with an experimental group and active control. We wanted to compare the differences between groups with dosage of the KB and hypothesized that the experimental group who had more interactions with the KB would increase their use of the selected measure greater than the active control group. This was not true as the active control group documented their selected measure as much as the control group at month 2 and sustained it at month 4, where the experimental did not. Due to the complexity of the study it was hard to determine if dosage really played a factor. There were contextual differences between the two sites which led to difficulty with comparison of the intervention.

Finally, through the realist evaluation we were able to determine some of the reasons why the clinicians declined in the use over time, but I lacked formal methodological training in realist evaluation and coding using the CFIR. The realist evaluation also analyzed two cases with a limited sample size and limited number of patients available to complete the measure. The chart auditor was an internal person and although training was provided, reliability could not be assured. The focus groups did not evaluate the reasons the PT's were more likely to use the selected measure at initial evaluation as compared to discharge throughout the course of the study.

Study Three Limitations

The major limitation to this qualitative study was the limited sample size which decreased saturation and generalizability of the findings. Our goal was to recruit up to 16 patients who had the TUG measured on them at initial evaluation and discharge. We also hoped to recruit from both the fully supported group and the partially supported group to compare, but we were unable to recruit any patients from the partially supported group. After six months of recruiting, we were only able to recruit six participants, four who participated and two had the TUG recorded in their charts. There were multiple recruitment issues including: patients had not signed the hospitals form for agreement to be contacted for research purposes, training and availability of the PT who recruited patients, a low census and PT perceptions of lack of clinical utility of the measure which lead to a deceased number of patients for recruitment. Our goal of for study three was to compare patients treated by PTs in both groups across time points to determine if there was a change in education on their selected measure. The multiple recruitment issues lead to changes in study design to include only patients treated by PTs in the experimental group and comparing those patients with perceptions of the PTs.

Comparisons between Study one and Study two

Table of Comparisons of Pilot Research and Randomized Cluster Trial:

	Pilot	**Randomized Trial**
Organizational	Small Organization	Large Organization
	Paper documentation easily adapted	Cannot change documentation
	Culture for change	Culture of research
PTs	Lack of confidence and use of outcome measures	Confidence and prior use of outcome measures in other patient populations
Study Design	All patient populations	Patients with orthopedic diagnoses
	All Therapists	Orthopedic Team Therapists Only

	Local Opinion Leader -Supervisor	Local Opinion Leaders -Clinicians
	Supervisor facilitation	No organizational facilitation
	KB chart audits	Separate investigator completed chart audits

Organizational and Therapists Differences

There were many differences that contributed to the success of the pilot research and possible lack of behavior change over time in the second study. The pilot research was successful based on a number of contextual factors including: smaller organization where the paper documentation was easily adapted, tracks were easily added with tape to the floors and the supervisor, who treated patients, was a participant in the study. As the size of the organization was smaller, all therapists and all patients were included in the study. Including all PTs may have enhanced social support and may helped with PTs getting into a routine of completing the measure.

All of these factors were not in place for study two. The size of the organization led to changes in study design from the pilot. The large size of the organization and large number of patients being admitted to the rehabilitation hospital lead to decisions to limit the PTs and patient population. PTs were included who were treating on the orthopedic teams and only patients with orthopedic issues were included. The organization believed this patient population and PT team would be more open to completing outcome measures than neurologic teams because of other requirements to complete outcome measures. We are unsure if the PTs actually perceived lack of outcome measure use was a problem or if involvement in the study was primarily because the PTs were interested in participating in research. Limiting the patient population also helped the organization conduct chart audits, but lead to issues when PTs rotated to different units because of census fluctuations which limited the number of charts available to audit. In addition, the patient's complexities changed during the study because of the Affordable Care Act which limited number of appropriate patients to complete the measure and competed with the intervention.

Starting with one outcome measure is a scaled approach recommended by the TDF as a way to increase confidence. This approach worked well for the PTs in the pilot as they reported they weren't confident with outcome measures. We used the same approach in the second study with clinicians who were confident with outcome measures and had reported using several of them with other patient populations. It is possible if the PTs could have selected from more outcome measures, we would have seen a different result in use.

Differences in study design

The sub-acute rehabilitation hospital where the pilot project was conducted had a culture of change and embraced collaboration and engagement with the PT staff. Several projects were in place that started bottom-up for example a stretching/exercise program that was started by the PT staff and instituted hospital wide. The rehabilitation hospital was used to a top-down approach as the size of the hospital made it more difficult to implement projects from the bottom-up. The bottom-up approach of the study design may have been the wrong approach at the hospital, as more organizational support was needed to implement change. In addition, the KB was allowed to do chart audits in study one, which may have served as a reminder to the PTs to complete the outcome measure. The chart audit at the pilot allowed the KB to get to know the PTs better and may have improved the outcome. In study two, the chart audit was conducted by an internal PT and not the external investigator which made it difficult for the KB and investigators to assess what was happening inside the organization. In addition, reliability of the chart audit could not be assured. For the second study, we decided to select clinicians to help as local opinion leaders as supervisors were not part of the study. The PTs helped facilitate meetings, coordinate consent processes in study three and encouraged the PTs to complete the outcome measure, but did not have the same authority over the PTs as the supervisor did in the pilot study.

FRAMEWORKS

We added a third framework to assist with data analysis in the second study. The three frameworks were used to design, implement and analyze the data because of the recommendations of the need for multiple frameworks to guide the KT process, barrier assessment, intervention development and evaluation to most accurately understand the complexity of behavior change interventions (Graham et al., 2006; Straus, Tetroe, & Graham, 2013). The KTA framework, was designed to evaluate the process of moving evidence into practice and based on planned action theories. The KTA framework was helpful to guide the overall implementation process, but the second study design should have included more iterative steps during the 6-month follow-up to continue to assess barriers and tailor the intervention. We used TDF to assess barriers to implementation and inform intervention design. The TDF was helpful to evaluate individual barriers and facilitators, but it was limited in assessment of organizational barriers and development of organizational intervention strategies seen in study two. The only TDF organizational factors assessed were environmental resources (space and time) and social influences. The CFIR was used to analyze the qualitative data from the 10 focus groups. Through the CFIR coding and the realist evaluation, new organizational factors were coded including external policy changes, compatibility, and relative priority. The CFIR coding helped identify organizational factors that influenced the outcome of the intervention. We determined a limitation in the TDF through using the CFIR for coding as that there were a lack of organizational constructs assessed in the TDF. If more organizational constructs were evaluated at baseline, a possible intervention could have been developed to address the barriers identified using the CFIR for analysis. This is why we removed the TDF from the revised C-M-O configuration. To highlight the contextual, mechanism and outcomes between frameworks a chart was developed:

Table of Comparisons of Frameworks

	KTA	TDF/ Consensus Matrix 14 Constructs	CFIR-5 domains: 33 constructs.
Context-individual		Knowledge Skills Social/professional role and identity Beliefs about capabilities Optimism Beliefs about consequences Reinforcement Intentions Goals Memory, attention, and decision processes Emotion Behavioral regulation	*Characteristics of the Individuals* -Knowledge and Beliefs about the innovation -Self-efficacy -Individual Stage of Change -Individual ID within organization -Other personal attributes

Context-Organization	-Identify the problem -Determine the know do gap -Adapt knowledge to local context -Assess Barriers and Facilitator to Knowledge Use	Environmental context and resources Social influences Reinforcement	*Inner Setting* -Structural Characteristics -Networks and Communications -Culture -Implementation Climate Tension for change Compatibility -Relative Priority -Organizational Incentives and Rewards -Goals and Feedback -Learning Climate -Readiness for Implementation -Leadership Engagement -Available Resources -Access to knowledge and information *Outer Setting* -Needs and Resources of those served by the organization -Cosmopolitanism -Peer Pressure -External Policy or Incentives

Mechanism	Select ,Tailor, Implement Interventions	Consensus Matrix used to match contextual factors with recommended interventions	*Characteristics of the Innovation* -Innovation Source -Evidence strength and quality -Relative Advantage -Adaptability -Trial-ability -Complexity -Design Quality and Packaging -Cost *Process* -Planning -Engaging -Opinion Leaders -Formally Appointed Internal Implementation Leaders -Champions -External Change Agents -Key Stakeholders -Innovation Participants Executing Reflecting and Evaluating
Outcome	-Monitor Knowledge Use -Evaluate Outcomes -Sustain Knowledge Use		

Generalizations

This research supports the need to build KT interventions that are tailored to the organization and that implementation using organizational support and clinician engagement is needed (Duncan and Murray, 2012). The use of an external KB to help with outcome measure utilization does have some influence on clinician's behavior, but an internal champion at a management level is also needed for sustainability.

Future Research

Ideas for future research projects include:

1. The development a KT project using a barrier assessment and intervention development that includes the clinician and organizational level
2. The use of the CFIR to assist with barrier assessment and design of a KT intervention
3. Evaluation of outcomes of a KT intervention on outcome measure use at the patient and organizational levels
4. Determining the value and comprehension of outcome measure results by patients seen in PT
5. Developing and evaluating strategies to interpret results and education patients on the standardized assessment used in therapy in order to make shared decisions.

Summary

This research adds to the body of knowledge on KT interventions aimed at outcome measure utilization by evaluating the efficacy of a longer term KT intervention using an external KB with an active control group. In addition, the evaluation of KT intervention using the CFIR and realist evaluation is new to physical therapy KT research. We have found that contextual/organizational factors influence the selected mechanisms and this influence changes over time.   Future KT intervention need to include organizational support to design and implement KT interventions. Last, understanding patient experiences while they are being evaluated and treated by PTs and understanding PT perceptions may help support new education on communication techniques and future training.

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Appendix A: Development and validation of the facilitators and barriers to evidence based practice and standardized assessment questionnaire.

Background and purpose:

Strategies to implement evidence into practice and improve the use of standardized assessments have shown modest to moderate effects (Grimshaw 2012, Scott, 2012). This is in part because implementation strategy design is often not based on assessment of barriers. This assessment is essential to determine both the facilitators and barriers that influence behavior change. Several authors have suggested that the use of theoretical frameworks is needed to determine more effective implementation strategies (Michie et al., 2005; Scott et al., 2012). The Knowledge to Action (KTA) framework was created using over 31 planned action theories, and it identifies activities that are needed to implement evidence into practice (Graham et al., 2006).

The implementation of the KTA framework includes assessing barriers and facilitators prior to implementing interventions to change behavior. The framework proposes that by understanding barriers and facilitators to using evidence, researchers can select, tailor, and implement successful interventions. Therefore, barrier assessment tools need to be designed to accurately identify barriers so behavior change interventions can be tailored appropriately.

There are many approaches to measure barriers, such as questionnaires, semi-structured interviews, and focus groups (Bekkering, Hendriks, et al., 2005; Bekkering, van Tulder, et al., 2005; Kerr et al., 2010). Several questionnaires that have been created and modified to measure the baseline knowledge, attitudes, confidence, skill and behaviors of evidence based practice (Jette et al., 2003; Salbach, Guilcher, et al., 2011b; Salbach & Jaglal, 2010; Salbach et al., 2007). Other questionnaires, with a more specific focus, on barriers and facilitators of using outcome measures have also been designed. Questionnaires are typically developed and designed iteratively. One of limitations of the existing questionnaires' is the lack of theoretical basis that inform design (Michie et al., 2005). The creation of a tools that are theoretically based on "behavior change theories can enhance understanding of the behavior change process inherent to implementation interventions" Michie et al. (2005). Tools need to be developed using theoretical rationale that consider the determinants of behavior change to improve the success of implementation interventions.

Another issue with current barrier assessment strategies, is the lack of measuring barriers in the local context. This is a step in the KTA framework, adapting the knowledge to the local context. Generic implementation strategies do not effectively apply new knowledge because they don't consider the key stakeholders in the setting where they work. This is true for barrier assessment as well. Investigators who completed barriers assessments on the actual clinicians in the environment in which they work often report positive behavior changes (Demmelmaier et al., 2012; Russell et al., 2010; Wiechula et al., 2009). Whereas literature that used barrier assessments based on a general sample of health care workers, often lacked behavior change (Bekkering, van Tulder, et al., 2005; Bernhardsson, Larsson, et al., 2014; Campbell et al., 2013; Kerr et al., 2010). Local stakeholders may be able to effectively assess barriers because they take into account the multiple factors that are both hierarchical (at different organizational levels) and dependent on the context.

Similar to implementing EBP strategies, applying standardized outcome measures in practice also has its challenges. Standardized outcome measures are valid and reliable, self-reports or performance based measures. They are used to determine need for therapy, determine patient progress, determine the outcome of an intervention, and communicate with the family or health care team (Jette et al., 2009). Lack of knowledge of outcome measures, lack of time to use the measures and lack of perceived value have been the major challenges to using standardized outcome measures (Duncan & Murray, 2012).

Evidence based practice and the use of standardized outcome measures are typically studied separately. However, in order to select, implement, and interpret standardized outcome measures, one must have the fundamental skills of EBP (Fetters & Tilson, 2012). By identifying gaps in EBP and use of standardized outcome measures, researchers may be able to create behavioral change interventions to address both and be more successful at changing behavior than doing them separately. Therefore, the purpose of the study was to create and validate two theoretically based questionnaires designed to measure the facilitators and barriers to using evidence based practice and standardized outcome measures. Once validated, these questionnaires will be used to design and measure the effective of KT interventions.

Methods:

Existing questionnaires that assess the facilitators and barriers to (1) EBP and (2) using standardized outcome measure questionnaires were identified with the intent of modifying them based on the Social Cognitive Theory and the Theoretical Domains Framework (TDF) (Bandura, 1977; Michie et al., 2005). The modified questionnaires were validated in two studies. Study one validated both questionnaires using a modified Delphi process in two phases. The modified Delphi method questions a panel of experts in two or more phases. In each round the researchers gather the results on the questionnaires and redistributes the findings to the experts for their response. This method continues until consensus is reached (Portney & Watkins, 2009) In Phase 1: the evidence based practice questionnaire and the standardized outcome measure questionnaire were sent to experts to assess face and content validity. In phase 2, both questionnaires were sent, with findings from phase one, to all experts to establish consensus. In study two, the final updated questionnaires were sent to end users to determine sensibility, which consists of face and construct validity and usability.

EBP: Theoretical Framework and Questionnaire Modification:

The evidence based practice questionnaire created by Jette et al. (2003) later modified by Salbach et al. (2007) was modified based on the SCT. The SCT proposes that confidence is the most important prerequisite for behavior change (Bandura, 1977). The original questionnaire contained five sections including: attitude, confidence, access to resources, educational preparation and barriers. The evidence based practice confidence scale (EPIC) by Salbach et al. (2010) was used in place of the confidence section of the Salbach et al. (2007) questionnaire because EPIC was validated for use by physical therapists. The EPIC asked participants to rate from 0-100% how confident they felt about eleven different EBP activities. The attitude section of the original questionnaire was also removed based on the previously established positive attitude of EBP by allied health professionals, it was deemed an unnecessary domain to assess (Duncan & Murray, 2012; Jette et al., 2003; Jette et al., 2009).

A new section on behavior, based on the capabilities and reinforcement constructs of the SCT, was created by the research team. It follows the steps to EBP (ask, search, appraise, apply and evaluate (Sackett et al., 1996). The final modified questionnaire contained five sections: two were new or modified (confidence, behavior) and three were from the original questionnaire (educational preparation, access to resources and barrier).

Theoretical Framework and Questionnaire Modification: Standardized Outcome Measures

The barriers and facilitators of using standardized outcome measures questionnaire was modified from a previous questionnaire (Swinkels et al., 2011). Questions were added based the TDF and a literature review that identified barriers and facilitators to using outcome measures (Duncan). A section on standardized assessment confidence and use was added based on SCT.

The TDF was created for in implementation research through an expert consensus and it combines 33 psychological theories (including organizational, motivational and action) that determine the domains that explain behavior and behavior change. The TDF has linked the domains through a consensus matrix with recommended behavior change techniques for implementation research (Michie et al., 2008). Once barriers are determined, interventions can be created through the consensus matrix to address health practitioner behavior. Questions were placed in eight of the fourteen constructs of the TDF which included: knowledge, attitude (motivation and goals), confidence (beliefs about capabilities), skill, behavior, social influences (social/professional role and identity), environmental context and resources, and beliefs about consequences. Participants were asked to rate statements from strongly disagree to strongly agree on a five point Likert scale in each of these domains.

The two modified questionnaires (1) Evidence Based Practice and (2) Use of Standardized Outcome Measures) were upload to SurveyMonkey® and two studies were completed to determine sensibility. This study was approved by the Rutgers University of New Jersey Institutional Review Board.

Study 1:

Participants for study one were purposely recruited based on their expertise in either evidence based practice or standardized assessments. Experts were defined as physical therapists whose scholarly agenda included evidence based practice or standardized assessments. Expert activities included: teaching EBP, presenting on EBP or standardized outcome measures at peer-reviewed conferences, publishing research articles, publishing book chapters or text books on EBP or standardized outcome measures, or acted as editors for EBP or standardized outcome measure websites.

Phase 1: Face and Content Validity

Experts were asked to review the questionnaires to determine face and content validity (Portney & Watkins, 2009). Experts were recruited via email and viewed the questionnaire and responded to validity questions via SurveyMonkey®. Responses to all questions were captured via free text.

Questions included:

- Was the domain completely covered?
- Were response categories adequate?
- Were instructions clear and easy to understand?
- Were questions clear and easy to understand?
- Were items repetitive or redundant?
- Were items missing?
- Were items out of order?

Open comment fields were available for participants to provide additional feedback. Participants were allowed one month to complete the first round. At the conclusion of phase one, the data were exported from SurveyMonkey® and feedback was gathered about the questionnaires.

Phase 2: Both revised questionnaires were sent via email to all experts who completed phase one.   Changes and new questions were highlighted and comments from the experts were placed throughout the in the revised questionnaires.

Participants were invited to write in track changes or comment directly on the survey in order to determine need for further phases or to meet consensus. Participants were asked to complete phase two within two weeks from the original email. Experts were asked which term they preferred for standardized outcome measures from a list including standardized assessments, standardized assessment tools, standardized outcome measures, and outcome measures.

Results:

Face and Content Validity:

Participants: Five out of 10 participants completed the EBP questionnaire (50%) and 4 out of 12 (25%) completed the standardized assessment questionnaire. Participant has a wide range of experience in the field of EBP and SA. Examples of expertise by participant are listed below.

Evidence Based Practice:

Participant	Expertise
1	EBP curricular guidelines task force, textbook on EBP, multiple articles
2	EBP curricular guidelines task force, textbook on EBP, multiple articles, PTNow editor
3	EBP curricular guidelines task force, grants for EBP work, presenter on EBP
4	EBP curricular guidelines task force, textbook on EBP, multiple articles, PTNow editor,
5	multiple articles and presentations on EBP, PTNow editor

Standardized Outcome Measures:

Participant	Expertise
1	Journal Editor, PTNow editor, textbook chapters

2	EDGE group Co-Chair, Section leader for outcome measurement Rehabilitation Measures Database contributor, PTNow Editor, several articles and presentations
3	Journal Editor, PTNow editor, textbook editor, several articles on measurement
4	Rehabilitation Measures Database Editor, several articles on measurement, several presentations on measurement

EBP survey:

Based on the first round of feedback five questions were added, nine questions were re-worded and instructions were refined (Supplementary Material: Questionniare). No disagreements between experts were identified. Several comments were made about the scale used to measure behavior and evidence based practice. The proposed scale asked participants to rate what percentage of the time they completed evidence based practice activities.   Due to the number of comments, an additional question was added to phase two to determine which scale (number or percentages) participants preferred. Recommendations for missing items under the behavior section included three new questions about types of research clinicians use to inform practice (such as individual research articles, clinical practice guideline and systematic reviews). Under availability of resources, additional questions were added about access to full text articles. Question clarity was also refined through this process. (See Questionnaire)

Standardized assessments:

Based on the first round of feedback ten questions were added, definitions were added to each domains and the definition of standardized assessments was modified. Questions on choosing, administering, interpreting and documenting were added to knowledge, confidence and skill domains. Definitions were added to each section using Webster-Merriam online dictionary ("Merriam-Webster Dictionary," 2014). Participants identified several missing questions from the environmental context and resources domain. In response to the feedback nine questions were added that included barriers such as time, equipment, access to measure, healthcare policies, and documentation.

Phase 2: Both the SA and EBP revised and annotated questionnaires were sent to the experts that completed phase one (n=9) for further feedback. One additional question was added to the evidence based practice questionnaire behavior domain to determine the preference of the scale used. Five of the nine original experts provided feedback on both questionnaires. Consensus was achieved as all experts agreed that the domains were completely covered. Eighty percent (n=4) recommended that the scale used to measure EBP behavior should be changed to numbers of times in the past eight weeks. Sixty percent suggested removing a question under the EBP availability of resources. Only minor changes were suggested from participants on phrasing of items. As a result of phase one and phase two, six new questions were added to the EBP questionnaire, 9 were revised and one was eliminated and for the standardized assessment questionnaire 20 new questions were added, 6 were revised and one was eliminated.

There was no consensus on the best term to use to define standardized assessments. One participant commented: *"I think it depends on what types of tools you are specifically interested. An outcome measure needs to be administered at least twice, an assessment could be used once to provide detailed information about a specific construct area."*

	Round 1 (n=4)	Round 2 (n=5)
Standardized Assessment	1	1
Standardized assessment tool	1	1
Outcome measures	1	1
Standardized outcome measure	1	2

STUDY 2:

METHODS

Sensibility

Study two was created for end-users to complete the questionnaire and answer questions on sensibility, which is defined as face and content validity as well as ease of use. Participants were selected from a sample of convenience. They were physical therapists who work as adjunct faculty and were recruited to participate. A recruitment email was sent to seventeen possible participants via SurveyMonkey® explaining the study. Consent was implied by completion of the questionnaire. Nine participants (53%) completed the questionnaire. The questions were adapted from the Sensibility Questionnaire by O'Brien et al. (2013). This questionnaire was based on Feinstein's Sensibility Framework (Feinstein, 1987; O'Brien et al., 2013) and contains three parts (face validity, content validity and easy of usage) (see table below). End users were asked to rate on a five point Likert scale, strongly disagree to strongly agree about questions on sensibility. End users were also asked which term they preferred for standardized assessments.

Sensibility was established if the median score was greater than or equal to 4/5 on the Likert scale or greater. Free text fields were available throughout the sensibility questionnaire.

Sensibility Results: Of the seventeen participants emailed, nine (53%) end users completed the questionnaire and reported on sensibility. The participants ranged from 24 to 62 years old, with 3 months to 39 years of experience, worked in a variety of settings (see table.)

Age mean (s.d)	37 years (13)
Gender n (%) Female Male	 6 (66%) 3 (33%)
Experience mean (s.d.)	13.7 years (13.7)
Setting n (%) Acute care hospital Sub-acute/SNF Outpatient Home Care	 5 (56%) 1 (11%) 2 (22%) 1 (11%)
Specialization n (%) NCS GCS	2 (22%) 1 (11%) 1 (11%)
Certification n (%) LSVT Hand Therapist Athletic Trainer	3 (33%) 1 (11%) 1 (11%) 1 (11%)

The median sensibility data for both the EBP and SA questionnaire was 4.5.

	Evidence based practice Median	Standardized Assessments Median
I was able to answer all the questions	5	4.5
The instructions were clear and easy to understand	5	4.5
The questions were clear and easy to understand	5	5
The response categories were adequate	5	Not assessed
The lay out of the response categories was adequate	5	Not assessed
The overall questionnaire made sense	5	5
The instrument included items that were repetitive or redundant*	4	4
There were missing items in the questionnaire that should have been included*	4	4
Some of the questions seemed out of order*	5	4
The questionnaire took me too long to complete	4	4
The survey required too much effort to complete*	4	4.5
Was the SurveyMonkey® tool appropriate?	5	4.5
TOTAL	4.6	4.6
*reverse coded		

Only seven people completed the answer on how to define standardized assessments and outcome measure was selected 57% of the time. Two participants commented "Validated and Standardized Assessments" and "I don't have a preference."

	N
Standardized Assessment	0
Standardized assessment tool	1
Outcome measures	4
Standardized outcome measure	0
Other	2

Discussion:

The aim of this study was to design and validate two theoretically based questionnaires on barriers and facilitators to practicing evidence based and using standardized outcome measures by physical therapists. Findings from this study support the face and content validity and ease of use of the two questionnaires. The multiphase process created a 35 item facilitators and barriers EBP questionnaire and a 50 item facilitators and barriers to using standardized outcome measures questionnaire. The use of theoretical frameworks informed the survey design. Expert feedback generated new items, suggested revisions and eliminated questions.

The substantive additions of the EBP survey revision are behavioral and confidence domains to the EBP survey. These domains will inform the design of interventions by identifying in the local context the specific deficiencies in self-efficacy that may need to be addressed prior to explicit behavior change

The specific changes to the standardized outcome measure survey were in the “Environmental Context and Resources” domain. Environmental context and resources includes any circumstance of a person’s situation or environment that influences their behavior. Feedback from experts added several new questions on environmental barriers to using standardized assessment. In addition, recommendations to add the steps of findings, selecting, using and documenting on standardized assessments were added to the knowledge, confidence, and skill domains. The addition of these questions may help guide interventions that change the environment, improve education, and encourage rehearsal. By identifying barriers or facilitators to using standardized outcome measures, researchers can address those factors when designing an intervention.

Interestingly, the experts and the end users did not agree on a term for standardized outcome measures or standardized assessments. The end users selected outcome measures most frequently (5 times), but one expert commented that outcome measures need to be completed at least twice in order to be an outcome measure. The experts did not have one term that was selected more than others. The lack of consensus in terminology needs further investigation.

The findings of this study support that survey design are consistent with an iterative process. Through validation, we were able to combine and modify previously reported questionnaires that may be later used to assist in KT intervention creation. By using theoretical frameworks the use of the questionnaires may guide interventions design, with the ultimate goal of creating efficacious interventions. The theoretical domains framework was created through expert consensus using over 30 motivational, organizational, and action theories (including the Social Cognitive Theory). The framework was designed to assist with implementation research, and that is why it has suggested questions for barrier assessment as well as recommendations for interventions that match barriers (Michie et al., 2005; Michie et al., 2008). The TDF may be instrumental in future intervention design.

Limitations: The sample used for sensibility was limited in size and practice setting. There were only 9 end users who participated and the majority practiced in acute care setting. Other limitation was that sensibility was determined only through a survey. Other survey validation studies establish sensibility through surveys and interviews. By using interviews, the research team can listen to feedback directly from the end user. Salbach et al. (2010) highlighted how interviews improved the clarity of questions in the Evidence Based Practice Confidence Scale. O'Brien et al. (2013) used both surveys and interviews to determine sensibility.

Conclusion:

This study supports face and content validity as well as ease of use of two theoretically based questionnaires that can be used together to measure facilitators and barriers of evidence based practice and use of standardized outcome measures. By determining facilitators and barriers researchers may be able to tailor behavior change interventions that address the specific domain or barrier. Additional studies are needed to determine construct validity and reliability.

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Supplementary Material: Evidence Based Practice and Standardized Assessment

Questionnaire

New questions in bold, changes in italics and deleted question have been crossed out.

CONFIDENCE

Please indicate how **confident** you are in your current level of ability by choosing the corresponding number on the following rating scale:

O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

No Confidence **Completely Confident**

How **confident** are you in your ability to…

1. Identify a gap in your knowledge related to a patient or client situation (e.g. history, assessment, treatment)
2. Formulate a question to guide a literature search based on a gap in your knowledge?
3. Effectively conduct an online literature search to address the question?
4. Critically appraise the strengths and weaknesses of study methods (e.g. appropriateness of study design, recruitment, data collection and analysis)?

5. Critically appraise the measurement properties (e.g. reliability and validity, sensitivity and specificity) of standardized tests or assessment tools you are considering using in your practice?
6. Interpret study results obtained using statistical tests such as t-tests or chi-square tests?
7. Interpret study results obtained using statistical procedures such as linear or logistic regression?
8. Determine if evidence from the research literature applies to your patient's or client's situation?
9. Ask your patient or client about his/her needs, values and treatment preferences?
10. Decide on an appropriate course of action based on integrating the research evidence, clinical judgment and patient or client preferences?
11. Continually evaluate the effect of your course of action on your patient's or client's outcomes?

(Salbach & Jaglal, 2010)

BEHAVIOR

The following section inquires about your current behavior and use of evidence using the following scale: *[ ] 0 [ ] 1-2 [ ]3-4 [ ] 5-8 [ ] Greater than 8*

Please rate how many times in the past 8 weeks you have:

12. Conducted a literature search to answer a clinical question (e.g. PubMed, OVID, google scholar, etc.)
13. **Used individual research articles to answer a clinical question.**
14. **Used clinical practice guidelines to answer a clinical question.**
15. **Used a systematic review to answer a clinical question.**
16. Used evidence based internet resources (rehabmeasures.org, PTNow.org) to answer clinical questions.

    ~~Used knowledge gained from a conference to guide patient care.~~
17. Used knowledge gained from *continuing education course or conference* to guide patient care.
18. Used standardized assessment tools (outcome measures) to examine patients.
19. Used evidence to guide the diagnosis of patients.
20. Used evidence to guide the prognosis of patients.
21. Used evidence to guide the treatment of patients.

AVAILABILITY OF RESOURCES

The following section inquires about the availability of resources that support EBP.

For the following items, place a mark in the appropriate box that indicates your response.

22. At my facility, I have access to professional journals in their paper form.
23. At my facility, I can access relevant databases (e.g. PubMed, OVID, EBSCO).
24. **At my facility, I can access full text articles.**
25. At my facility, there is a resource person (e.g. clinical practice leader, librarian, research therapist) who can assist with implementing EBP.

26. My facility has *missions/goals/values* regarding the use of evidence in practice.
27. My facility provides protected time for me to conduct literature reviews and appraise the literature.
28. My facility provides financial support to attend educational meetings and conferences.
29. **I have the access to relevant databases with full text articles on the internet at home or locations other than my facility.**
30. I have colleagues who *can mentor or facilitate* my use of research findings in my practice.

EDUCATIONAL PREPARATION

The following section inquires about your educational preparation.

For the following items, place a mark in the appropriate box that indicates your response:

Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree

31. I learned the foundations of EBP as part of my academic preparation.
32. I have received formal training *(e.g. workshops, courses, post graduate training, continuing education, or entry level education) in search strategies for finding research relevant to my practice.*
33. I received formal training *(e.g. workshops, courses, post graduate training, continuing education, or entry level education) in how to critically evaluate research literature.*
34. **I received formal training (e.g. workshops, courses, post graduate training, continuing education, or entry level education) on how to apply research evidence to a specific patient case.**

(Salbach et al., 2007)

BARRIERS

The following item inquires about the top 3 barriers to updating your clinical practice with new knowledge.

35. Indicate the 3 greatest barriers to using evidence in your practice

[ ] Lack of time

[ ] Lack of access to resources

[ ] Lack of search skills

[ ] Poor ability to critically appraise the literature

[ ] Lack of generalizability of research findings to my patient population

[ ] Inability to apply research findings to individual patients with unique characteristics

[ ] Lack of understanding of statistical analyses

[ ] Lack of support among my colleagues in my facility

[ ] Lack of interest

[ ] Lack of an organizational requirement

[ ] Other, please specify:

____

[ ] Other, please specify:

____

[ ] Other, please specify:

____

(Salbach et al., 2007)

STANDARDIZED ASSESSMENTS
The purpose of the following section is to capture the overall practitioner and organizational barriers and facilitators to using standaridzed assessments. It is broken down into 10 sections: knowledge, attitude, confidence, skill, behavior, social influences, environmental context and resources, beliefs about consequences, additional barriers and faciliators and confidence and use of standardized assessments.

***Standardized assessments** are valid and reliable questionnaires or specific protocols "that assess actual or perceived ability of an individual to carry out activities such as moving in an environment or completing personal care and to participate in life situations such as work or household management and to participate in daily life." (Jette et al., 2009)*

Examples include: Berg Balance Scale, 10 Meter Walk Test or Disability in Arm, Shoulder, and Hand Scale (DASH).

Below there are a number of statements on standardized assessments. Please indicate whether you strongly disagree, disagree, are neutral, agree, or strongly agree.

KNOWLEDGE: The following sections inquires about your knowledge of standardized assessments. Knowledge is the state of being aware of something (Merriam-Webster).

36. I have sufficient knowledge of standardized assessments.
37. **I know how to choose valid and reliable standardized assessments.**
38. **I know how to administer standardized assessments.**
39. **I know how to interpret standardized assessment using minimal clinically important difference, clinical meaningful difference, etc.**
40. **I know how to document the results when using standardized assessments.**
41. I would like to know more about the standardized assessments before I decide to use them.

ATTITUDE: The following section inquires about your attitude about using standardized assessments. Attitude is a feeling or a way of thinking that affects a person's behavior (Merriam-Webster).

42. Using standardized assessments improves the quality of patient care
43. In general, I *avoid* using standardized assessments.
44. Using standardized assessments allows me to include patient preferences.
45. Using standardized assessments is too time consuming.
46. *The use of standardized assessments fits my way of working in the clinic.*
47. The use of standardized assessments *helps direct patient care (e.g. Write goals, re-evaluate, or progress).*
48. The use of standardized assessments motivates my patients.
    ~~I am free to make my own clinical decisions when using standardized assessments~~

CONFIDENCE: The following section inquires about your confidence or self-efficacy. Confidence is defined as feeling or belief that you can do something well or succeed at something (Merriam-Webster).

49. I feel confident that I choose the best standardized assessments for patient care.
50. **I feel confident administering standardized assessments.**
51. **I feel confident interpreting standardized assessments.**

52. **I feel confident when documenting about the results of standardized assessments.**
    ~~There are so many different assessments, I do not feel confident choosing a measure~~

SKILL: The following sections inquires about your skill in the use of Standardized Assessments. Skill is defined as proficiency acquired through practice.

53. **I have sufficient skills in identifying standardized assessments.**
54. **I have sufficient skills obtaining standardized assessments.**
55. *I have sufficient skills administering standardized assessments.*
56. **I have sufficient skills explaining results of standardized assessment to patients.**

BEHAVIOR: The following section inquires about your behavior using standardized assessments. Behavior is defined as the manner of conducting oneself (Merriam-Webster).

57. I use standardized measures to educate the patient and family.
58. I use standardized assessments primarily for diagnostic purposes.
59. I use standardized assessments primarily for prognostic purposes.
60. I use standardized assessments primarily for evaluative purposes.
61. The use of standardized assessments is always an integral part of my examination.
62. **I always follow the protocol when administering standardized assessments.**
63. *With what percentage of patients that you evaluate, do you use standardized assessments?*
    O 0% O 10 O 20 O 30 O 40 O 50 O 60 O 70 O 80 O 90 O 100%

SOCIAL INFLUENCES: The following section inquires about the social influences that impact the use of standardized assessments. Social influences are defined as those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviors.

64. Patients value the use of standardized assessments to gain insight into their functioning.
65. Patients find the use of standardized assessments too time consuming.
66. The kinds of patients I treat are *not appropriate* for the use of standardized assessments.
67. My co-workers (PTs) support the use of standardized assessments.
68. My supervisor supports the use of standardized assessments.
69. Standardized assessments are valuable when speaking about a patient to the healthcare team.

ENVIRONMENTAL CONTEXT AND RESOURCES: The following section inquires about the environmental context or resources that influence your use of outcome measures. This is defined as any circumstance of a person's situation or environment that influences their behavior.

70. I find using standardized assessments a problem because I do not have (physical) space in my practice.
71. There are enough standardized assessment tools to use in my daily clinical practice.
72. **I don't have enough time to use standardized assessments.**
73. **I don't have the equipment I need to use standardized assessments.**
74. **The use of standardized assessments is required in the practice where I work.**

75. **I have access (e.g. paper copies) to the standardized assessments I want to use.**
76. The use of standardized assessments is part of the organizational goals of our practice.
77. **Health care policies support the use of standardized assessments.**
78. **I have increased my use of standardized assessments because of Medicare and Medicaid.**
79. **I have increased my use of standardized assessments because of other third party payers.**
80. **The documentation system where I work supports the use of standardized assessments.**
81. **The documentation system where I work does not support the use of standardized assessments.**

BELIEFS ABOUT CONSEQUENCES: The following section inquires about your beliefs about consequences of using standardized assessments. This can be defined as acceptance of the truth, reality or validity about outcomes of a behavior in a given situation

82. Physical therapists who use standardized assessments should recieve additional financial compensation.
83. Referral sources want treatment results objectively evaluated.
84. Using standardized assessments might strengthen negotiations with insurers.

ADDITIONAL BARRIRES AND FACILITATORS: Please type any additional barriers or facilitators that you feel limit or help you effectively use standardized measures

85. What others factors may increase your use of standardized assessment tools? ____
86. What other factors may stop you from using standardized assessment tools? ____

(Swinkels et al., 2011)

STANDARDIZED ASSESSMENTS USE AND CONFIDENCE

Please indicate the top 5 standardized assessments you use and for each measurement rate what percentage of time you use it with **appropriate** patients (0% never to 100% always) and overall, how confident you feel choosing, administering, interpreting and documenting on the assessment (0% not confident to 100% completely confident) (example: Lower Extremity Functional Score).

1. ____

   Use: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

   Confidence: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

2. ____

   Use: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

   Confidence: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

3. ____

   Use: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

   Confidence: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

4. ____

   Use: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

   Confidence: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

5. ____

Use: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

Confidence: O **0%** O **10** O **20** O **30** O **40** O **50** O **60** O **70** O **80** O **90** O **100%**

6. What standardized assessment tool(s) would you like to use more frequently?

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