A MIXED METHOD ANALYSIS OF THE ROLE OF BALANCE OUTCOME MEASURES IN THERAPIST DECISION-MAKING AND PATIENT OUTCOMES

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DEDICATION

To the four Lyon women who have inspired the strength, faith, and patience that made this possible, my mother, my sister, my wife, and my daughter.

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ABSTRACT

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The purpose of these three studies was to assess the impact of using outcome measures on physical therapists' decision-making and patient functional outcomes. An online survey was completed by 373 physical therapists. This survey was focused on their use of outcome measures and their relationship with decision-making for patients with acquired brain injury. Physical therapists reported that the use of outcome measures frequently impacted decision-making in estimating prognosis, identifying a patient's risk for adverse events, setting goals, communicating, educating, making discharge decisions, and selecting treatment interventions. Semi-structured interviews focused on outcome measures' impact on decision-making and patient outcomes were conducted by 23 physical therapists. Therapists indicated that outcome measures played a large role in clinical decisions, and a majority reported they believed there was a relationship between outcome measures and patient outcomes. Finally, eight physical therapists and physical therapist assistants participated in a knowledge translation intervention focused on outcome measures. Patients treated by these therapists demonstrated significantly better ambulation ability and participated in significantly fewer minutes of physical therapy compared to patients treated by six physical therapists and physical therapist assistants who did not participate in an educational intervention.

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CHAPTER I

INTRODUCTION

INTRODUCTION

Balance impairments are common after brain injuries and can have a significant negative impact on patient health, activities, quality of life, and participation in social roles. To mitigate these possible negative effects, including balance in the physical therapy (PT) plan of care is an important part of working with individuals after acquired brain injury (ABI).

The American Physical Therapy Association (APTA), APTA Academy of Neurologic Physical Therapy, and other professional organizations recommend using standardized balance assessments as an essential part of evidence-based practice (EBP).[1-7] Outcome measures, standardized assessments that quantify change in patient status over time,[8] have been recommended as a way to evaluate quality of PT care since the early 1980s and have become an increasingly frequent topic in neurological PT literature since 2000.[1,8-12] Despite this increased focus, evidence indicates that outcome measure use in the United States remains low. The most recently available evidence, from a 2009 survey, reports that only 48% of APTA members use outcome measures in clinical practice, and facility "home grown" measures are the second most commonly used.[13]

The focus of much of the outcome measure research since 2009 has been on increasing utilization through analysis of barriers and facilitators, and determining the impact of knowledge translation interventions.[1-5,13-20] Physical therapists report time constraints, difficulty changing daily routine, lack of equipment, and limited knowledge related to selection, use, and interpretation as barriers to outcome measure use.[13,18,21] Therapists are more likely to use outcome

measures if they believe they are clinically meaningful, if they have hands-on experience administering the measure, if the facility culture and administration support their use, if a therapist has recently participated in an academic program, or if a therapist primarily works in the inpatient rehabilitation or outpatient setting.[2-4,13,14]

Authors have proposed that the use of standardized measures improves patient care through guiding clinical decision-making, informing the process of treatment intervention, and enhancing communication.[2-4,7,8,14,22] Standardized measures have been reported to "enhance the quality of physical therapist services by providing reliable indicators of patient status and guiding selection of relevant treatments,"[8] as well as "accurate diagnosis of potential impairments, identifying fall risk, treatment planning, and evaluating change over time."[4] Danzl and Hunter[2] proposed that use of outcome measures is a possible means by which healthcare organizations can optimize and justify the services they provide. Though the reported relationship between standardized measurement and patient care is extensively seen in the outcome measure literature, it has been primarily based on expert opinion, minimal subjective interview and survey data, and limited objective examination. No published study has validated that use of standardized measures has the proposed, or any, impact on patient care.

The purpose of the studies within this dissertation was to determine if appropriate use of assessment tools leads to changes in patient care decisions. Balance assessment of individuals with history of ABI served as a model. An additional purpose was to determine if changes in patient care do occur, was there an impact on patient health-related outcomes? Using a mixed methods analysis, two studies were completed to explore the behaviors, perceptions, and beliefs of physical therapists in the United States regarding standardized balance measurement in individuals with ABI. A third study examined the relationship between balance measurement, therapist decisions, and patient outcomes. During the first study, an online survey with physical

therapists who treat ABI in a variety of settings and geographic regions was used to determine how physical therapists across the United States utilize the results of outcome measures. In Study 2, qualitative interviews with physical therapists were conducted to deepen the understanding of how the use of outcome measures and their results impacts clinical decision-making and, in turn, patient outcomes. For Study 3, an educational intervention focused on therapist utilization of optimal standardized balance measurement was conducted. The change in delivery of PT services and the change in patient outcomes was measured. A schematic of the order of the studies can be seen in Appendix A. After 35 years of published research focused on increasing the utilization of outcome measures by physical therapists, this research focused on the impact this has had on therapist decision-making and patient outcomes.

STUDY 1

Introduction

Since the last survey of PT outcome measure use was completed 8 years ago, research focused on outcome measure implementation has increased, a national online database of outcome measure psychometric properties was published by Rehabilitation Institute of Chicago, and the APTA Section on Research published the evaluation database to guide effectiveness (EDGE).[7] However, the current state of standardized outcome measures use by physical therapists is in the United States is not well understood.

Purpose

The purpose of Study 1 was to explore current practices in clinical balance assessment for individuals after ABI among physical therapists in the United States. The secondary purpose was to examine how physical therapists use the results of balance assessments.

Research Questions

When working with individuals with ABI: of the available balance measures, which measures are used by 50% or more of physical therapists? How do physical therapists use the results of balance measures? Which demographic characteristics demonstrate a significant relationship with choice of balance measure or reported use of balance measurement results?

Method

Participants. The target sample was 350 physical therapists. Those licensed in the United States and currently in clinical practice who provide services to individuals after ABI were eligible for the study. Recruitment occured through an invitation to complete an online survey sent through email. A snowball recruitment strategy was utilized with initial invitations sent to 1) Texas Woman's University (TWU) School of Physical Therapy alumni directory, 2) 84 Directors of Clinical Education at physical therapist programs, and 3) listed contact information for 27 randomly selected facilities found searching for terms "stroke rehabilitation" and "brain injury rehabilitation" on popular social media platforms. Included in this message was a request for recipients to forward the survey link to all physical therapists known to work with individuals with ABI.

Instrumentation. The first two survey questions screened respondents for eligibility. Participants were informed at the beginning of each survey that completion of the survey constituted their informed consent. Questionnaire items collected basic demographic information and answered the stated research questions concerning practice and perceptions. Respondents were asked to choose the balance measures used most in clinical practice. Respondents then were asked to indicate level of agreement with statements related to rationale for choosing a measure and the relationship between balance measurement and decision-making on a 5-point Likert scale with descriptive anchors. These statements were taken from qualitative studies exploring similar

concepts in Canada and the Netherlands, standardized measures of walking, or proposed uses of standardized measures by professional organizations.[2-4,7,11,14,18,23] Additionally, free response boxes were allowed for each outcome measure of interest, each balance measure chosen, rationale for choosing measure, and use of results of balance measure, as well as a final free response box at the end of the survey.

A pilot survey was sent to a sample of convenience of 10 individuals to assess sensibility, face, and content validity. Pilot data was used to modify the instrument to improve validity. Data collected during the pilot phase was not used in the final analysis. The final survey questionnaire, after modifications were made in the pilot phase, can be seen in Appendix B.

Procedures

This study was a cross-sectional survey of licensed physical therapists practicing in the United States who work with individuals with ABI. The survey was created, administered, and data was collected using PsychData. A pre-notification email message outlining the purpose of the survey was sent to the sample to prime potential participants. After one week, an initial invitation to participate was sent including a link to the survey instrument, followed by a reminder email message 2 days later. Data collection lasted 2 weeks from initial mailing.[24,25] The period of survey instrument availability was designed to create a sense of scarcity of time to increase response rate.[24]

Data Analysis. Demographic and practice setting information was summarized with mean, median, interquartile range, and standard deviations. The outcomes of interest were summarized with frequencies and percentages and displayed graphically during initial analysis. Non-parametric analysis of differences was used to analyze the differences in the outcomes of interest for each demographic characteristic, gender, age, practice setting, primary patient population, years' experience as physical therapist, APTA membership, APTA section

membership, specialty certifications, entry-level degree, years since entry-level degree, terminal degree, and years since terminal degree. The qualitative data collected in the free response boxes was coded as reported in Study 2.

STUDY 2

Introduction

Limited research has investigated how therapists use the results of balance assessments. In qualitative interviews in limited geographic regions, therapists reported they are used as tools of communication regarding presence of deficit, functional status, level of safety, goals, and progress[2,3] and as objective data to justify payment by third-party payers.[2,14] Therapists also report using measures to support clinical decision-making in planning discharge[22] and selecting treatment interventions and determining appropriate intensity.[2,14]

Purpose

The purpose of Study 2 was to understand how physical therapists use the results of balance assessments. The secondary purpose was to understand how therapists believe the interaction between balance assessments and clinical decisions impacts patient outcomes.

Research Questions

How are the results of standardized balance measurements used by physical therapists in clinical decision-making? What is the perceived impact of this interaction on patient outcomes, according to physical therapists who treat individuals with ABI?

Method

Qualitative tradition. This was a qualitative study using semi-structured in-person and video conference interviews. Two theories of qualitative inquiry guided study design, data collection, and analysis. Because professional and organization culture is a strong component of therapist beliefs and behaviors,[3,14,26,27] ethnography, the study of the implications of culture,[28]

guided coding and interview questioning. Pragmatic theory, the examination of how practical applications of research findings can inform future actions,[28(p154)] influenced the line of follow-up questioning and data analysis.

Participants. A sampling strategy called group characteristics sampling was used to appreciate group patterns. This strategy involves selecting specific cases purposefully to create an information rich group. Maximum variation sampling, a sub-type of group characteristic sampling, of physical therapists working with the ABI population was utilized to document diverse answers to the research question. Because outcome measure use varies based on practice setting[4,13] and neurological rehabilitation varies across geographic region,[29,30] therapists from a heterogenous sampling of these variables were selected to participate. This allowed for determination of common themes and concepts across the dimensions of geography and practice setting and an improved understanding of the diversity of physical therapists' practices.[28(p267,283)]

The number of participants was based on the schematic in Appendix C. The goal distribution was a total of 24 participants, with two in each cross section of practice setting and geographic area. Therapists were invited to participate on a volunteer basis through direct email to individuals identified through contact with key informants. Key informants are identified as individuals whose social and professional positions give them special knowledge about other people or processes.[31]

Instrumentation. Data collection occurred through one-on-one semi-structured in-person or video conference interview, with use of an interview guide technique. Interview guide questions were focused on reported behaviors and beliefs and follow-up questions were formulated during the interview based on the stated research questions (see Appendix D).

Disclosure of Bias

The primary researcher's bias was that physical therapists should use standardized outcome measures regularly to guide treatment and plan of care decisions and this is likely to lead to improved patient outcomes. To limit the influence of bias, interview questions were worded neutrally (e.g. the terms "standardized balance assessment" and "balance test" used rather than "outcome measure"[3]) and field notes included reflective entries.

Procedures

All interviews were audio recorded and transcribed verbatim. Interviews occurred at the TWU Institute of Health Science Houston Center, when in-person, or a location chosen by the participant, when through telephone. The interview was conducted one-on-one by the primary researcher or a research assistant trained in qualitative interviewing. Transcript data was augmented prior to data analysis with memos about subject non-verbal communication and researcher reflections. These memos were related to concepts of balance, measurement, decision-making, and patient outcomes. Analytic memos were recorded during the interview by the primary researcher and by a secondary researcher during playback of the video recorded interview.

Data Analysis

Computer assisted open coding was completed on the transcribed interview as described by Saldaña,[32] with an a priori determined focus on emic phrases and indigenous patterns and themes. That is, coding was completed with words, phrases, and categories used by those interviewed.[28] All interview transcripts were coded line-by-line by the primary researcher or a research assistant trained in qualitative interview coding techniques and an evolving list of codes, categories, and themes was maintained.

Trustworthiness Techniques

Trustworthiness was sought through a multi-modal approach including mixed-methods triangulation, triangulation of data sources, triangulation of analysis (member checking and peer examination during analysis), documentation of an audit trail, and interview techniques aimed at reducing threats to internal validity.[28,33] Data was verified through comparing results across the maximum variation sample[33] and investigating areas of convergence and divergence with the results of the quantitative and qualitative data from the first study.[28] Each participant was provided a copy of the coded interview, including categories and themes gleaned from that interview, and invited to provide feedback on the accuracy, fairness, and validity of the analysis.[28] Impartial colleagues who have clinical or research experience with the concepts of the study were consulted during the analysis phase to check categories, look for disconfirming cases, and discuss working hypotheses to enhance analysis credibility.[33] Detailed documentation of the data gathering and analysis along with records of all raw data, data analysis and synthesis products, and instrument development were kept as part of the audit trail. Interview strategies that enhance data credibility were used, including reframing of questions, indirect questions about the participants' experiences, and structured hypothetical situations.[33]

STUDY 3

Introduction

No published study has objectively explored how therapists use the results of balance outcome measures, including the proposed relationship with diagnosis, prognosis, intervention selection, or patient education. Further, no published study has determined if there is a relationship between these changes in the plan of care and patient outcomes.

Purpose

The primary purpose of this study was to examine the difference in functional outcomes for patients treated by therapists who did or did not participate in the education intervention. The secondary purpose was to examine the differences in the quantity of physical therapy services provided to patients treated by therapists who did or did not participate in an educational intervention focused on outcome measures.

Research Question

Three months after an educational intervention, will patients treated by physical therapists educated on outcome measures: be significantly different ($\alpha \leq .05$) at discharge on functional independence than patients treated by physical therapists not educated on outcome measures? Be significantly different ($\alpha \leq .05$) on minutes, number of days, or number of sessions of physical therapy compared to patients treated by physical therapists not education on outcome measures?

Method

Participants. Physical therapists at a minimum of four Houston metropolitan area skilled nursing facilities (SNFs) were recruited for the study. Inclusion criteria for target facilities was: 75 or more beds, four or more full-time equivalent physical therapists, minimum of 10 individuals with ABI admitted in the last calendar year, and department managers agreeing to participate in intervention. Physical therapists working as a 0.5 to 1.0 full time equivalent at a participating site who report working with 10 or more individuals with an ABI in the last year were invited to participate and were provided an informed consent form.

Procedures. This was a prospective interventional case-control study with a non-randomized quota sample. The study occurred at four facilities with skilled nursing services in one healthcare system. SNFs have been selected as the optimal model in this study because past

research has found that physical therapists working in SNFs report lower incidence of outcome measure use,[1,13,14] thus potentially increasing the expected effect size. Facilities were assigned sequentially to alternating groups, either a knowledge translation interventional group or a control group with no knowledge translation intervention.

The experimental group participated in an educational intervention based on recent literature and information gained in the first two studies. The intervention included one 1-hour educational module focused on standardized balance measures in ABI, with a recommended set of outcome measures. The outcome measure set was developed based on current literature, professional organization recommendations, input from opinion leaders, and the specific needs of the facility (e.g., time allowed for evaluation, case mix). The educational meeting included active practice performing, scoring, and interpreting each measure. Identified opinion leaders were provided a penultimate draft of the presentation and recommendations prior to the educational meeting, with opportunity to provide feedback.

Because of the previously mentioned impact of organizational culture, [3,14,26,27,34] physical therapists and rehabilitation department managers were asked to complete the Organizational Readiness to Change Assessment (ORCA) context subscale prior to the internvention.[35,36] Baseline data was collected for all patients admitted with diagnosis of ABI. For the 3 months before the first educational module and 3 months after the final education module, data was collected on all individuals admitted for care with a diagnosis of ABI. Outcome data collected on these patients included: total minutes of PT, days from admit to discharge from PT, number of PT sessions, independence w/ bed mobility, transfers, ambulation, and stairs, maximum distance ambulated. Additionally, demographic characteristics will be collected, including diagnosis, admission source, age range, gender, and if living alone, with family, or facility staff. An a priori power analysis was conducted utilizing G*Power[37] based on an alpha level of .05, estimated

effect size of d = 0.4, and power of 90%, indicating that a total sample size of 68 patients will be required. Documentation in the electronic health record of date of admission, standardized balance measurement, and date of balance measurement was recorded**.**

Data Analysis

To test if a difference between therapist groups existed at baseline, demographic characteristics of the therapists in each group, including years' experience, years' experience in current setting, entry level degree, years since entry level degree, terminal degree, years since terminal degree, specialty certification, APTA membership, and section membership was compared between using parametric and non-parametric statistics. The same was done for baseline demographics of patients, including diagnosis, time since onset, source of admission, functional status at admission (as recorded by the MDS), age, gender, and marital status. The mean, median, and standard deviation of each of the parametric variables was assessed, while the frequency distributions was assessed for the non-parametric variables. The primary outcomes of interest, minutes of physical therapy, length of plan of care in days, number of sessions of physical therapy, functional independence at discharge from therapy, and maximum distance walk at discharge were compared between groups with the use of *t* tests and Mann-Whitney tests.

CHAPTER II

REVIEW OF THE LITERATURE

INTRODUCTION

ABIs are devastating events that impact many aspects of a person's life. The etiology and contributing factors associated with an acquired brain injury play a role in the disease's long-term presentation. Weakness, increased muscular tone, difficulty walking, and imbalance result in decreased ability to be mobile in the community and participate in meaningful roles and work. There are many interventions focused on rehabilitating the deficits associated with ABI. Balance retraining can help facilitate the return of individuals who are post-stroke and post-traumatic brain injury (TBI) to more independent lives. An essential part of designing a balance training program is the initial and ongoing assessments of balance. These assessment tools can quantify the severity of balance problems and document response to treatment. There is an opportunity for these measures to guide and support the clinical decisions made by physical therapists.

ACQUIRED BRAIN INJURY

ABI is a significant cause of disability in the United States. ABI's definition is damage to the cerebral hemispheres, cerebellum, or brain stem that occurs after an individual's birth. This damage can result from a TBI, stroke, brain tumor, or infection.

This most common cause of ABI is a traumatic brain injury. TBI is defined as an external force, including a bump, blow, jolt, or penetrating injury that disrupts normal brain function. An estimated 2.5 million people in the United States sustain TBI annually. The most impacted age groups are children 0-4 years old, adolescents aged 15-19 years, and older adults 75 years or

older. TBI's most common causes are falls, being struck by an object, motor vehicle accidents, and assault.[1-3]

Stroke, or cerebral vascular accident, is a sudden vascular event that causes damage to surrounding brain tissue. Each year, 800,000 people in the United States experience a new or recurrent stroke. Strokes result from ischemia 87% of cases, when a clot or mass blocks a blood vessel, depriving a region of the brain of blood. Stroke results from a hemorrhage in 13% of cases, which is when a blood vessel inside the skull ruptures or leaks. Prevalence increases with advancing age, women are slightly more likely to be impacted by a stroke than males, and black, Hispanic, and Indigenous Americans are more likely to experience a stroke than Caucasian individuals.[4] Another cause of ABI are tumors in or near the brain. Tumors are growths of abnormal cells and can develop in the brain or surrounding area as benign masses that press on surrounding structures or malignancies that grow rapidly and spread locally or globally. The estimated annual incidence of primary brain tumors was 23 890 in 2020 in and secondary brain tumors incidence was estimated at 98 000-170 000 in 2020. Like stroke, brain tumors' incidence increases with advancing age, with incidence rates highest among those 85 years or older and lowest for those 0-19 years. Benign tumors are more common than malignant ones; the most common site for benign tumors is the meninges, the membranes that surround the brain structures, and the most common location for malignant tumors are the frontal (23.7%), temporal (17.4%), parietal (10.5%), and occipital (2.7%) lobes accounting for 54.3% of tumors.[5]

The least common cause of ABI is infectious diseases. Infections in the central nervous system can include meningitis, encephalitis, and prion diseases. These diseases are relatively rare, with an annual incidence in the United States of 375 cases of meningitis,[6] 1310 cases of neuroinvasive West Nile Virus causing meningitis or encephalitis,[7] and less than 50 cases per year of other causes of encephalitis.[7] Prion disease is caused by abnormal proteins that affect the

function of normal proteins in the brain. The most common human prion disease is Cretzfeldt-Jakob Disease, with an incidence of 1.5 cases per 1 million in the United States.[8] There are more than 12.5 million people in the United States, almost 5% of the population, across both genders, all ages, diverse ethnic backgrounds, and geographic distributions are living with the effects of ABI.[3-6]

The immediate and long-term effects significantly impact the health and quality of life of individuals with ABI. The clinical presentation of ABI will depend on the etiology and location of the damage. Notably, the diffuse injury more common to TBIs and encephalopathies has a different profile than the focal damage of many ischemic strokes and tumors.[9] The symptoms of ABI are categorized as somatic, cognitive, behavioral and emotional, motor, and sensory.[3] Medically, individuals can present with impairments in arousal and consciousness, which is most likely to be seen with diffuse bilateral cerebral trauma, infectious disorders, or focal damage that impacts the brainstem.[9] Common somatic symptoms include headache, fatigue, sleep disturbances, dizziness, nausea, and chronic pain.[3] Headache occurs in one third to one-half of individuals with intracranial tumors and, along with nausea and vomiting, is a common initial clinical sign of neoplasm. Additionally, lethargy and easy fatigability may occur early with a brain tumor.[9] Dizziness occurs regularly after TBI, particularly in mild TBI.[9] After ABI, individuals can also experience cognitive impairments, including difficulties in learning, memory, planning, organization, inhibition, problem-solving, language, communication, reaction time, reasoning, and judgment. Communication disorders also occur in individuals with stroke due to infarction of the middle cerebral artery or stroke due to large infarction areas. Executive functions, planning, organization, inhibition, and problem-solving are impaired in individuals with damage to the cerebrum's frontal lobe due to TBI, neoplasm, or infarction.

TBI also causes disorders of learning, complex information processing, and difficulty with abstract thinking. Embolus or occlusion of the posterior cerebral artery can lead to stroke with symptoms of dementia, impaired memory, and impaired executive function.[9] Delusions, hallucinations, agitation, aggression, depression, confusion, impulsivity, social inappropriateness, and other behavioral and emotional issues can also occur after ABI. Agitation is seen in severe encephalitis cases, and hallucinations and memory impairments may occur in certain kinds of encephalitis. Apathy and personality changes are seen with posterior cerebral artery occlusion. Behavioral disturbances occur after TBI with damage to the orbitofrontal area, septal area, and can also include pseudobulbar affect, inappropriate laughing or crying not associated with emotions.[9]

Motor and sensory symptoms may include muscle tone changes, impaired coordination, loss of selective motor control, abnormal balance reactions, and vision and hearing changes. The most common motor and sensory impairments among individuals with a history of stroke or tumor are hemiplegia and hemianesthesia on the contralesional side. However, lesions at the level of the brainstem and cerebellum can also have ipsilesional facial weakness and sensory loss. Specific clinical manifestations depend on the location of the lesion. For example, with occlusions of the middle cerebral artery, weakness in the upper extremities is more profound than the lower extremities, and the anterior cerebral artery preferentially impacts the lower extremities. After bacterial meningitis, these symptoms can be restricted to cranial nerve palsies, weakness in the eyes, face, or tongue, but can also present as hemiplegia and tetraplegia. Encephalitis, mainly when related to neuroinvasive West Nile Virus, can lead to flaccid paralysis. Stroke and TBI more commonly result in increased muscular tone, spasticity, and rigidity. Lack of coordinated movement, known as ataxia, is most commonly associated with cerebellar damage, which can be caused by any form of ABI but can also occur with damage to the thalamus and vestibular nuclei.

Ataxia can present as a postural tremor, imprecise movements, imbalance, and gait disorders and typically occurs on the ipsilesional side when presenting unilaterally. Movement disorders, including bradykinetic movement, hyperkinetic movement, dystonias, myoclonus, and ballismus, can result from ischemia or other localized brain lesions to the basal ganglia or subthalamic nucleus while the most severe form, akinetic mutism, is seen with the prion diseases. Loss of pain and temperature sense may occur with ABI in the brain stem region. Mild to profound hearing loss or impairment is a common complaint after bacterial meningitis or anterior inferior cerebellar artery stroke. Diplopia can occur with the elevated intracranial pressure that occurs early with a brain tumor, and 70-75% of those with central nervous system neoplasm will experience optic disc edema, causing decreased visual acuity, enlarged blind spot, and deficits in the visual field. [9]

Reports indicate that 10% of those with mild injury and 100% of those with severe brain injuries will continue to have some residual disability.[10] The residual deficits related to ABI have the potential to have a profound and lasting impact on a person's ability to perform day-to-day activities safely and independently, engage in the community, and participate in productive and recreational pursuits.[3]

Postural Stability Dysfunction After Acquired Brain Injury

Deficits in postural control are of particular interest in the field of physical therapy because of their broad impact on mobility. Postural control is dependent on the interaction between individual characteristics, a task's demands, and the environmental constraints. Individual characteristics include the ability to maintain stability and posture. Postural control involves maintaining the body relative to the surrounding environment.[11] The maintenance of postural stability, or control of the body's center of gravity relative to its base of support, is termed balance.[11] The center of mass is the point that is the center of the total body mass. The base of support is the area of the body in contact with a support surface. Many individual

processes contribute to the successful maintenance of balance. These include neural mechanisms of motor control, sensory perception and integration of visual, vestibular, and somatosensory inputs, and cognitive processes. Normal muscular tone and stiffness due to stretch reflexes appropriately regulated by descending pathways and muscular structure contribute to postural stability. In addition to these neural mechanisms, appropriate joint range of motion, muscular properties, spinal flexibility, soft tissue integrity, and biomechanical properties are necessary for successful balance maintenance. Cognitive resources needed for balance include attention, anticipation, and adaptation of automatic motor responses and organization of various sensory inputs.[11]

Postural stability demands are different depending on the task. During walking, the body is in a state of forward motion, which means the center of mass cannot consistently stay within the moving base of support. There is additional activation of motor neurons to generate forces sufficient to counteract the sway that typically occurs to maintain the center of mass within the functional limits of stability. Limits of stability are how far the center of mass can move before the base of support must move, typically through taking a step or reaching for a support surface with the upper limb. The neurological and musculoskeletal systems are minimally active when a person is standing still. During quiet standing, the soleus's baseline tone, gastrocnemius, tibialis anterior, gluteus medius, tensor fascia latae, iliopsoas, and thoracic erector spinae are the primary contributors to stability.[8]

The brain and spinal cord contribute to controlling postural stability. The cerebral cortex selects the appropriate strategy in response to the environment and perceives and integrates visual information. Mainly, the motor cortex and frontal cortex are involved in higher-level motor planning on postural stability. The brain stem and cerebellum maintain postural tone, receive vestibular inputs, integrate sensory information, and contribute to anticipatory postural control.

The basal ganglia are involved in quickly changing muscle activation patterns in response to changes in the environment. The spinal cord also contributes to the maintenance of tone in anti-gravity muscles and processing somatosensory inputs. Motor neurons propagate signals for muscles to generate the forces that control the body's position.[11]

Each of the neural, musculoskeletal, and cognitive processes that impact balance has the potential to be impaired after ABI, as described earlier. Because of this, balance impairments are one of the most common issues after brain injury, with more than 80% of individuals presenting with balance impairments at the time of injury and one-third continuing to have impairments 5 years after injury.[12-14] These residual effects can significantly negatively impact health, activities, quality of life, and participation in social roles. Individuals with ABI demonstrate the delayed onset of the postural responses necessary to keep the center of mass within limits of stability and demonstrate an increase in the velocity and size of sway movement during quiet standing.[11] Individuals with a stroke history demonstrate a characteristic asymmetrical weight-bearing pattern on lower limbs with asymmetrical and increased sway area in quiet stance. After a stroke, people also show evidence of asymmetrical muscular tone, somatosensory deficits, spatial perceptual disorder impacting the visual perception of vertical, all which contribute to decreased postural stability.[11] Basford et al[15] reported that individuals with a history of ABI have significantly worse performance on static computerized posturography testing than individuals without a history of ABI. During walking, those with ABI also demonstrated less anterior-posterior movement, indicative of reduced speed, and greater medial-lateral velocities and displacements, indicative of reduced stability[15]. Geurts et al[16] found static and dynamic balance impairments present in individuals lacking deficits in strength, sensation, tone, coordination, and gait.[16] Individuals with stroke and TBI consistently demonstrate lower scores on clinical balance assessments.[17-24]

Individuals with ABI who demonstrate worse balance are less mobile, which is problematic because increased mobility is correlated with improved quality of life in those with ABI.[13,15,18,25] In fact, standing balance is the strongest predictor of mobility in chronic stroke survivors, responsible for 30% of the variance in the number of steps per day for this population.[26] Additionally, balance at admission to the hospital is the strongest predictor of a patient's need for assistance with mobility tasks and activities of daily living at discharge from the hospital and one year after discharge. These mobility tasks and activities of daily living include bed transfers, toilet transfers, tub transfers, ambulation, stair climbing, eating, grooming, bathing, upper body dressing, lower body dressing, and toileting.[27,28] Performance on clinical balance tests is also a good predictor of future motor function and risk for future falls in those with stroke.[29,30] Those with more significant impairments in balance and mobility are also more likely to be limited in their ability to participate in paid work, school, and volunteer activities.[20,21] Individuals with a history of ABI have decreased confidence in their ability to participate in activities without falling or losing their balance. There is also a correlation with decreased balance confidence and decreased physical health, increased need for assistance with mobility and activities of daily living, decreased ambulation speed, and increased risk for falls.[31,32] To mitigate these adverse effects, including balance in the PT plan of care is an essential part of working with individuals after ABI.

There is evidence that specific training interventions can positively affect postural stability control of individuals with a history of acquired brain injury. Among individuals with a history of stroke, those who have a history of falling demonstrate paretic limb responses that are slowed and insufficient in amplitude. After 5 weeks of reactive balance training, people with a history of stroke demonstrate an improved latency period on the paretic lower limb in response to perturbations.[33] After a stroke, individuals also demonstrate a higher reliance on visual input than

somatosensory and vestibular sensory inputs. Individuals who participated in 8 weeks of training balance tasks designed to challenge somatosensory and vestibular input utilization demonstrate improved balance scores.[11]

A 2011 systematic review of 17 randomized controlled trials assessed the impact of exercise interventions on clinical balance tests among those with a history of stroke. The reviewers found that individuals who participated in balance interventions for 1 hour a day three to five times per week improved their balance assessment scores. Balance exercises included challenges to different sensory systems. This systematic review also reported that stroke survivors who participated in gait interventions for 30 minutes a day, three to five times per week, had significant improvements in balance text scores. Gait exercises included walking on a treadmill, walking on a treadmill with body weight support, or walking overground.[34] A 2010 systematic review analyzed 20 studies that investigated balance training after TBI. Though this review was unable to determine which training interventions were most effective, the authors did note that the participants with TBI demonstrated overall improvements in balance performance.[35] PT practice should incorporate assessment and treatment of postural stability in those with a history of acquired brain injury because postural stability is a common problem. Postural stability has a substantial impact on safety and quality of life and has been shown to improve with intervention.

OUTCOME MEASUREMENT

Measuring outcomes through standardized tests and measures has been recommended to evaluate and enhance the quality of health care since the early 1980s. It has become an increasingly frequent topic in health literature since 2000.[36-41] In 1982, Partridge[42] proposed the consistent use of quantitative and qualitative measurements of the patient's condition before, during, and after PT treatment. He pointed out that physical therapists cannot provide effective service if they do no clearly state the aims of treatments and measure the outcomes of different

approaches.[42] This recommendation occurred within the broader scope of a paradigm shift sweeping health care professions across the world.[39] A new concept emerged in the 1980s that patient outcomes could be most improved if clinical decisions were based on sound evidence, not individual decisions.[39] Researchers developed randomized controlled trials, and Archie Cochrane promoted them as the best foundation for medical decision-making.[39] David Sackett proposed methodologies and techniques for the critical appraisal of the soundness of literature. In 1992, he coined and defined the term evidence-based medicine.[43] Evidence-based medicine was later re-termed the more inclusive evidence-based practice (EBP). In addition to applying the soundest evidence using Dr. Sacket's appraisal methodologies, the use of "health status measures" was deemed an integral part of EBP. The use of health status measures was promoted among physicians, therapists, and allied health professionals. These measures were reproducible and valid measurements of individual patient outcomes by measuring items like the surface area of a wound or general health status with an instrument like the "Short-Form 36."[42,44] In PT, the systematic measurement of change in a patient's health status, or outcomes, as described by Partridge, is now considered to be an essential part of EBP by the APTA and the Academy of Neurologic Physical Therapy (ANPT).[37,45-50]

The standardized test or measure used to monitor change in a specific construct during an episode of care is called an "outcome measure," according to publication by the APTA in 2018.[51] A more detailed definition offered by Hammond[38] and Jette[52] includes that the measure is administered and interpreted by physical therapists, that psychometric analyses indicate the tools measures accurately, and the tool utilizes closed-ended questionnaire formats or specific protocols for implementation.[38,52] Outcome measures can assess body functions and structures, activities, and participation. They can be of varying degrees of complexity from the length of time an individual can stand on one leg to complicated computerized testing batteries. Outcome

measures can include both performance-based assessments and patient reports. There are reliable and valid outcome measures available for physical therapists to utilize in their clinical practice.[53] Despite this availability, the importance of EBP, and universal recommendation from professional organizations, evidence indicates that outcome measure usage around the world has slowly risen but remains low, especially in the United States.[49,52,54-59]

Historical Use of Outcome Measures

The 1990s. Turner et al completed an audit of the physiotherapist documentation for patients with low back pain in five hospitals in North England between 1994 and 1996. The authors found that phsyiotherapists documented an initial measurement of range of motion in 75% of cases and follow-up range of motion in less than 33% of cases. Pain was primarily documented in descriptive terms such as "improved," and functional performance was measured in less than 6% of cases.[60] A 1998 survey of 418 physiotherapists in 14 European countries found that therapists primarily assessed orthopedic patients with impairment measures like range of motion, manual muscle tests, and the visual analog pain scale. Therapists typically assessed patients with neurological conditions with manual muscle testing, the Modified Ashworth Scale, the functional independence measure, or the Barthel index. Therapists did not utilize self-report questionnaires or other performance-based assessments frequently. As an example, in one year, therapists completed range of motion measurements on 22 561 patients with low back pain, but the McGill Pain Questionnaire was only completed with 3092 patients, the Roland & Morris with 2177 patients, and the Oswestry Low Back Pain Questionnaire with 2001 patients.[39] Torenbeek et al[61] reported on a survey sent to the management of 581 rehabilitation facilities in Germany, Italy, Ireland, Austria, and the Netherlands in 1998. Surveys were returned for 102 rehabilitation centers, 23 from Austria, 11 from Germany, 12 from Ireland, 25 from Italy, and 31 from the Netherlands. Responding managers reported that the most commonly used outcome measures

were locally developed, unpublished, and had no established reliability or validity. Published outcome measures were used in stroke rehabilitation by 75% of respondents in Ireland, 64% in Italy, and 88.5% in the Netherlands and low back pain rehabilitation by 50% in Ireland, 40% in Italy, and 70% in the Netherlands. The most commonly used measures were the Functional Independence Measure and Barthel Index for individuals after stroke and the Oswestry Pain Disability Questionnaire and the Visual Analog Scale for individuals undergoing treatment for low back pain.[61]

The 2000s. In a March 2003 survey, physiotherapists in Australia working with orthopedic clients (n = 318) reported using outcome measures with 30% of clients. Respondents reported using outcome measures more when working with clients with spine conditions compared to clients with conditions affecting the extremities.[62] Members of the Royal Dutch Society for Physical Therapy (n = 167) were surveyed in 2004 regarding compliance with outcome measure recommendations in the Clinical Practice Guidelines on the Physiotherapy Management of Patients with Stroke published in the Netherlands. Despite 91% of respondents reporting that they had reviewed the clinical practice guidelines, therapists reported they only used the recommended measures with 7 to 49% of patients. Therapists reported using a recommended outcome measure during the initial evaluation for 69% of patients and at the time of discharge for 57% of patients with a history of stroke.[63] Douglas et al[64] surveyed Australian physiotherapists (n = 440) using a modified version of the European survey completed in 1998. Therapists reported measuring outcomes most commonly with range of motion, Visual Analog Scale, and muscle function testing for orthopedic conditions. For neurologic conditions, therapists most often used manual muscle testing, the Functional Independence Measure, range of motion, and muscle function testing. Douglas et al[64] noted that there was considerable variability in which outcome measure physical therapists reported using.

Physical therapists also reported using measures of activity and participation infrequently in this study. The Functional Independence Measure was used with 51.5% of patients with a history of stroke and 47.8% of patients with neuromuscular disease. The Berg Balance Scale was used with 31.9% of patients with a history of stroke and 17.1% of those diagnosed with TBI. The Functional Independence Measure and the Berg Balance Scale were the two most frequently used activity-based outcome measures.[64] Akinpelu and Eluchie[65] distributed a survey at the 2000 conference of the Nigeria Society of Physiotherapy, receiving 236 responses. The survey asked respondents if they were familiar with and used 16 outcome measures frequently recommended in the scientific literature. Greater than 50% of respondents indicated they were not familiar or barely familiar with 14 of the 16 measures. Greater than 60% of respondents indicated they never used 14 of the 16 measures. The two most frequently used measures were the Visual Analog Scale and the Gross Motor Function Measure; 65% of therapists reported using the Visual Analog Scale "often" or "always," and 33% reported using the Gross Motor Function Measure "often" or "always."[65] In a 2009 United States survey of 498 APTA members, 52% of respondents reported they did not use outcome measures in clinical practice, and 49% reported they did not plan to use outcome measures in the future. Respondents reported the measures they used most often were the Oswestry Low Back Disability Index, facility "homegrown" measures, and the Lower Extremity Functional Scale.[52]

The 2010s. In a survey published in 2015, Swedish physiotherapists (n = 1 217) reported how frequently they used various special tests and patient-reported outcome measures when working with individuals with low back pain. The Visual Analog Scale was used "always/often" by 68% of respondents. However, the Patient-Specific Functional Scale, 36-Item Short Form Survey, Tampa Scale for Kinesiophobia, Fear-Avoidance Belief Questionnaire, depression and anxiety scales, and scales to measure risk or prognosis were used "never/seldom"

by >80% of respondents.[66] A 2014 survey of physical therapists in India (n = 81) reported that 80% of musculoskeletal therapists reported using outcome measures. However, of those who reported using outcome measures, 92% reported primarily using impairment-based measures. The majority of respondents were unfamiliar with most of the standardized self-report measures, including the Roland-Morris Disability Questionnaire, Oswestry Disability Index, Disabilities of Arm, Shoulder, and Hand.[57] The studies reviewed reveal that physical therapists in North America, Europe, Asia, Africa, and Australia use outcome measures infrequently.

Measures of balance. A few published studies have looked specifically at how therapists measure balance in neurologic populations. Andrews et al[67] completed a survey in 2008 of United States Neurologic Clinical Specialists and Geriatric Clinical Specialists (n = 128) regarding which measures they used "frequently" when working with individuals with stroke. Respondents reported frequent use of the following measures of balance and mobility: Berg Balance Scale (85.2%), comfortable gait speed (75.8%), Functional Reach Test (66.4%), Single leg stance test (62.5%), Timed Up and Go Test (62.5%), Romberg Test (60.9%), and fast gait speed (60.3%).[67] Sibley at al[47] surveyed Ontario physical therapists (n = 337) regarding the frequency of assessing automatic balance reactions and found that 42.6% of respondents reported regularly assessing it, 43.2% reported periodic assessment, and 14.3% reported never assessing automatic balance. Of those who did assess automatic balance, only 15.4% reported using standardized measures, with the most common being the Berg Balance Scale, Tinetti Performance Oriented Mobility Assessment, single leg stance test, and the Timed Up and Go Test. Respondents reported they assessed reactive balance with non-standardized perturbations and movements analysis the majority of the time and with the Berg Balance Scale in 8.4% of cases, the Tinetti Performance Oriented Mobility Assessment in 5.4% of cases, the Single leg stance test in 5.0% of cases, and the Timed Up and Go Test in 4.2% of cases.[68]

Benefits and Barriers to Outcome Measure Use

Much of the outcome measure research published in the last decade has focused on increasing utilization of outcome measures by analyzing barriers and facilitators. The reasons for using or not using standardized outcome measures are multi-faceted and have changed over the years. Physical therapists have reported time constraints, difficulty changing daily routine, lack of equipment, and limited knowledge related to selection, use, and interpretation as barriers to outcome measure used.[52,59,69] Hands-on experience administering a measure, facility culture, administrator support, participation in a recent academic program, and perceived clinical usefulness were all reported to facilitate the use of outcome measures.[45-47,52,70]

Outcome measures have several potential benefits to PT practice. Because the belief that a measure is clinically meaningful is a primary facilitator to increased use, understanding therapists' perceived benefits is integral to understanding this topic. Wedge et al[70] interviewed physical therapists (n = 21) from the Chicago area working in outpatient, inpatient rehabilitation, and skilled nursing settings with various patient populations. Interviews focused on therapists' use of outcome measures, how they learned about outcome measures, what factors influenced their decisions related to outcome measures, and the therapists' perceived value of outcome measures. The participants in this study reported that outcome measures could augment practice by aiding in decision-making, including treatment intervention decisions, providing objective data to justify treatment, and documenting the effectiveness of the plan of care. Therapists also described that outcome measures benefit the profession of PT by providing reliable and valid tools that can be used to grow the body of research. Some therapists interviewed also reported that the use of outcome measures could enhance the professional image of physical therapy with other health professions. They believed that an elevated image for physical therapy might improve autonomy.[70]

Jette et al[52] surveyed 498 members of the APTA about what benefits they believed using outcome measured afforded physical therapists. More than 80% of respondents endorsed the following outcome measure benefits: enhanced communication with patients (94.5%), helped direct plan of care (93.6%), enhanced communications with payers (87.2%), enhanced thoroughness of physical therapist examination (87.2%), improved patient outcomes (84.4%), and helped focus the intervention (83.5%). Fewer therapists indicated that the benefit of outcome measures includes decreasing insurance denials (68.8%) and enhancing the marketing of a facility (52.8%).[52] McAuley et al[56] surveyed 172 Canadian physiotherapists working with clients with osteoarthritis or after total joint arthroplasty. Most respondents reported that they used outcome measures to facilitate decision-making. The proportion of respondents who endorsed using a measure was variable and depended on the outcome measure. Up to 98% of therapists reported using the numeric pain rating scale, 75% the Timed Up and Go Test, 59% the Lower Extremity Functional Scale, and less than 5% the Knee Injury and Osteoarthritis Outcome Score. A significantly smaller number of respondents used outcome measures for program evaluation.[56]

Specific to the neurological population, Pattison et al[46] interviewed 28 Canadian physiotherapists, and Danzl and Hunter[45] interviewed 18 administrators and physical therapists in Kentucky. Participants in both studies worked in all levels of the continuum of care, acute care, inpatient rehabilitation, and outpatient, and discussed the role of outcome measures in working with individuals after stroke. The Canadian therapists in the study conducted by Pattison et al[46] reported that walking measures supported clinical practice by allowing physical therapists to better communicate with other healthcare providers, communicate with patients more efficiently, motivate patients, formulate prognosis for walking recovery, plan treatments, and plan discharge. The Kentucky therapists from Danzl and Hunter's[45] investigation also reported that outcome measures with the stroke the population had the benefit of enhancing clinical communication and

supporting decision-making. The use of outcome measures facilitated the therapist's ability to determine a patient's need for services better, assess progress, set goals, and select intervention type and intensity. Outcome measures that supported decision-making were perceived by therapists to be clinically relevant, spanned multiple constructs, and related to the patient's functional capacity or performance. Therapists in this study cited the additional benefit of outcome measures as objective data to document the need for services or equipment to payers or document need for assistance for inpatients to prevent falls.[45]

McGinnis et al[48] interviewed 11 inpatient and outpatient physical therapists in one suburban health system in the Northeastern United States, and Sibley et al[68] surveyed 369 Ontario physiotherapists to investigate therapist behaviors and beliefs related to balance assessment. The role of balance outcome measures in the decision-making process was one of the major themes that emerged from the interviews conducted by McGinnis et al. Therapists report relying on movement observation to guide the selection of an outcome measure and, in turn, used the outcome measure for goal setting and measuring patient progress. Interviews revealed the usefulness of an outcome measure depended on the setting in which a therapist worked. However, therapists reported that even outcome measures that took a long time to complete would still be performed if the measure had sufficient perceived clinical value.[48] Given a list of outcome measures, Sibley et al[47] asked respondents to use a 5-point Likert scale to rate each measure's ability to inform clinical decision-making and treatment choice. This study illuminated a difference in usefulness for specific measures between therapists who worked in different practice areas as well. Therapists who worked primarily with orthopedic clients agreed that the Single leg Stance Test was useful for decision-making in 91.2% of cases, compared to 78.5% of neurologic physical therapists and 62.1% of those working with geriatric clients. The Berg Balance Scale, on the other hand, was reported as useful by 94.9% of neurological physical therapists, 72.4% of

geriatric physical therapists, and 58.5% of orthopedic physical therapists. These results highlight the context-specific nature of outcome measure's clinical utility, specifically when looking at decision-making related to rehabilitating impaired balance.[68]

CLINICAL REASONING AND DECISION-MAKING IN HEALTH CARE

Health care goals are typically focused on preventing death and disability and maintaining or improving quality of life. Clinical decision-making is a complex process by which health care providers integrate collected data, knowledge and skills, and contextual factors to determine the most appropriate course of action to meet these goals.[71(pp6)] It is defined as "reasoning that results in action." There are three assumptions regarding the process of clinical decision-making: 1) deliberation about the appropriate course of action occurs in a specific context and with specific desired outcomes, 2) the thought process and outcome are tied to prior personal and professional experiences, and 3) prior experiences form the framework around which the plan of action is decided.[72]

Clinical reasoning is a non-linear cognitive process, underpinned by three assumptions, that are used to make a clinical decision. Clinical decisions are typically related to diagnosing and engaging in patient management.[72] This process is multi-dimensional and involves knowledge of evidence, collaboration with clients, caregivers, and other health professionals, and personal reflection. Awareness of current literature occurs through multiple avenues; clinicians must possess the appropriate skills to appraise the evidence and determine appropriateness for integrating it into practice. Beyond this, therapists' expertise, psychomotor skills, and problem-solving skills have an impact on the clinical reasoning process and resultant clinical decisions.[73] The strategy of patients and clinicians working together to share decisions, with mutual respect of goals, values, and beliefs, is gaining prominence in health care policy. Shared decision-making has been posited to improve patient health outcomes. While that has not yet been supported

systematically, shared decision-making is associated with improved affective-cognitive patient outcomes. Affective-cognitive outcomes include knowledge, understanding, trust, satisfaction, and other affective-emotional effects.[74] Practicing self-reflection has also been highlighted in literature for multiple health professions as an integral tool for refining clinical reasoning skills and progressing from novice to expert practice. It involves self-awareness, recognizing and recalling salient events, critical analysis of a situation, assumptions, and alternative approaches, synthesis of new knowledge, and evaluation of values.[72] In the practice of PT, clinical reasoning also depends on the personal and environmental contexts in which it occurs. Of specific impact are the available resources, time, financial support, and culture, as well as the physical, psychosocial, and educational factors of the patient and therapist.[73]

Clinical reasoning frameworks can be used to understand how the process occurs systematically. Examples of such frameworks in frequent include the World Health Organization (WHO) International Classification of Functioning and Health (ICF) and the Guide to Physical Therapist Practice. The WHO ICF designates patient problems as existing in the realm of body structure and functions, activities, or participation, with further consideration for environmental context. The use of this framework by health care practitioners in different disciplines provides a common language, facilitating a common understanding. This common language allows them to determine team member roles and systematically diagnose, establish prognosis, and prescribe interventions focused on each area of a patient problem.[75]

The patient and client management model, as proposed by the Guide to Physical Therapist Practice,[53] is composed of phases of patient management: completion of examination procedures, evaluation of data and identification of problems, determination of diagnosis and prognosis, intervention, and re-examination and evaluation.[53] These steps can be completed sequentially or non-sequentially during an episode of patient management. Clinical reasoning is

understood to occur during each step; one step's reasoning and decisions affect those that occur during iterative steps.[73] McGinnis et al[48] investigated physical therapists' clinical reasoning and decision-making process when working with patients with balance deficits. During qualitative interviews, therapists described that they employed three clinical reasoning stages and made decisions regarding balance impairment that were analogous to the steps in the PT patient and client management model. The therapists' first step was typically movement analysis than data gathering to make decisions regarding diagnosis and treatment planning. Data gathering and diagnosis and treatment planning were repeated through multiple iterations, each iteration contributing to decisions made in future iterations. The specific role of examination procedures in the clinical reasoning process was highlighted among rehabilitation health care providers.[48] Kuipers et al[76] illustrated the responsibility of examination among occupational therapists during clinical reasoning and decision-making in the management of the upper limb with hypertonicity. This investigation reported that findings in the physical testing of resistance to passive movement and occupational therapy intervention goals were the two most essential factors in predicting what intervention was selected.

The clinical reasoning process used to diagnose and manage a patient can be categorized into deductive and inductive approaches. These reasoning processes are rooted in positivism, the philosophical theory that truth about the natural world is objective and knowable, and the empirico-analytic paradigm, the research paradigm on which randomized control trials are based.[77] Novice and expert health care practitioners have traditionally been reported to use different approaches to decision-making.[30] Less experienced clinicians, or clinicians faced with a new or complicated situation, will follow a deductive approach, which is alternatively called a hypothetico-deductive approach because it is driven by hypotheses. The hypothetico-deductive clinical reasoning process is the most prevalent process used in medicine, where the diagnosis is

the primary goal of patient interactions. When using deductive reasoning, a clinician notes initial clues from or about a patient and formulates a provisional hypothesis. Further information gathering, patient examination, and patient management are used to confirm or negate the hypotheses. Clinical reasoning utilizing the deductive approach aims to measure and test available data reliably.[77]

Experienced therapists have been reported to use an inductive process, especially when in familiar situations. Inductive reasoning involves systematically analyzing history, patient report, movement analysis, and objective testing to recognize patterns, or "illness scripts." Using this strategy, clinicians utilize knowledge gained from their clinical experience to recognize the features of a case to conclude the most likely diagnosis quickly. Inductive reasoning is faster and typically more efficient than deductive reasoning.[77] However, inductive reasoning is more prone to the reasoner's biases, like relying on information that is currently or readily available or the tendency to confirm a current hypothesis.

Edwards et al[77] used ground theory to study the explore the clinical reasoning of six physical therapists in-depth. The authors of this study observed clinical interactions, conducted interviews, and read written reflections. Therapists engaged in an interplay of reasoning strategies. Rather than relying primarily on one approach, therapists used deductive and inductive reasoning. Therapists also utilized a non-positivist reasoning strategy, narrative reasoning, aimed at understanding the experiences, beliefs, and assumptions of patients. In this study, clinical was portrayed as a dynamic process that underlies all interactions that involve communicating, completing procedures, teaching, collaborating with patients, making predictions, and navigating ethical problems.[77]

KNOWLEDGE TRANSLATION IN HEALTH CARE

An essential part of clinical decision-making is working within the best practice parameters of a given environment and situation. Constant innovations provide the potential for care that is more effective, efficient, and safe. However, problems arise in incorporating these improvements into routine practice, with as many as 30-40% of patients in the United States receiving care that is not in line with current scientific evidence and about 20-25% receiving unnecessary care.[78,79] Behavior change is possible, and many methods to facilitate this change have been proposed.[80] The field of knowledge translation (KT) is focused on this application of research to practical and clinical settings in order for clinicians to incorporate best practice innovations. This field is a response to the paradigm shift in health care from authority and tradition-based to evidenced-based. The incongruency between evidence and practice has prompted the study of the complex mechanisms through which knowledge transitions from research to clinical use. Considerable effort has been put into development and assessment of which strategies are most effective at changing behaviors.[81]

A concrete definition of KT is necessary for an in-depth discussion of this field; two concordant definitions can be used. Most generally, the WHO adapted the original definition of KT proposed by the Canadian Institutes of Health Research: KT is "the synthesis, exchange, and application of knowledge by relevant stakeholders to accelerate the benefits of global and local innovation in strengthening health systems and improving people's health." Specific to rehabilitation, the National Center for the Dissemination of Disability Research (NCDDR) proposed KT is "the collaborative and systematic review, assessment, identification, aggregation, and practical application of high-quality disability and rehabilitation research by key stakeholders (i.e., consumers, researchers, practitioners, and policymakers) to improve the lives of individuals with disabilities."[81]

Knowledge Translation Models

As with clinical reasoning, frameworks can be used to conceptualize and organize ideas related to KT. In a review of best practice recommendations for knowledge translation interventions with physical therapists, Zidarov et al[82] recommended the use of a conceptual model to ensure an understanding of the process and focus efforts among all stakeholders and predict intended change. The Canadian Health Institutes of Health Research, the institute that coined the term knowledge translation, represents the process in 6-steps:

1. Defining the research question
2. Conducting research
3. Publishing research findings
4. Placing research findings in the context of other knowledge and norms
5. Making a decision, taking action informed by research findings
6. Influencing subsequent research based on knowledge impact

This model encompasses many phases of KT. Other frameworks have been described that focus on one or two steps of this process.[81] These models are primarily concerned with the individual level, the context, or interactions between them. The Stetler Model of Research Utilization is an individual-focused KT model, designed to be a prescriptive and conceptual guide for practitioners. This model has two parts, a graphical representation of the five phases of research utilization and a clarification and options section. The newest version does caution users to be vigilant regarding which type of research, seeking systematic reviews over primary studies. The five phases of research utilization according to this model are[83]:

1. Preparation – identify potential problems, determine priorities, involve others, consider internal and external factors, and select evidence

2. Validation – rate the quality of evidence, determine clinical significance, determine appropriateness for implementation
3. Comparative evaluation/Decision-making – evaluate the fit of the evidence of in the setting, determine the value and feasibility of the practice change, and compare to current practice
4. Translation/Application – confirm the type, level, and method of use
5. Evaluation – pilot or evaluate the formal implementation of practice change

There are four context-focused frameworks that have been published, The Ottawa Model of Research Use, The Knowledge-to-Action Process Framework, The Promoting Action on Research Implementation in Health Services Framework, and The Coordinated Implementation Model. Each of these is concerned with how context impacts KT. The Ottawa Model of Research Use requires users to assess, evaluate, and monitor six elements before, during, and after implementing an intervention. These six elements are evidence-based innovation, potential adopters, practice environment, implementation of interventions, adoption of innovation, outcomes of results from the implementation of the innovation.[84] This model has been found to be feasible and effective in clinical application.[84,85] The Knowledge-to-Action Process framework emphasizes the relationship between knowledge creators and knowledge users. This framework encompasses the application of knowledge to the clinical environment and the creation of knowledge. This framework is more inclusive, as stakeholders include practitioners, policymakers, patients, and the public.[86] The Knowledge-to-Action framework is one of the most frequently cited conceptual frameworks. As reported by a 2014 systematic review, it is used in practice with varying levels of adherence to theory; the majority of studies reporting utilization of this framework were conducted in Canada.[87]

The Promoting Action on Research Implementation in Health Services Framework is concerned with the interplay between the nature and level of evidence, the context the research is to be placed, and the method the research implementation will be facilitated. A distinguishing feature of this model is the focus on a facilitator's role to help enable potential research users. More work is needed to determine the applicability of this model to practice.[88] The Coordinated Implementation Model highlights the typically unexploited pathways for research to influence clinical practice, specifically the role that patients play in affecting clinicians' decisions. This model purports that implementation strategies should consider the views, activities, and available resources of the interest groups in the community, administrators, public policy makers, and clinical policymakers.[89] The Understanding-User-Framework is an interaction-focused framework. This conceptual model indicates five domains to consider when establishing interactions:

1. The user group – characteristics of the group, operational context, decision-making practices, access to information, attitude toward research, experience with KT
2. The issue – characteristics and context of the issue to be resolve through KT
3. The research – relevance, congruence, and compatibility of research to the user group
4. The research-user relationship – the relationship between researcher and user group
5. The dissemination strategy – mode of interaction, level of detail, use of feedback from the user group

The framework recommends questions to determine available information in each domain to guide the implementation of knowledge.[90] These frameworks can serve as helpful tools for any stage of the KT process and serve as guides in which contextual factors, stakeholders, and issues are taken into consideration.

Evidence for Knowledge Translation Delivery Modes

Much research on the effectiveness of KT strategies has focused on physicians, with fewer investigations in the allied health fields.[81] A consistent finding has been that efforts are more successful when they are intensive, thorough, and constrained to a single subject.[91] Educational meetings are the most commonly utilized strategy used to translate research into practice in rehabilitation disciplines.[54,92] These meetings utilize multiple teaching and learning methods, including passive instruction, active engagement, visits from experts in the content area, or delivery of education materials. One-on-one mentoring or engaging with individuals identified as influential, has also been successfully utilized as a knowledge translation tactic. Using tools to remind clinicians of the material they have been educated on and providing a summary of performance are techniques that may be used to augment meetings, mentoring, or material delivery.[54,92]

Passive instruction. Research with physicians indicates that didactic educational meetings or educational materials alone are not enough to change clinical practice.[89] Systematic reviews by Bero et al[91] and Grimshaw et al[93] found that passive instruction is generally ineffective at influencing behavior change. Heinemann et al[94] reported that lecture-based education on post-stroke rehabilitation guidelines elicited in knowledge or practice behaviors among physicians or allied health professionals as self-reported on a questionnaire.[94] This finding is consistent, independent of the perceived importance of a topic. These findings are consistent with those of behavioral scientists who have determined that increasing confidence and skill base is necessary for individuals to attempt new behaviors and for those behaviors to persist when they experience obstacles. Didactic instruction alone is unlikely to impact behavior change.[95] However, passive interventions may be beneficial at improving awareness of a problem.[81]

Interactive strategies. Interactive elements can be used to combat the ineffectiveness of passive didactic instruction. These interactive elements can be incorporated as interactive educational meetings or as an ongoing collaboration between researchers and knowledge users. Interactive meetings, including the incorporation of physical practice of skills or problem-solving skill-related tasks, are consistently effective at changing practitioners' behavior.[91,96]

Vingilis and colleagues[97] reported that integration of knowledge creation and knowledge utilization through the development of researcher-clinician partnerships is feasible. This descriptive study involved collaboration between potential knowledge users and researchers at the Consortium for Applied Research and Evaluation in Mental Health. In this publication, potential knowledge users included mental health professionals, medical providers at a local emergency department, the staff at a community homeless shelter, and consumers and their families. The authors indicated that strategies that involve interaction require more time, money, and effort than those without collaboration between researchers and knowledge users.[97]

Educational outreach visits. It is effective when persons trained in educational interventions and understand the evidence meet with practitioners in their practice setting to deliver content and facilitate the application of knowledge. Bekkering et al[98] found that educational sessions focused on the Dutch guidelines for patients with low back pain delivered through education, group discussion, role-playing, and feedback did result in changes in clinical practice and patient outcomes. Patients treated by therapists who participated in this intervention had improved physical functioning.[98] A 2016 systematic review found that education visits that incorporated didactic and interactive content resulted in behavior change among clinicians.[96]

Mentoring. An experienced mentor's individualized support based on a mentee's particular needs has been posed as another potential KT intervention. Mentoring requires the development of an interpersonal relationship with mutual benefit and commitment. A 2014

systematic review of the effectiveness of mentoring KT interventions found mixed support. Mentoring alone was linked to changes in clinician behavior in one study assessed in this review.[99] Mentoring, along with other strategies, had mixed finding in nine of the studies assessed by this review.[99] Multifaced interventions with mentoring improved participants' knowledge, beliefs, and organizational outcomes.[99]

Local consensus or opinion leaders. The Knowledge-to-Action Framework highlights the importance of adapting knowledge to the local context during the action phase. Adapting to the local context can be done through collaboration with local opinion leaders. Opinion leaders are individuals, either formally established or informally recognized, that impact the beliefs and perceptions of others in the group. When used with the director of a facility, the chief of staff, department managers, physicians, nurses, and physician's assistants, this technique was found to have variable effectiveness.[93]

Reminders. Tools can be used to remind knowledge users, through manual or electronic means, to change behavior. Reminders can enhance compliance and are consistently effective at changing health care provider behaviors in various settings. A systematic review of systematic reviews reported a small to moderate effect size among residents, attending physicians, and nurse practitioners working in primary care, emergency departments, and outpatient centers.[96]

Audit and feedback. Generally, audit and feedback have variable effectiveness in KT. Audit and feedback are summaries of performance over a specified period provided in written or verbal formats. They are more effective when baseline adherence to a target practice behavior is low before intervention than when baseline adherence is average or high. Additionally, feedback that is delivered in high intensity is timely, is provided on an individual basis rather than aggregate, and is non-punitive is most effective. Active participation in audits also increases the impact on behavior change, rather than passive delivery.[81,100,101]

Multifaced interventions. Evidence is unclear regarding the use of multiple KT strategies. Grimshaw et al[93] in 2001 completed a systematic review, finding that interventions that utilize two or more of the above strategies and target several barriers to behavior change have consistently been found to be more effective than single strategies used alone.[93] However, a systematic review by Albrecht et al[96] in 2016 found that one KT strategy was equally as effective at influencing behavior change as multiple strategies for child health professionals working in acute care and urgent care settings. The influence of context is not known concerning these intervention strategies.[96]

Impact of Training Evidenced-Based Practice Skills

Young et al[102] synthesized 16 systematic reviews, and reviewed 81 additional studies, and reported that EBP training programs could improve EBP knowledge, skills, and attitudes. In one such study, nurses enrolled in a course focused on evidence-based practice, including 5 hours of face-to-face instruction and 30 hours of online learning, demonstrated measurable improvements in self-reported knowledge and skills related to evidence. However, the nurses did not report a change in practice behavior, including integrating evidence, evaluating outcomes of practice, or sharing knowledge with colleagues.[103] Similarly, students enrolled in a Bachelor of Physical Therapy program at the University of Ferrara, Italy, participated in training on EBP. The training included formal didactic training and application during internships. Participating students reported improvements in knowledge and skills from baseline, but did not change in practice behaviors after the intervention.[104] However, a different study with primary care physicians and nurse practitioners who participated in weekly face-to-face evidence-based medicine instruction for 8 weeks reported improvements in knowledge, application, and planned future use.

Additionally, patients whose primary care providers participated in evidence-based medicine demonstrated improved blood pressure control and higher patient satisfaction scores.[105]

The difference in results could potentially be attributed to a finding by Aasekjær et al[106] that middle-range managers held an essential role in implementing EBP. Nurses in Norway who had participated in post-graduate education on EBP skills indicated that they could better utilize these skills if their managers had also participated in EBP education and were willing to coordinate education meetings in their department.[106] A 2018 systematic review further investigated the specific question of the impact of EBP training on patient outcomes. Of 18 studies reviewed, 15 reported improved patient outcomes following health care provider education focused on evidence-based processes and principles delivered through didactic means, workshops, or mentoring. The areas of improvement included pain management, urinary catheter utilization rate, pressure ulcer frequency, length of hospital stay, dialysis catheter infection rates, central line infection rates, aspiration pneumonia rates, ventilator-associated pneumonia rates, and patient anxiety.[107]

Impact of Knowledge Translation Programs in Physical Therapy

Numerous studies have indicated that physical therapists have favorable attitudes about the EBP and agree that practicing based on the current evidence is essential but, like other health care professions, frequently do not meet current evidence-based recommendations for practice.[108] Dannapfel et al[108] investigated the theoretical foundations for the integration of evidence in practice. The authors conducted 11 group interviews with 45 physical therapists in Sweden about their motivations for using research. Most subjects were motivated to engage in EBP autonomously, but some therapists described externally regulated motivation or lack of motivation. Autonomously motivated behaviors were more stable than externally regulated behaviors, and providers who were autonomously motivated performed with higher quality than other providers who demonstrated externally motivated behaviors.[108]

In a review of the current evidence for knowledge translation interventions specifically implemented with physical therapists, several potentially effective interventions emerged. Knowledge interventions with a physical therapist that did not report outcomes were detailed by two authors.[109,110] Christensen et al[111] described a case report of a knowledge translation program at an extensive pediatric hospital system in Ohio. The program incorporated an EBP coordinator to facilitate staff participation, develop a knowledge translation process, educate staff, and facilitate the creation and implementation of evidence-based recommendations for use within the hospital system. After six years, due to the limited involvement of PT staff and only one clinical recommendation, the program was revised. This revision included an analysis of organizational, leadership, and individual barriers with strategies designed to reduce these barriers. Strategies included requiring physical therapist participation in the KT program and linking it to annual performance reviews, one-on-one educational meetings focused on EBP skills, education to staff on developed recommendations through in-services, clinical recommendations supported with changes in the medical record, EBP coordinators designated for each sub-specialty of PT, and administration providing paid non-clinical time to staff and coordinators. After the revisions, the overall compliance with recommendations was 79%, which indicated improved compliance with EBP above the average for all health conditions and all health care providers; however, the baseline compliance with recommendations was not reported. Therefore, the improvement linked to the knowledge translation intervention is not known. Additionally, because multiple types of interventions were utilized, the impact of each is not known.[111]

At three facilities in the University of Southern California system, a 6-month education program consisting of four steps was implemented to promote physical therapists' use of research in clinical reasoning. This program consisted of securing management support, the distribution of electronic education materials, a two-day didactic and interactive training workshop, and five

months of small group meetings culminating in the creation of a "Best Practice List" for physical therapy for lumbar spine conditions that included 38 evidence-based behaviors at each department.[112] The sixteen physical therapists who participated in this program demonstrated improvement in evidence-based practice self-efficacy, self-reported behaviors from baseline to 6-month follow-up, and evidence-based practice knowledge and skills from post-implementation to 6-month follow-up. Through qualitative analysis, therapists reported that the program as engaging and motivating. Though patient outcomes were not measured in this publication, therapists reported that they believed the process of creating and using the "Best Practice List" would lead to better patient outcomes.[113]

Outcome measure utilization. The focus of most knowledge translation related publications in PT is on outcome measure utilization. The Brain Recovery Core system is a multidisciplinary, interinstitutional partnership in St Louis, MO, implemented in 2010. The system's goal was to support clinical and program decisions and research through data using a common set of outcome measurements. This program was focused on patients with a diagnosis of stroke admitted to acute care and then transferred to inpatient rehabilitation or outpatient facility within the partnership. A test battery for each discipline was established, with criteria for maximizing reliability, validity, responsiveness, and clinical utility while minimizing change for current practice. Recommendations were made for 9 measures of strength, sensation, gait, and balance, to be performed by physical therapists at evaluation, progress summary, and discharge. The knowledge implementation strategy occurred through 1) communication of clear administrative support, 2) a lead therapist in each service acting as a "clinical champion," 3) distribution of education materials, 4) interactive educational meetings, and 5) feedback to staff and administrators. Therapist compliance with recommendations varied from 60-100% for

months April to December 2010. Measurement started 3 months after the educational intervention. Baseline compliance was not reported, so the change in behavior is not known.[114]

Dutch physiotherapists (n = 30) who volunteered to participate in an education program focused on outcome measurement in stroke were randomized to a tutor with less than 6 months experience with outcome measures in stroke or a tutor with more than 10 years' experience. Both groups attended five 2-hour training sessions EBP concepts, seven recommended measures for walking and hand and arm use, and practice and discussion of measures. Those with a more experienced tutor increased the actual use of outcome tools, from a median of three outcome measures to six outcome measures for each patient. In comparison, participants mentored by a less experienced tutor demonstrated a median change in outcome measure use from three measures to four measures per patient. Both groups had similar increases in self-reported usage of measures, except that the group with the more experienced tutor reported higher use of one arm measure, the Frenchay Arm Test.[63]

An administrative case reported identified outpatient pediatric physical therapists who demonstrated significant increases in frequency and variety of outcome measures utilized after a knowledge translation intervention. The interventions implemented with the 17 participating therapists were based on the knowledge-to-action framework. The specific interventions included a baseline knowledge assessment with private individualized feedback from an administrator, a 2-hour practice-based educational session, and a 1-hour educational session 2 months after the first workshop. The workshops included required readings, lectures, and active practice. These were led and presented by co-workers of the participating therapists. Staff members also received a periodic newsletter with reminders about the program and were asked to contribute examples of successes and barriers to an online message board. Each therapist was provided with paper and electronic copies of the five recommended measures and a decision-making algorithm. Increases

in outcome measure use were apparent through self-report and medical chart documentation after the educational intervention. The case-reported indicated that all therapists who worked at the four facilities involved in this project were required to participate by their department manager. However, no punitive actions were detailed in the report for therapists who chose not to participate, and no information was included regarding how this requirement was communicated to the therapists. All participating therapists did provide informed consent for data from their patient documentation to be anonymously assessed.[55] Intervention have been reported at the national level by two nations aiming to improve the frequency of outcome measure utilization. In 1994, Health Canada and the Canadian Physiotherapy Association published the Physical Rehabilitation Outcomes Measures manual, a compendium of the overview, instructions, scoring, interpretation, and psychometric properties of 60 measures. The Canadian Physiotherapy Association then conducted workshops in nine Canadian cities. Despite Canada's concerted efforts focused on increasing outcome measure utilization, there was little change from 1992 to 1998 in the frequency of outcome measure use. The percentage of therapists using published measurement tools changed nominally, from 41% of therapists in a 1992 survey to 43% of therapists in a 1998 survey.[69] The Royal Dutch Society for Physical Therapy conducted a national outcome measure implementation program with 366 physical therapists who volunteered.

The strategies used included a toolkit of recommended outcome measures specific to practice setting and four interactive half-day training sessions over 4 to 5 months that incorporated coaching, feedback, discussion of recommended instruments, guidance on the interpretation of test results in relation to clinical reasoning, and recommendations on reducing the impact of organizational barriers. Training sessions occurred over a 5-month period. An online survey was sent to every therapist who participated in the educational programming and 1000 randomly selected therapists who did not participate in the program. Therapists who

participated in the education program were asked to complete one survey within 3 weeks after participating in the last training session and a follow-up survey 8 months after the last training session. Results were available for 265 therapists from the education group and 279 from the control group. After participating in the education program, participants had a more positive attitude about outcome measures, a higher self-reported ability to choose appropriate measures, and self-reported using outcome measures with more patients, as compared to before the program. In contrast, the control group, who did not participate in the implementation program, demonstrated no change in attitude, confidence, or practice behaviors. The 247 therapists from the education group who completed the 8-month follow-up survey reported using outcome measures more frequently. The intervention group reported using outcome measures with 26% of patients at baseline and 41% of patients at follow-up. This is compared to the 190 control group therapists who completed the follow-up survey, who reported no change from baseline to follow-up in outcome measure use[115]

To promote the use of the best outcome measures in the United States, various components of the APTA have engaged in an intervention on a national scale. First, the Section on Research formed the EDGE task force in 2006. The Neurology Section of the APTA, now known as the ANPT, utilized the framework and resources developed by the Research Section to create diagnosis-specific recommendations for outcome measure use in clinical practice, education, and research. Recommendations were published in peer-reviewed journals from 2013-2016 for stroke, multiple sclerosis, TBI, and spinal cord injury.[116-119] Free printable resources related to these publications were made available to physical therapists on the ANPT website starting in 2013.[120] Education sessions focused on applying the information published by the EDGE task forces was presented at the Combined Sections Meeting in 2011, 2012, 2013, and 2016. In 2018, the ANPT completed the development of a clinical practice guideline for outcome

measures with patients with neurologic diagnoses, including the recommendation to include a "core set" of six measures with all patients. This core set was published in the *Journal of Neurologic Physical Therapy*, printable resources for administration, scoring, and environmental set up were made available online, and the recommendations were shared at the Combined Sections Meeting in 2020.[51] Unlike the large scale interventions that were conducted in Canada and the Netherlands, there is no follow-up data on which measures and how frequently measures are used in the United States since these publications and educational meetings were conducted.

METHODOLOGY

Mixed Methods Research

In this three-part research, elements of methodological strategies will be combined to enhance the value and breadth of data. This will include 1) qualitative data from interviewing, 2) quantitative data and statistical analysis from a cross-sectional survey, and 3) quantitative and statistical analysis from a longitudinal interventional study. This strategy is employed to reduce the impact of the limitations of each unique design strategy while maintaining its strengths. Triangulation of data sources and methodology has the opportunity to test for the inconsistency of findings and offer more in-depth insight than any single method employed in isolation.[121(pp316-319)] Hong and Espelage[122] propose that mixed methods have the potential to enhance study validity beyond one method used alone to provide more significant insights and to fill in gaps.

The specific sequence used is multi-phase, explanatory sequential, followed by exploratory sequential. Explanatory sequential occurs when quantitative data is first collected and analyzed, and then qualitative data is collected and analyzed to enhance understanding. An example would be an online survey followed by interviews. Exploratory sequential study is the process of first performing qualitative investigation, the results of which guide a proceeding quantitative study. In this case, interviewing is followed by interventional analysis. The selected

design and order and methodologies are ideal for the research question at hand: what is the role of standardized balance measurements in clinical decision-making and patient outcomes? Because beliefs, perceptions, and culture are non-observable and require self-report, surveys and interviews can be used to explore these concepts. Surveys allow a breadth of understanding while interviewing offers depth. Behaviors and the relationship between behaviors and outcomes are observable and can be analyzed; a combination of broad self-report with situation observation and analysis are appropriate.[122,123] This combination progresses from exploratory to descriptive than explanatory research.

Online Surveys

Survey research is a type of inquiry that depends on a subject's self-report of their knowledge, beliefs, or behaviors. No observations or measurements are taken, and no experimentation, or intervention, occurs. The assumption that underpins this design choice is that people will provide truthful and useful information when asked. Survey research can explore, describe, and analyze relationships and differences. The benefits of this study methodology include that it is time-efficient, typically low cost, can capture a vast geographic region, allows for anonymity, and is not restrained by the participant's schedule as it can be completed on their timetable. The anonymity can allow exploration of sensitive topics that respondents may not be comfortable discussing in an interview or allowing a researcher to observe. What surveys offer in improved geographic breadth, they do lose in the depth of responses and ability to ask or answer clarifying questions.[124]

Distribution of surveys can occur through mail, online, and by telephone. Web-based and email-based surveys are preferred when a population is geographically distributed, and the goal sample size is large. Compared to postal mail surveys, online surveys have a faster turnaround, have more design options, are lower cost, and are less burdensome on scientists for data entry.

However, according to Fan and Yan,[125] the response rates for online surveys can be as much as 11% lower than the response rate for surveys delivered through other modes.[125] Online surveys include any survey sent through email, posted on websites, and those sent through mobile phone messaging, with email being the most common. Of note, the reach can be limited in some populations as participants must have an email address or smartphone to receive the survey invitation and participate. Spam filters on email have also created a barrier to accessing the desired population. Some authors have proposed mixed-mode survey delivery, with invitations sent through email and postal mail for online surveys. However, the effectiveness of this strategy in increasing the sample size and response rate is not known.[125]

Beyond delivery methods, other design elements are critical to successfully managing survey research. Such elements include methods of selecting participants, design of the survey instrument and questions, design of the invitation, and the frequency and timing of pre-notification, invitations, and reminders. Some surveys may also include incentives, like loyalty points, lotteries, and electronic gift certificates. The goal is to maximize the response rate while maintaining the truthfulness of responses. The response rate is defined as the number of completed surveys divided by the number of eligible surveys.[125]

It is not possible in most populations of interest to contact all members of the population, so probability sampling and non-probability sampling are typically used in survey research. Probability sampling is considered best practice for methodological rigor.[124] This strategy employs a random selection from a population, of which the identity of all members may or may not be readily available. Probability samples allow calculation of margins of error for sample size, the expected potential difference between the sample data and population data measured in percentage points with a given confidence level. Non-probability sampling is not a random selection. This is most appropriate for exploratory research and is considered a less theoretically

sound technique. However, it has been argued that non-probability sampling is frequently the only practical option, and "it is better to have collected some data and gained some insight than to have collected no data."[126] The present study is an example of non-probability sampling, where every licensed physical therapist in the United States could not be obtained due to financial, legal, and privacy restrictions. With this type of sampling, generalizability is limited and should not be overstated. Non-probability includes samples of convenience, those who have volunteered to participate in the research, and snowball samples, where individuals refer known members of the population. Because margins of error do not drive sample size requirements with this sample strategy, the sample size recommendations for non-probability sampling is less clear. For maximal external validity, the general guide is more than 30, less than 500, and at least 10 times larger than the number of variables studied.[126] Online surveys have a bias toward individuals with internet access, so respondents will probably be younger, well-educated, and have a higher income than a general population.[125]

The survey instrument is typically comprised of a welcome statement, instructions, and survey questions. Best practices in the design of the survey instrument aim to maximize the response rate, minimize early termination, and maintain data quality. Response rates are impacted by the identity of the survey sponsor or source, the survey topic, and the time required to complete the survey. Surveys sponsored by universities or governmental organizations tend to have higher response rates. When a survey is on a topic of high interest to potential respondents, the response rate is higher.[125] Generally, surveys with shorter announced lengths are more likely to be started and completed by respondents.[127] Published work with college students estimates 13 minutes as the ideal length.[125] Survey questions without grammatical or spelling errors that are unbiased are easy to understand, and do not have technical errors can limit respondent drop out. Online survey displays can either be a screen-by-screen design with one question per page,

requiring respondents to click “next” to reach each subsequent item. Alternatively, scrolling design displays all questions on one page. Neither design has been found to affect participation or drop-out. A screen-by-screen design allows respondents to skip questions that are not relevant and provides a simple avenue for reminding respondents of the format of expected answers on each page.[125] A scrolling format provides a richer context for respondents and requires fewer computer resources, which may reduce technical errors or computer speed that can contribute to the termination of a survey.[125] Galesic and Bosnjak[127] reported that the position of a survey question has an impact on data quality. They found that questions asked earlier had longer answers to free-response questions and more variability to grid-style questions.[127]

Timing and style of contact with potential survey respondents play an integral role in participation. Personalization of the salutation and providing the title, office, and name of the sender have been found to increase the response rate. More socially desirable answers may be provided to sensitive questions when personalization is used. Mentions of the scarcity of time, like including a statement about an upcoming deadline for completing the survey, increase the response rate. Response rates are higher when participants are not required to create a username and password for participation. Authors have also suggested it is best practice to communicate how emails for those invited were obtained, to provide a realistic estimation of time to complete the survey and to refrain from including attachments. Use of pre-notification and reminder emails have both been found to increase response rates. Reminder emails sent 2 days after the initial invitation are more effective than those sent 5 days after. Though incentives paid prior to participation do increase response rates, incentives provided after participation have not been found to have an effect.[125]

Qualitative Interviewing

Some research questions are best answered through methods other than what is today considered the "gold standard," the double-blind, randomized control trial. Rigorous quantitative experimental studies have taken precedence in the field of health science. Many systematic reviews only include research completed with this method and proposed hierarchies of evidence incorporate only quantitative studies with a predictable ordering. However, health, and thus health care, occurs in the real world of the people experiencing it. Health care is defined just as much by the meanings people bring to it as any assigned numerical value. Hence, some data collection should occur in the natural environment of the people under study, be sensitive to the people under study, and interpret findings within their context. This is the role of qualitative inquiry.[121]

Qualitative research methods include participant observation and fieldwork, analysis of documents and objects, and interviews and focus groups. The purpose can either be to test an a priori hypothesis, as with typical quantitative research, or to explore meaning to gain a better understanding and generate a hypothesis. Either way, the goal is to contribute to a body of knowledge through understanding the meanings people assign to things, capturing people's perspectives, understanding how things work and how systems function and recognizing context. The selection of data collection strategy depends on the philosophical foundation of the research, the aim of the project, the people being studied, and the available resources.[121] Observations and fieldwork document observable aspects of human activity, including behaviors, conversations, interactions, and organizational processes. The data units are detailed descriptions of observations. Document analysis includes a review of clinical or organizational records, social media posts, correspondence, publications, reports, diaries, artistic works, and written responses to surveys. Data include excerpts from documents.[121] Interviews and focus groups use open-

ended questions to explore experiences, perceptions, opinions, feelings, and knowledge. They allow in-depth responses, and a typical data unit is direct quotations in context. Individual interviews allow the researcher to delve deep into personal opinions and issues where the group interview allows the collection of a broad range of opinions. Group interviews typically occur in the form of focus groups, where participants share experience or perceptions and researchers record statements and observations of group dynamics.[128]

Qualitative interviews are categorized by most texts as unstructured, semi-structured, and structured. Structured interviews are usually deductive, testing an a priori hypothesis, and yield more quantitative data. Unstructured interviews are a guided conversation where the researcher observes individuals and takes notes about their behaviors. The researcher then asks key people about the meanings of their activities, interactions, objects, and further questions that emerge over time. Semi-structured interviews are usually scheduled at predesignated times outside of everyday events. They utilize a set of predetermined open-ended questions with follow-up questions emerging during the interview. Semi-structured interviews are the most commonly used qualitative inquiry method. Interviews can occur with individuals or as a group interview.[128] Individual semi-structured interviews are most successful at capturing the complex meanings and understandings of participants when specific strategies are utilized. Researchers should strive to develop rapport quickly by communicating openness and respect for the information shared. The first question should be broad, open-ended, focused on the research question, and non-threatening. Follow-up questions should restate the words of the interviewee in order to avoid misleading answers.[128] Open-ended questions are used throughout the interview to allow participants to respond in a way that accurately represents their point of view about the world and the topic at hand.[121] Researchers should strive to develop expertise in the topic of interest as much as possible in order to formulate appropriate follow-up questions.[128] Interview questions and

study design typically change throughout the study, adapting to new knowledge as it becomes known. Each interview is placed in a social and environmental context and treated as one manifestation of a phenomenon, not as a generalization of a sample of a population. Because the qualitative researcher is the instrument of inquiry, they should reflect on their own perspective, be self-analytical, and authentic in expressing their own voice.[121]

Foundational frameworks. The epistemological perspective with which a qualitative research study is aligned has an impact on design, implementation, and analysis. Qualitative and quantitative research are both bound by theoretical paradigms. Quantitative research is founded on objectivity, positivism, and empiricism. Objectivity purports that truth can be known independently from individual subjectivity caused by perceptions. Empiricism is the theory that knowledge of truth comes from sensory experience, typically through experiments. Positivism is a system of thought that states that every assertion is capable of being scientifically verified or mathematically proven. In contrast, qualitative inquiry assumes that the natural world is understood in context. There are other more specific philosophical worldviews that offer a different framework, focus, or emphasis beyond that broad umbrella of naturalism. Ethnography, grounded theory, phenomenology, heuristic inquiry, constructivism, narrative inquiry, ethnomethodology, hermeneutics, systems theory, grounded theory, and pragmatism are some of the traditions that are seen. No study is required to prescribe to one framework, but due to the nature of the inquiry and foundational beliefs of the researcher, one or more frameworks typically have a more significant influence on decisions of methods and analysis of the study. Ethnography is the first evident tradition of qualitative inquiry. This framework asks the questions, “What is the culture of this group of people?” and “How does culture explain their perspectives and behaviors?” A group of people, according to ethnography, can be a tribe in a remote area, attendees at one school, a virtual community, or an organization. The primary tool of data

collection is intense participant observation, frequently where the investigator is immersed in the culture of study. Ethnography can also involve participating in groups in less intense ways or interviewing techniques that are underpinned by concerns regarding the cultural perspective. Applied ethnography uses the understanding of culture in change efforts. Pragmatism is concerned with how research findings can be applied to the practical understanding of issues. Rather than focusing on generating theory or understanding phenomena, pragmatic research aims to inform action. Pragmatism draws from various data collection techniques and mixed-method design is typical in research-informed by pragmatism.[121]

Audio recording. Past studies that have utilized interviews to explore outcome measure use among physical therapists have used audio recording[46,70,129] or have been recorded with no specifics provided.[45] Danzl and Hunter interviewed 18 administrators and physical therapists about outcome measure use with patients with a history of stroke. Though the authors did not provide recording specifics, they did describe transcription methods and results that were more consistent with audio recording than video recording, and no body language or non-verbal communication was mentioned. In other interview studies exploring topics noted by the authors to be potentially sensitive, with oncologists exploring patient quality of life issues or mental health practitioners discussing the evaluation of outcomes, audio recording was again chosen over video recording.[130,131] Though video recording is a fundamental method for many observational studies, mainly when subjects perform physical tasks or social interactions are occurring, the evidence for appropriate use in qualitative interviews is limited. In the 2012 publication, *An introduction to using video for research* from the National Centre for Research Methods (UK), video recording during semi-structured or structured interviews was not recommended.[132] Garcez et al[133] noted that video recording could capture complex phenomena beyond speech but recommended that the researcher completing the interviews collect audio recording, not video

recording. Methodologically, audio recording keeps the material produced more consistent with what is collected. Using audio recording instead of video recording is also more pragmatic, enhancing the transcription process's efficiency.[133] Additionally, video and audio recordings were found in one 2013 study to be equivalent to capturing the affective and emotional aspects of communication between nursing home residents and care providers.[134]

Open coding. Data collected through qualitative methods can be analyzed and presented numerically, visually, or through language. Language-based analysis is the most frequently used and is typically presented in the form of codes. A code is a generated construct in the form of a word or phrase that categorizes, summarizes, or depicts patterns of collected data. Authors have proposed many strategies to generate meaning from qualitative data through coding authentically. What is considered rigorous synthesis and analysis is dependent on the foundational framework, the form of collected data, and methods used in the collection. The purpose of coding is the reduction of data into fewer words that are more easily presented. Additionally, codifying adds value to the data by decoding the meaning and encoding a label. During the coding process, codes are applied to patterns and concepts that are seen multiple times in the data. Once codes are applied to these patterns, codes can be grouped into categories, and categories are grouped in overarching themes. Themes are used to infer assertions and theories about the phenomenon of study.

Though the process of applying, grouping, and interpreting codes differs between the frameworks and study, there are consistent techniques that are recommended to optimize the reliability and usefulness of data. The third edition of the *The Coding Manual for Qualitative Researcher* by Johnny Saldaña details a number of these, including data layout, pre-coding, coding concurrent with the collection, maintenance of a codebook, collaboration with other knowledgeable professionals, and consulting the research participants. Regarding layout, text-

based data is best prepared with enough space between lines to mark codes and into units with line breaks. Coding using specialized software must include headings and a layout dependent on the software requirements, but the strategy of dividing into accessible units is still best practice. Pre-coding includes highlighting, circling, bolding, underlining, or otherwise noting rich or significant text. Rather than beginning analysis after all data has been collected, as commonly done with quantitative studies, coding is recommended to occur both during data collection and once data collection is complete.[135] Coding concurrent with data collection allows research methods to be flexible to the evolving understanding of the phenomena. This allows the researcher to capture more depth and richness.[121] The codebook is a compilation of codes, content descriptions, and a brief data example. These are updated periodically and referenced regularly by the researcher. Maintaining a codebook provides an opportunity for analysis as well as the organization of categories and themes. Collaboration during coding can take the form of coding in a team, where all members of joint research endeavors are involved in the analysis. Alternatively, a lone ethnographer can consult with colleagues and mentors about coding and analysis. Member-checking can be used during analysis, by seeking advice from research participants related to codes, categories, and themes.[135]

There are specific coding methods that can be selected depending on the research's goal, type of data collected, and researcher experience. In vivo coding draws from the perspective of the participants. This specific method explores the body of the data to build a foundation for future coding. The words and phrases that make up the codes are derived from the subjects' words and phrases. These participant-generated codes are appropriate for action-oriented research and research that focuses on honoring the participant's voice. The theme of honoring the voice and expression of participants is based on the principles of ethnography on which this research

explicitly draws. In vivo coding is also a recommended coding method for beginner qualitative researchers.[135]

Trustworthiness. Qualitative research shares similar techniques to journalism. The trustworthiness of data is a key characteristic that distinguishes qualitative inquiry. Qualitative research employs strategies to maximize trustworthiness like quantitative research design maximizes internal and external validity and reliability. There is not a consensus on the criteria for optimal trustworthiness in qualitative research. However, shared categories have been proposed by qualitative researchers in the health sciences: integrity of data, the richness of data, balance between participant meaning and researcher interpretation, and transferability.

Data integrity is the integrity and adequacy of the data. Dependability is reached by the researcher clearly articulating the methods and analytic strategy used so that the study could be replicated. Triangulation can also be used to improve integrity. Combing multiple observers, theories, methods, and data sources are known as triangulation.[136] Triangulation of data, researcher, and method can provide evidence of data quality. Data triangulation includes collecting the same data set in different places, at different time points, or different levels of people. Levels of people include individual, group, or community. An example in health care research can be completing interviews with physical therapists, patients, and administrators, as well as focus groups. Researcher triangulation indicates that two more researchers are involved in the analysis of collected data. Typically, this includes concurrent or sequential coding with meetings to discuss areas of convergence and divergence. Methodological triangulation is when multiple methods are used to investigate the same research questions; this can include qualitative and quantitative methods or multiple qualitative methods like interviews and observations. Health care research can triangulate the findings of interviews and focus groups with observations of therapists in clinical practice or patients in their daily life. Another option is to triangulate the

interview and focus group findings with medical record documentation. [137] Lastly, impartial colleagues who have clinical or research experience with the concepts of the study should be consulted during the analysis phase to check categories, look for disconfirming cases, and discuss working hypotheses to enhance analysis credibility

Data richness can be achieved by sampling enough diversity and a sufficient number of participants. Though this number cannot be definitively known, the recommendation is typically to collect until redundancy. Redundancy occurs when no further data points, categories, or theories emerge from data collection.[137] Rich detail of the context and methods employed should be reported.[136] Direct quotes that exemplify the interpretations of analysis are also useful to develop a detailed description of the data.[137]

Subjectivity and reflexivity are vital to achieving a trustworthy balance between what the participants say and what the researchers interpret. Self-reflective journaling by the researcher is useful to help them become aware of biases and previously held assumptions. Member-checking, involving the participants in the data analysis process, by providing participants the opportunity to read and comment on the findings is another strategy to establish trustworthiness. The balance between researcher interpretation and participant meaning is another reason to employ auditing and feedback from researchers outside the study.[137]

Transferability describes the ability for a reader of qualitative researcher to transfer the findings to another context. To achieve optimal transferability, authors must include a detailed description of the participants,[136] findings supported by direct quotes, and the precise application of the findings.[137] Additionally, tying findings to current theory and practice can guide the reader to understand better where the study's findings fit in the gestalt of the topic.[137]

Krefting[138] proposed additional techniques specific to qualitative interviewing to maximize trustworthiness. These include reframing questions, including indirect questions about

the participants' experiences, and structured hypothetical situations. Additionally, Krefting[138] recommended detailed documentation of the data gathering and analysis and records of all raw data, data analysis, and synthesis products, and instrument development being be kept as part of the audit trail.

INSTRUMENTATION

Ratings of Functional Independence

The amount of physical assistance that an individual requires to complete a movement can be rated with various clinical tools. Health care facilities that provide care to patients funded by federal programs, Medicare or Medicaid, are mandated to complete the rating of specific tasks with a standardized rating form. The scale found in Section GG, Functional Abilities and Goals, of the *Long-Term Care Facility Resident Assessment Instrument User's Manual Version 3.0* is required in SNFs. The items and scoring in Section GG were initially part of the Continuity Assessment Record and Evaluation (CARE) item set. The items related to functional mobility included in the CARE item set are rolling right and left, moving from sitting to lying, lying to sitting, sit to stand, transferring to a chair, toilet transfer, car transfer, walk 10 feet, walk 50 feet with two turns, and walk 150 feet. Items are scored on a 6-point Likert scale with descriptive anchors. Each task is rated as requiring total (1), maximal (2), moderate (3), or touching assistance (4), only requiring help with set-up or clean-up (5) or requiring no assistance (6) with the task. Each task is rated separately. The CARE item set was developed by a task force using input from stakeholders, experts, and clinical groups, and the previously established functional independence scales from the Inpatient Rehabilitation Facility Patient Assessment Instrument (IRF-PAI) and the Outcome and Assessment Information Set (OASIS). In the development of the scale, the task force found it to have limited ceiling and floor effects and a stable hierarchy of tasks.[139] In a non-peer-reviewed analysis, the Center for Medicare and Medicaid Services reports

that the CARE item set had moderate inter-rater reliability. Greater than 50% of the items were found to have moderate agreement, with a kappa of .6 or higher. The kappa for each item and which items had acceptable kappa values were not reported.[140] No further reliability or validity measurements are available for the GG codes or CARE item set. It is used universally in SNFs because of the federal mandate. The Functional Independence Measure, on which the CARE item set and GG Code were based, was assessed in a 2019 systematic review. This study reported good responsiveness over time and with treatment, with large effect sizes of 1.4-1.7 points, good predictive validity for return to work or study 6 months after injury, and no floor or ceiling effects.[141]

Organizational Readiness to Change Assessment

Culture is an essential factor that impacts the results of a behavior change intervention implemented at an organization.[46,70,142-144] It is essential to understand the pre-existing culture of an organization and the readiness people have to change at each level of the leadership hierarchy. It is helpful to have information on organization culture when designing an intervention, because this allows for focus on predetermined barriers and improves the ability to evaluate the program's success. The ORCA is one tool that measures the baseline level of readiness for implementation of evidence-based practice with clinicians in facilities undergoing KT. This survey instrument was developed by researchers in the Quality Enhancement Research Initiative on Ischemic Heart Disease at the Veterans Health Administration as a tool to identify barriers and measure the readiness for clinicians to participate in a quality improvement project. The instrument was constructed based on interviews with staff at six hospitals after implementing a novel intervention, or multiple interventions, to improve measurement and management of low-density lipoprotein cholesterol in patients with coronary heart disease.

Additionally, researchers incorporated elements of two other organizational surveys, the Quality Improvement Implementation Survey and the Service Line Research Project Survey.[145] The ORCA consists of 77 items, divided into three scales that measure the strength of evidence for the proposed change, the quality of the organizational context to support the change, and the organizational capacity to facilitate the change. These scales, labeled evidence, context, and facilitation, are grouped according to the Promoting Action on Research in Health Services (PARIHS) framework.[145] The evidence scale is comprised of four subscales: research evidence, clinical experience, patient preferences, and level of discord among practice team. The context scale is comprised of six subscales: senior leadership culture, staff culture, leadership behavior, measurement, opinion leaders, and available resources. Lastly, the facilitation scale is comprised of nine elements: senior leaders' practices, champion characteristics, leadership implementation roles, implementation team roles, implementation plan, project communication, project progress tracking, project resources and context, and project evaluation.

Hagedorn and Heidman[146] provided preliminary support of the ORCA's clinical utility at baseline and after behavior change intervention in a substance abuse clinic. Additionally, this instrument has some psychometric support for use in the context KT in health care. Cronbach alpha for scale reliability for the evidence, context, and facilitation scales was 0.74, 0.85, and 0.95, respectively, among 113 observations for three quality improvement initiatives, as reported by Helfrich, Yu-Fant, and Sales.[147] The context and facilitation scales met the standard threshold for internal consistency, which is typically considered a Cronbach alpha of 0.80 or greater. The evidence scale did not meet this threshold, and neither did the constituent subscales, 0.44, 0.62, and 0.70 for research evidence, clinical experience, and patient preference, respectively. The Cronbach alpha for the context subscales, as listed above, were found by these authors to be 0.92, 0.90, 0.93, 0.88, 0.91, and 0.86. Finally, the nine subscales of the facilitation scale were also

found to have sufficient internal reliability at Cronbach alpha values of 0.87, 0.94, 0.87, 0.86, 0.95, 0.92, 0.82, 0.87, and 0.87. Therefore, the items within the context and facilitation scales can be considered to have a good correlation with each other, which is supportive of the general cohesiveness of these scales. Exploratory factor analysis on the aggregated subscales found that seven of the nine facilitation subscales loaded on one factor, five of the six context subscales loaded on a second factor, and all three evidence subscales loaded on a third factor. These results indicate that most items and subscales clustered based on the PARIHS framework as intended by the creators. The exceptions were the champion characteristics and available resources, which failed to load, and the leadership practices, which loaded on context rather than facilitation. There is moderate support for the aggregation of items by scales based on this evidence, with an understanding of the limitations for each scale.[146,147]

NEED FOR CURRENT STUDIES

As shown by the lack of published evidence regarding the relationship between outcome measures, clinical reasoning, and patient outcomes, little is known about the role these tools play in the process of diagnosis and patient management. One national survey in the United States did incorporate questions regarding the role of outcome measures in decision-making. However, many changes have occurred in the field of PT, particularly in the area of outcome measures since 2009, when this survey was published. That survey also restricted participation to members of the APTA, of which approximately 30% of licensed physical therapists in the United States are members.[148] Consequently, this study provides a limited contribution to our understanding of the relationship between outcome measures and decision-making for all physical therapists in the United States. In addition to this 2009 survey, two qualitative interview studies investigated outcome measures role in clinical reasoning. However, they were limited to the Ontario province of Canada, Chicago, Illinois, and Lexington, Kentucky.[45,46,70] Due to differences in the

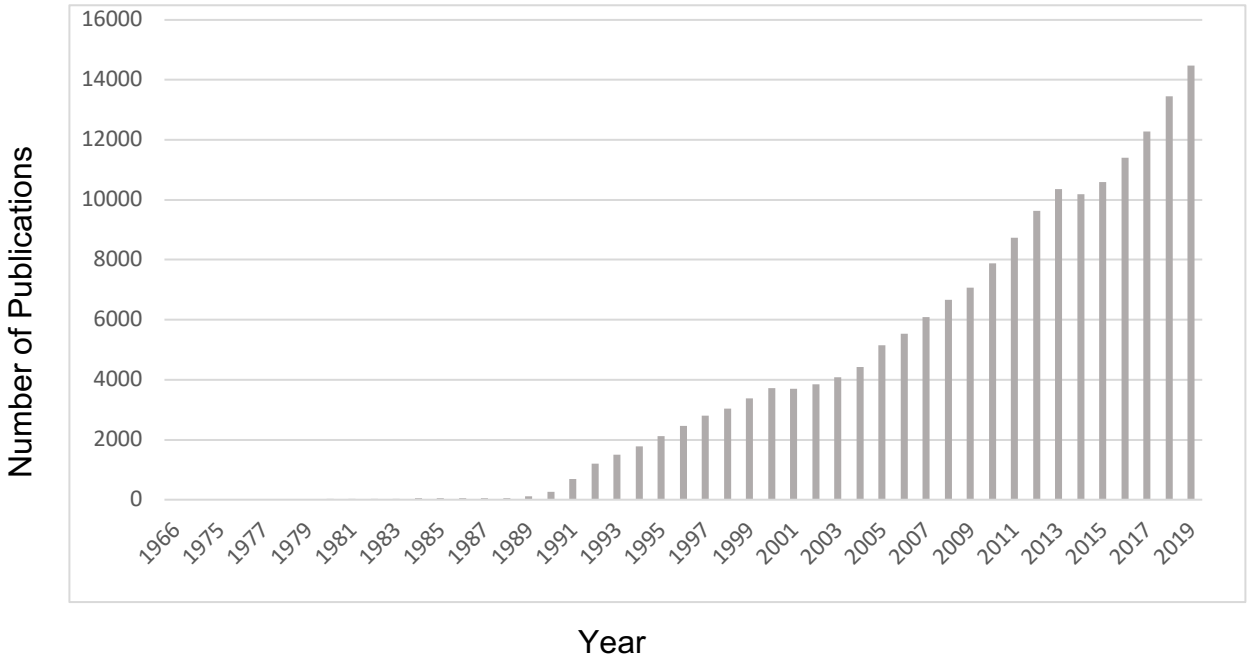
educational requirements, reimbursement model, health care system structure, and professional culture, the findings from Canada may not have a broad impact on our understanding of PT in the United States. The Illinois and Kentucky studies' scope was limited geographically and only incorporated large health care systems. These studies did contribute a wealth of knowledge to a foundation of understanding of the interplay between outcome measures and decision-making. However, the data collected can only be generalized to similar health systems and urban centers. Thus, further study is needed to understand how physical therapists across the United States use standardized assessment tools in their clinical reasoning process.

Educational interventions focused on training health care providers on evidence-based practice have yielded conflicting results. Two studies found that evidence-based practice training with nurses or physical therapy improved knowledge and skills but no practice behavior changes. Nurses who participated in 30 hours of online learning and 5 hours of face-to-face instruction demonstrated improved self-reported knowledge and skills related to finding and interpreting evidence. Italian PT students participated in formal didactic training and application of EBP while on clinical internships. After this training, students reported improvements in knowledge and skills.[104] The study of nurses and PT students trained on EBP found no measurable changes in self-reported behaviors after training. In contrast, a study with physicians who engaged in 8 weeks of weekly face-to-face evidence-based instruction reported improvements in knowledge and application, and their patients demonstrated improved blood pressure control and higher patient satisfaction scores. No published study has assessed the impact of evidence-based training on practice behaviors of physical therapists. Additionally, no published study has investigated the impact on patient outcomes of evidence-based training delivered to physical therapists.

Professional organizations, insurance providers, and researchers have converged in their efforts to increase outcome measure utilization frequency. Research has proliferated in this field

of study over the last 30 years, as shown in the sharp increase in the frequency of publications in Figure 1.

Figure 1. PubMed Results by Year for Keyword "Outcome Measure"



In 2014, the Center for Medicare and Medicaid Services directed providers in inpatient rehabilitation, long-term care, skilled nursing, and home health settings to record functional and outcome measures on all patients.[149] As detailed earlier, the ANPT created diagnosis-specific recommendations for outcome measure use from 2013-2016 for stroke, multiple sclerosis, TBI, and spinal cord injury and completed the development of a clinical practice guideline for outcome measures with patients with neurologic diagnoses in 2018.[51,116,118,119,150,151] With this increased production of publications and recommendations, it is essential that we better understand the impact of using outcome measures. It is crucial to determine what effect this will have on patients and practitioners.

CONCLUSION

The population of individuals experiencing and surviving stroke, TBI, and brain infections is large and expanding.[2-4,6-8,152] Postural control and balance are a significant impairment in individuals after acquired brain injury. Deficits in these areas impact an individual's ability to work, attend school, participate with their family, and complete self-care. Balance problems contribute to slower gait speed, increasing fall risk, and decreasing confidence in moving without falling, which contributes to immobility-related secondary conditions. Because specific PT interventions can improve balance impairments, it is essential for physical therapists to use reliable and valid measurement tools to screen, assess, and track changes in balance after brain injury.

The role of measurement tools in PT practice has grown over the last 40 years.* The frequency of use in the United States and worldwide shows a steady increase.* Authors and organizations purport a growing list of benefits and roles of outcome measures in the care and management of patients.* The contemporary understanding of clinical reasoning supports the theory that examination procedures play a role in decision-making,[144,153,154] but the exact role of standardized test procedures and test batteries in the field of rehabilitation is not understood.

KT is focused on the application of research to practical and clinical settings in order for clinicians to incorporate best practice innovations. Multi-faceted interventions that incorporate local consensus leaders, active participation in learning, educational outreach visits from experts, reminders, and timely non-punitive feedback has been found to be most effective.[81,91,93,96,97,99-101] There is varying evidence that training in specific aspects of EBP can improve patient outcomes.[102-107] There has been no published study on the impact of training focused on the examination procedures and re-examination phase of the patient management model.

**References* 36,37,39,44,49,52,55-59,64-67,90,115,150-155

The increasing utilization of outcome measures creates an unknown impact on therapist clinical reasoning, decision-making, and patient outcomes. Little work has been published on the relationship between outcome measures and clinical reasoning. The purpose of the studies within this dissertation is to explore current practices and perceptions among physical therapists in the United States related to the use of clinical balance assessments and their role of guiding clinical decisions for individuals after acquired brain injury. A secondary purpose is to investigate the relationship between delivery of a knowledge translation intervention focused on outcome measures on physical therapists' clinical decisions and patient outcomes.

CHAPTER III

THE ROLE OF STANDARDIZED BALANCE MEASUREMENT IN THERAPIST DECISION-MAKING AND PATIENT OUTCOMES: A SURVEY OF CURRENT PRACTICE AND PERCEPTIONS

INTRODUCTION

Balance impairments are common after brain injuries[1-3] and can have a significant negative impact on patient health, activities, quality of life, and participation in social roles.[4-9] To mitigate these possible negative effects, including balance in the physical therapy plan of care is an important part of working with individuals after acquired brain injury (ABI).[10]

The American Physical Therapy Association (APTA), the APTA's Academy of Neurologic Physical Therapy (ANPT), and other professional organizations recommend using standardized balance assessments as an essential part of evidence-based practice.[11-17] Outcome measures, standardized assessments that quantify change in patient status over time,[18] have been recommended as a way to evaluate effectiveness of physical therapy care since the early 1980s and have become an increasingly frequent topic in neurological physical therapy literature since 2000.[11,18-22] Despite this increased focus, evidence indicates that outcome measure use remains low. The most recently available evidence in the United States from a 2009 survey reports that only 48% of APTA members use outcome measures in clinical practice, and facility "home grown" measures are the second most commonly used.[23]

Authors have proposed that the use of standardized measures may improve patient care through guiding clinical decision-making, informing the process of treatment intervention, and enhancing communication.[12-14,17,18,24,25] Standardized measures have been reported to enhance the

quality of physical therapy care through correct diagnosis of impairments, accurate identification of those at risk for future falls, guiding selection of intervention, providing objective indicators of health status, allowing accurate evaluation of patient change over time.[14,18] Danzl and Hunter[12] also proposed that the use of outcome measures is a possible means by which healthcare organizations can optimize and justify the services they provide. Though the reported relationship between standardized measurement and patient care is extensively seen in the outcome measure literature, it has been primarily based on expert opinion, minimal subjective interview and survey data, and limited objective examination. No published study has investigated how physical therapists (PTs) utilize outcome measures or validated that these measures have the proposed impact on patient care.

Since the last survey of physical therapy outcome measure use was completed and published 10 years ago, research focused on outcome measure implementation has increased. The national online database of outcome measure psychometric properties was published by Rehabilitation Institute of Chicago, and the APTA Section on Research published the Evaluation Database to Guide Effectiveness (EDGE).[17] However, the current degree of standardized outcome measures use by PTs in the United States is not well understood.

The purposes of this study were to explore current practices and perceptions related to the use of clinical balance assessment and their role in guiding clinical decisions for individuals after ABI among PTs in the United States.

METHODS

Study Design

An online survey was sent to PTs practicing in the United States.

Participants and Sampling

The target population was PTs licensed in the United States and currently in clinical practice who provide services to individuals after ABI. A snowball sampling strategy[26] was used to maximize responses. Recruitment occurred through email to 1) all individuals with available email addresses in the Texas Woman's University (TWU) School of Physical Therapy alumni directory, comprised of 880 available addresses, 2) 84 Directors of Clinical Education at physical therapist programs in the United States, and 3) 27 randomly selected facilities in the United States that were determined using search terms "stroke rehabilitation" and "brain injury rehabilitation" on popular social media platforms. Included in the recruitment message was a request for recipients to forward the survey link to all physical therapists known to work with individuals with ABI. The survey invitation was sent April 24, 2018 and one reminder was sent on May 1, 2018. The first two questions on the survey instrument screened respondents for eligibility: PT licensure in the United States and having worked with at least one individual with ABI in the last year. Participants were informed that completion of the survey constituted their informed consent.

Survey Instrument

Survey items were designed to collect demographic information and answer the research questions concerning practice and perceptions**.** For the primary research questions, respondents were asked to rate the frequency of clinical use for 18 balance measures, indicate level of agreement with nine statements related to rationale for choosing a measure, and indicate the frequency that balance measurement results impacted each of 13 decision-making constructs. These survey questions were scored on a six-point Likert Scale with descriptive anchors. The 18 measures were included based on past findings of the most commonly used measures and measures recommended by the APTA.[17,23,27] The nine statements regarding the relationship between balance measurement and decision-making were derived from qualitative studies

exploring similar concepts or proposed uses of standardized measures by professional organizations.[12-14,17,21,24,28,29] Additionally, free responses were allowed for each of these items as well as a final free response box at the end of the survey. Demographic information collected included gender, age, years worked as a PT, APTA membership, APTA section membership, specialty certifications, entry level physical therapy degree, years since entry level degree was obtained, most recent physical therapy degree, and years since most recent degree was obtained. Practice characteristics included state in which respondent currently practiced, primary setting of practice, and primary patient population.

A pilot survey was sent to a sample of convenience of 10 individuals to assess sensibility, face, and content validity. Pilot data was used to modify the instrument for ease of use and include common statements in free response boxes within answer choices. Data collected during the pilot phase was not used in the final analysis. A pre-notification email message outlining the purpose of the study was sent to the sample to prime potential participants. One week later, the initial invitation to participate was sent including a link to the survey instrument. A reminder was sent through email 7 days after the initial invitation was sent. Data collection lasted two weeks from initial mailing.[30,31] The short period of survey instrument availability was intended to create a sense of scarcity of time and increase response rate.[30]

Data Analysis

The survey was created, administered, and data was collected using PsychData. The primary variables of interest, balance measure(s) used, justification for choosing balance measure(s), and use of balance measure results, were transformed into ordinal variables with one level for each step on the Likert Scale. Items were collapsed when insufficient variation was present, defined as less than 5% on more than one level. Demographic and practice characteristics were assessed with appropriate descriptive statistics. When a free response answer fit into one of

the options for the related survey question, the answer was converted into that answer choice, as assessed by the primary researcher. Primary variables of interest were summarized with frequencies, percentages, skewness, and kurtosis and displayed graphically during initial analysis**.** To determine if there was a relationship between if a respondent reported using outcome measures and demographic and practice characteristics; chi-square test was used for categorical data and point-biserial correlation was used for continuous data.

Multinomial logistic regression was used to test the relationship among answers on each survey item related to use of balance measure results and demographic and practice parameters. Bivariate analysis (chi-square, point-biserial correlation) was used to determine which variables to include in the regression model. The regressions were completed forward stepwise. Statistical significance was set at $p < .05$ for all analysis. Data analysis was conducted using IBM SPSS Statistics 25.0 (IBM, New York).

RESULTS

Participants

A survey invitation was sent to 1188 potential respondents by the researcher, of which 195 (16%) were returned to sender and 3 individuals requested to be removed from mailings. It is not known how many were forwarded through email or social media. Of the 607 questionnaires that were initiated, 127 respondents were excluded based on the screening questions. Of the remaining 480 surveys, 100 did not complete the survey beyond the first three questions, 7 completed all but the demographic portion; all 107 were excluded from data analysis, as can be seen in Figure 2. A total of 373 surveys were included in data analysis. Demographic and practice characteristics are shown in Tables 1-3.

Figure 2. Consort diagram: Inclusion and exclusion of survey respondents

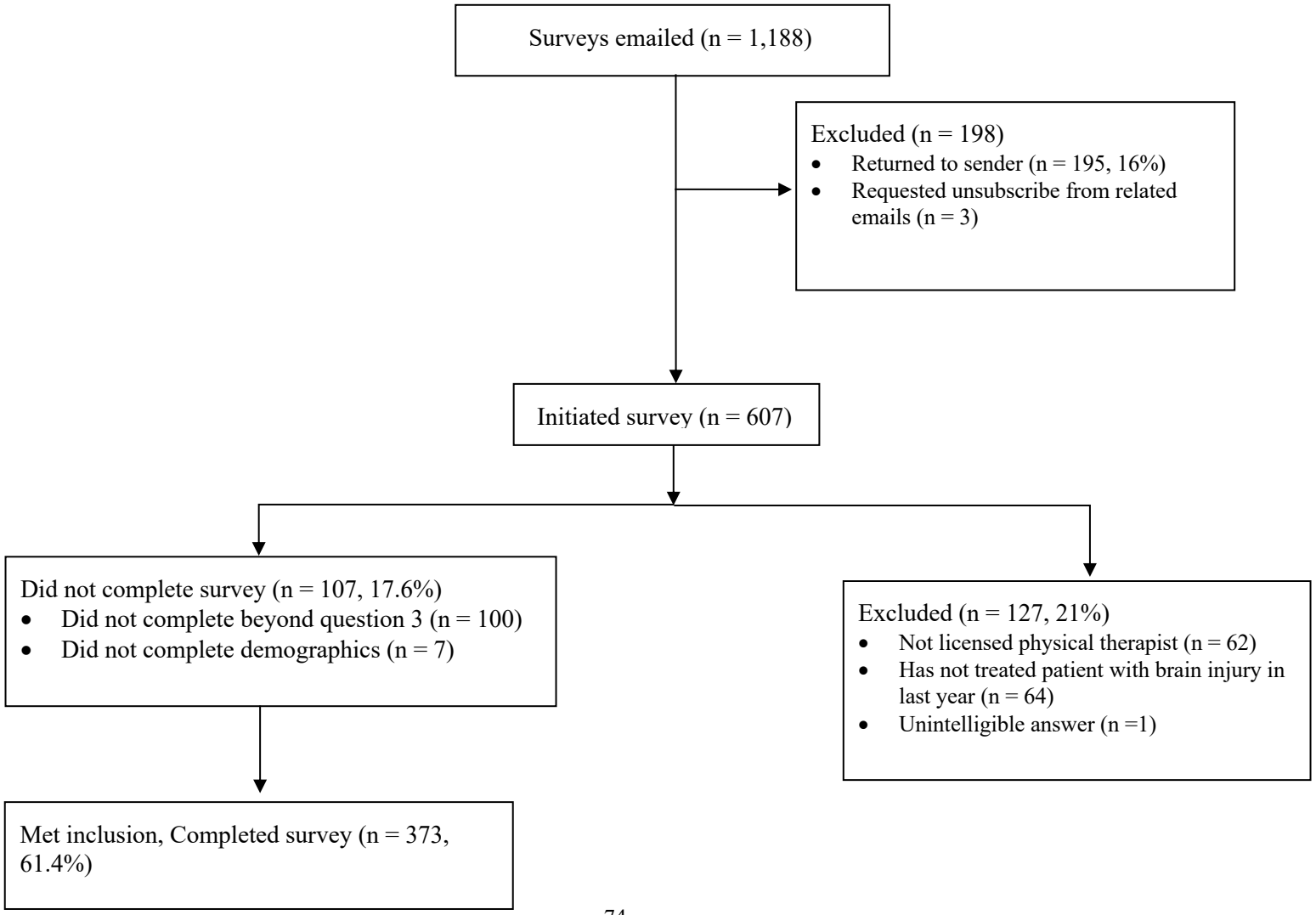


Table 1. Survey Respondent Demographic and Practice Characteristics

	n (%)
Gender	
Female	326 (87.4%)
Male	47 (12.6%)
APTA Member	
Yes	210 (56.3%)
No	163 (43.7%)
APTA Section Member	
Yes	165 (44.2%)
No	208 (55.8%)
Neurologic Section Member	
Yes	88 (23.6%)
No	285 (76.4%)
Specialty Certifications	
Yes	131 (35.1%)
No	242 (64.9%)
ABPTS Certification	
Yes	42 (11.3%)
No	331 (88.7%)
NCS	
Yes	28 (7.5%)
No	345 (92.5%)
Entry-level Degree	
Doctorate	300 (80.4%)
Master's	40 (10.7%)
Bachelor's	30 (8.0%)
Associate's	3 (0.8%)
Most Recent Degree	
Doctorate	331 (88.7%)
Master's	30 (8.0%)
Bachelor's	9 (2.4%)
Associate's	3 (0.8%)
Primary setting	N (%)
Acute	43 (11.5%)
Inpatient Rehab/Sub-acute Rehab	67 (18.0%)
Nursing Home/SNF/Extended Care	30 (8.0%)
Outpatient	192 (51.5%)
Home health	19 (5.1%)
Mixed	13 (3.5%)
Other	9 (2.4%)
Primary patient population	
Orthopedic	115 (30.8%)
Neurologic	126 (33.8%)
Pediatric	20 (5.4%)
Geriatric	91 (24.4%)
Oncology	3 (0.8%)

General Medicine	1 (0.3%)
Cardiovascular/Pulmonary	2 (0.5%)
Vestibular	2 (0.5%)
Other/Mixed	13 (3.5%)
United States Region	
Northeast	53 (14.2%)
Midwest	69 (18.5%)
South	175 (46.9%)
West	65 (17.4%)
Federal	11 (2.9%)

	Range	Mode	Median	Mean (SD)
Age (years)	23-67	27	29	32.65 (9.19)
Time since entry-level degree (years)	0-43	1	3	7.03 (8.89)
Time since most recent degree (years)	0-43	1	3	5.70 (6.70)

Table 2. Survey Outcome Measure Use

Do you use outcome measures or standardized balance measures with your patients with history of acquired brain injury?			
	Yes	No	
Total	346	27	
Setting			p < .001
Acute	31	12	
Inpatient Rehab/Sub-acute Rehab	65	2	
Nursing Home/SNF/Extended Care	29	1	
Outpatient	183	9	
Home health	17	2	
Mixed	12	1	
Other	9	0	
Population			p < .001
Orthopedic	100	15	
Neurologic	126	0	
Pediatric	18	2	
Geriatric	84	7	
Oncology	3	0	
General Medicine	0	1	
Cardiovascular/Pulmonary	2	0	
Vestibular	2	0	
Other/Mixed	11	2	
Section Membership			p = .005
Yes	160	5	
No	186	22	
Neurologic Section Membership			p = .009
Yes	87	1	
No	259	26	
Certification related to neurologic physical therapy			p = .028
Yes	53	0	
No	293	27	

Table 3. Survey Choice of Outcome Measure

When you measure balance for individuals with history of brain injury, how often do you use the following standard tests?							
	Never (0%)	Rarely (1-20%)	Occasionally (21-40%)	Sometimes (41-60%)	Frequently (61-80%)	Most of the time (>80%)	Skewness (SE)
Balance Error Scoring System (BESS)	**254 (68.1%)**	38 (10.2%)	7 (1.9%)	8 (2.1%)	4 (1.1%)	3 (0.8%)	3.26 (0.138)*
Balance Evaluation Systems Test (BEST)	**225 (60.3%)**	57 (15.3%)	13 (3.5%)	9 (2.4%)	4 (1.1%)	3 (0.8%)	2.65 (0.138)*
Berg Balance Scale (BBS)	9 (2.4%)	27 (7.2%)	36 (9.7%)	55 (14.7%)	84 (22.5%)	**126 (33.8%)**	-0.853 (0.133)*
Clinical Test of Sensory Interaction and Balance (CTSIB)	**131 (35.1%)**	45 (12.1%)	43 (11.5%)	30 (8.0%)	40 (10.7%)	34 (9.1%)	0.594 (0.136)*
Community Balance and Mobility Scale (CB&M)	**264 (70.8%)**	26 (7.0%)	7 (1.9%)	8 (2.1%)	5 1.3%)	2 (0.5%)	3.38 (0.138)*
Dynamic Gait Index (DGI)	44 (11.8%)	51 (13.7%)	52 (13.9%)	60 (16.1%)	**76 (20.4%)**	49 (13.1%)	-0.188 (0.134)
Four Square Step Test	**169 (45.3%)**	59 (15.8%)	28 (7.5%)	36 (9.7%)	14 (3.8%)	8 (2.1%)	1.24 (0.138)*
Fullerton Advanced Balance Scale	**293 (78.6%)**	15 (4.0%)	0 (0%)	2 (0.5%)	2 (0.5%)	0 (0%)	6.48 (0.138)*
Functional Gait Assessment (FGA)	**104 (27.9%)**	24 (6.4%)	41 (11.0%)	43 (11.5%)	70 (18.8%)	42 (11.3%)	0.037 (0.135)
Functional Reach Test (FRT)	**104 (27.9%)**	54 (14.5%)	49 (13.1%)	47 (12.6%)	35 (9.4%)	27 (7.2%)	0.481 (0.137)*
High Level Mobility Test (HiMAT)	**200 (53.6%)**	51 (13.7%)	31 (8.3%)	16 (4.3%)	11 (2.9%)	2 (0.5%)	1.71 (0.138)*
Mini-Balance Evaluation Systems Test (miniBEST)	**170 (45.6%)**	41 (11.0%)	38 (10.2%)	30 (8.0%)	24 (6.4%)	9 (2.4%)	1.09 (0.138)*
Sensory Organization Test (SOT)	**231 (61.9%)**	33 (8.8%)	18 (4.8%)	15 (4.0%)	8 (2.1%)	5 (1.3%)	2.24 (0.138)*
Timed Up and Go (TUG)	10 (2.7%)	32 (8.6%)	35 (9.4%)	47 (12.6%)	78 (20.9%)	**132 (35.4%)**	-0.847 (0.133)*
Timed Up and Go Cognitive (TUG-C)	**138 (37.0%)**	24 (6.4%)	21 (5.6%)	23 (6.2%)	40 (10.7%)	27 (7.2%)	0.666 (0.147)*
Timed Up and Go Manual (TUG-M)	**210 (56.3%)**	32 (8.6%)	16 (4.3%)	13 (3.5%)	19 (5.1%)	15 (4.0%)	1.76 (0.14)*
Tinetti Performance Oriented Mobility Assessment (POMA)	**133 (35.7%)**	45 (12.1%)	27 (7.2%)	35 (9.4%)	44 (11.8%)	41 (11.0%)	0.530 (0.135)*
Unipedal Stance/Single Leg Stance (SLS)	**110 (29.5%)**	16 (4.3%)	37 (9.9%)	51 (13.7%)	40 (10.7%)	63 (16.9%)	0.088 (0.137)
*Significant at $p < .05$ **BOLD** indicates mode							

Outcome Measures Used

Of the 373 surveys included in the final analysis, 27 respondents (7.2%) indicated they never used outcome measures. Those who reported not using outcome measures with patients with ABI were significantly more likely to work primarily in acute care ($p < .001$), to work primarily with orthopedic or geriatric clients ($p < .001$), to not be a member of any APTA section ($p = .005$), and to not be a member of the ANPT ($p = .011$). The presence of specialty certifications was nearing significant ($p = .061$), so follow-up analysis was completed with expanded variables based on qualitative data and theoretical foundations. Those with specialty certifications related to neurologic PT were significantly more likely ($p = .028$) to use outcome measures than those without these certifications, but this did not follow for those with any American Board of Physical Therapy (ABPTS) certification, ABPTS neurologic certification, or credentialed clinical instructors. This is shown in Table 2.

Frequency of use of each outcome measure is shown in Table 3. The Berg Balance Scale, Dynamic Gait Index and the Timed Up and Go Test were the measures reported to be used most frequently. The level of importance for each variable related to choosing an outcome measures is shown in Table 4. The most frequently reported reasons for choosing a measure were comfort with the measure, having the available equipment, and the measure having strong psychometric properties.

Table 4. Survey Respondent Rationale for Choice of Outcome Measure

When selecting an outcome measure, how important are each of the following when making your decision?							
	Not at all important	Low importance	Slightly important	Important	Very important	Extremely important	Skewness (SE)
It is widely used	12 (3.2%)	16 (4.3%)	37 (9.9%)	**134 (35.9%)**	95 (25.5%)	45 (12.1%)	-0.678 (0.132)*
It is fast	1 (0.3%)	5 (1.3%)	30 (8.0%)	**124 (33.2%)**	84 (22.5%)	101 (27.1%)	-0.307 (0.131)*
I am comfortable with the measure	1 (0.3%)	4 (1.1%)	12 (3.2%)	70 (18.8%)	116 (31.3%)	**140 (37.5%)**	-0.941 (0.131)*
I have the equipment available in my clinic	0 (0%)	2 (0.5%)	4 (1.1%)	55 (14.7%)	99 (26.5%)	**182 (48.8%)**	-1.055 (0.132)*
The measure is recommended or required by my facility	43 (11.5%)	58 (15.5%)	49 (13.1%)	**83 (22.3%)**	53 (14.2%)	38 (10.2%)	0.093 (0.132)
I was educated on it in physical therapy school	40 (10.2%)	56 (15.0%)	78 (20.9%)	**88 (23.6%)**	50 (13.4%)	28 (7.5%)	0.069 (0.131)
It has strong psychometric (reliability, validity) properties	4 (1.1%)	3 (0.8%)	10 (2.7%)	87 (23.3%)	119 (31.9%)	**120 (32.2%)**	-0.998 (0.131)*
It has available minimal detectable change (MDC) or minimally clinically important difference (MCID)	6 (1.6%)	11 (2.9%)	46 (12.3%)	92 (24.7%)	**106 (28.4%)**	76 (20.4%)	-0.518 (0.132)*
It captures a specific construct of balance	5 (1.3%)	12 (3.2%)	29 (7.8%)	**111 (29.8%)**	102 (27.3%)	82 (22.0%)	-0.628 (0.132)*
*Significant at $p < .05$ **BOLD** indicates mode							

Use of Outcome Measure Results

The frequency of using outcome measure results to inform a component of decision-making is shown in Table 5. Each item was collapsed into an ordinal variable with three levels, 0-60%, 61-80%, and >80% of the time. This was due to low variation among the first three level of the original variables. A regression model was able to fit to the following variables: guide treatment interventions (setting $\chi^2(10) = 30.11$, $p = .001$, special certifications $\chi^2(2) = 9.202$, $p = .010$); identify patients at risk for adverse outcomes (entry level degree, $\chi^2(4) = 12.4$, $p = .014$); set goals (setting $\chi^2(10) = 30.13$, $p = .001$, recent degree $\chi^2(4) = 10.23$, $p= .037$); evaluate change (setting $\chi^2(10) = 24.50$, $p = .006$, population $\chi^2(8) = 24.50$, $p = .002$); communicate with other providers (population $\chi^2(8) = 21.35$, $p = .006$); educate patients and family (population $\chi^2(8) = 21.00$, $p = .007$); discharge decisions (setting $\chi^2(10) = 27.91$, $p = .002$); assess my performance and that of others (special certification $\chi^2(2) = 16.30$, $p < .001$).

Table 5. Use of Outcome Measure Results

How often do you use the results of standard balance measures for the following?							
	Never (0%)	Rarely (1-20%)	Occasionally (21-40%)	Sometimes (41-60%)	Frequently (61-80%)	Most of the time (>80%)	Skewness (SE)
Guide treatment interventions	1 (0.3%)	4 (1.1%)	17 (4.6%)	39 (10.5%)	**147 (39.4%)**	138 (37.0%)	-1.26 (0.131)*
Identify patients at risk for adverse outcomes (falls, hospitalization, etc.)	0 (0%)	3 (0.8%)	5 (1.3%)	37 (9.9%)	112 (30.0%)	**189 (50.7%)**	-1.38 (0.131)*
Estimate prognosis	1 (0.3%)	4 (1.1%)	8 (2.1%)	19 (5.1%)	120 (32.2%)	**194 (52.0%)**	-0.464 (0.131)*
Set goals	1 (0.3%)	0 (0%)	13 (3.5%)	24 (6.4%)	120 (32.2%)	**194 (52.0%)**	-1.94 (0.131)*
Describe impairments objectively and numerically	1 (0.3%)	0 (0%)	13 (3.5%)	24 (6.4%)	118 (31.6%)	**190 (50.9%)**	-1.58 (0.131)*
Evaluate patient change over time	1 (0.3%)	2 (0.5%)	5 (1.3%)	10 (2.7%)	97 (26.0%)	**231 (61.9%)**	-2.48 (0.131)*
Communicate with other health care providers (concerning safety or functional ability)	4 (1.1%)	13 (3.5%)	30 (8.0%)	64 (17.2%)	**131 (35.1%)**	104 (27.9%)	-.987 (0.131)*
Educate patients and/or family (concerning safety or functional ability)	3 (0.8%)	12 (3.2%)	16 (4.3%)	51 (13.7%)	**142 (38.1%)**	122 (32.7%)	-1.30 (0.131)*
Justify services with third party payers (i.e. insurance providers)	9 (2.4%)	13 (3.5%)	11 (2.9%)	31 (8.3%)	111 (45.8%)	**171 (45.8%)**	-1.77 (0.131)*
Help make discharge decisions	2 (0.5%)	10 (2.7%)	22 (5.9%)	52 (13.9%)	128 (34.3%)	**132 (35.4%)**	-1.16 (0.131)*
Evaluate clinical programs	44 (11.8%)	65 (17.4%)	54 (14.5%)	63 (16.9%)	**74 (19.8%)**	46 (12.3%)	-0.081 (0.131)
Assess my performance or the performance of others	65 (17.4%)	82 (22.0%)	42 (11.3%)	58 (15.5%)	**64 (17.2%)**	35 (9.4%)	0.163 (0.131)
To improve patient outcomes	5 (1.3%)	10 (2.7 %)	20 (5.4 %)	59 (15.8%)	**137 (36.7%)**	115 (30.8%)	-1.23 (0.131)*

*Significant at $p < .05$ **BOLD** indicates mode

An odds ratio indicates the increased likelihood that a member of a given group is more likely to endorse a given a statement than the reference category. For example, the odds ratio below of 9.627 indicates that a therapist working in a nursing home is nine times more likely than a therapist working in acute care to endorse using outcome measures to guide treatment interventions. Characteristics associated with change in outcome measure selection with odds ratio that met criteria for significance ($p < .05$) are as follows: guide treatment interventions ($OR_{nursing\ home} = 9.627$ (1.739-53.301) $p = .009$, $OR_{outpatient} = 2.969$ (1.075-8.205) $p = .036$, reference = acute care; $OR_{special\ certification} = 2.79$ (1.328-5.858) $p = .007$); set goals ($OR_{outpatient} = 9.929$ (2.925-33.703) $p < .001$); evaluate change ($OR_{outpatient} = 11.303$ (2.191-58.314) $p = .004$; $OR_{orthopedic} = .055$ (.005-.554) $p = .014$, $OR_{geriatric} = .095$ (.010-.896) $p = .04$, $OR_{pediatric} = .057$ (.004-.722) $p = .027$, $OR_{other\ population} = .057$ (.004-.722) $p = .027$, reference = neurologic); communicate with other providers ($OR_{outpatient} = .265$ (.133-.529) $p < .001$, $OR_{geriatric} = .364$ (.174-.763) p.007); educate patients and family ($OR_{orthopedic} = .248$ (.121-.507) $p < .001$, $OR_{geriatric} = .450$ (.209-.970) $p = .042$); guide discharge decisions ($OR_{other\ population} = .156$ (.025-.974) $p = .047$; $OR_{inpatient\ rehab} = .074$ (.015-.369) $p = .001$, $OR_{nursing\ home} = .125$ (.021-.753) $p = .023$); assess my performance or performance of others (OR = 3.525 (1.673-7.426) $p = .001$).

DISCUSSION

The sample diverged from the population on a few key factors. Unlike previous surveys, we were able to capture 163 individuals, 43.7% of the sample, who are not APTA members. Though this is a substantial number, the APTA's estimates are that 60% of physical therapists are not APTA members. Additionally, with a mean time since entry level degree of 7 years and a strong skew toward a doctoral degree (-2, SE .126), the sample was younger and possessed more advanced degrees than the general population of physical therapists engaged in treating patients with ABI. The percentage of respondents with ABPTS certification was similar to the population

of interest, though the rate of individuals with neurologic certification specialty was higher than that in the target population. Lastly, 47% of individuals who completed the survey were practicing in the southern United States. Though this should all be considered when interpreting these results, during data analysis none of these factors had a significant relationship to responses on the survey.

Though most survey respondents did report using standardized outcome measures, there was a notable lack of diversity in which measures were used. Of the 18 measures listed, only three had a mode that was not "never 0% of the time." Of the listed measures, 9 demonstrated a significant skew statistic greater than 1.0 toward the "never" end of the Likert scale. Particularly notable are the infrequent use of the HiMAT and COB&M, which are recommended for individuals with history of TBI by the Academy of Neurologic Physical Therapy TBI EDGE taskforce.[17]

The reasons respondents reporting choosing a given measure indicate a deviation from past published research. Though many studies have cited limited time as a burden for using outcome measures, in the present study, a measure being quickly completed was one of the least important reasons for choosing a measure here. This survey also indicated a stronger rating of importance of psychometric properties when making decisions regarding outcome measures compared to past published research.

Therapist decision-making was frequently impacted by the balance outcome measures, as indicated by a strong significant skew toward the affirmative end of the Likert scale for all items but "evaluate clinical programs" and "assess my performance." Among all demographic and practice characteristics, the only consistent predictors of the frequency of using balance outcome measures to inform clinical decisions were practice setting, primary population, and presence of specialty certification. Of note, physical therapists in the outpatient setting were nine times more

likely to report using outcome measures to set goals > 80% of the time and 11 times more likely to report using outcome measures > 80% of the time to measure change, as compared to therapists working in the acute care environment, but no greater odds for therapists in the inpatient rehabilitation or skilled nursing settings. This survey's findings regarding the relationships between balance outcome measures and clinical decision-making are consistent with the interviews conducted by Danzl and Hunter[12] in Ontaria and Pattison[13] in Kentucky.

CONCLUSION

This survey indicates an increase in the number of physical therapists utilizing outcome measures, particularly standardized balance assessments, since 2009. The frequent use of the Berg, DGI, and TUG do indicate a shift in practice from "home grown" measures to those with more robust psychometric support. However, the low reported frequency of use of the assessments recommended by national professional organization warrants further investigation into the most effective interventions to increase utilization and integration into practice.

Though some early surveys among physical therapists indicated that outcome measures have limited clinical relevance,[23,29,32,33] this survey found a high rate of respondents using outcome measures to inform clinical practice for intervention, prediction, communication, discharge, and changing the patient's outcome. Future research will include in-depth qualitative analysis exploring the complex relationships among measurement, decision-making, and patient outcomes to better understand this phenomenon.

CHAPTER IV

THE ROLE OF STANDARDIZED BALANCE MEASUREMENT IN THERAPIST DECISION-MAKING AND PATIENT OUTCOMES: A QUALITATIVE ANALYSIS OF PRACTICE AND PERCEPTIONS

INTRODUCTION

Measuring health related outcomes with standardized tests and measures has been recommended since the shift to evidence-based practice in the 1980s.[1-6] Partridge proposed in 1982 that physical therapists should consistently use quantitative and qualitative measurements to clearly state the aims and document outcomes of care.[7] Since then, researchers and professional organizations have focused on maximizing the availability of measures with robust psychometric properties and improving therapist compliance with recommendations to perform a standard measure with all patients to properly quantify deficits and progress.[2,5,6,8] Much has been published on the many benefits of using standard health measures for therapists, health systems, and the profession.[1,3,5,6,8,9] These benefits include aiding in decision-making, formulating prognosis, providing objective data to justify treatment, enhancing communication with patients, and assessing plan of care success.[10-13] Today, use of outcome measures by physical therapists is on the rise, particularly when therapists work with patients in their own specialty.[10,14-16] Despite the growing literature some questions remain. Are outcome measures as beneficial as predicted? In what ways is incorporating outcome measures affecting the clinical reasoning process of clinicians and does this have any impact on patients?

Some researchers have investigated the impact of outcome measurement tools on therapist decisions and care. Therapists in Ontario, Canada, Chicago, Illinois, and Lexington, Kentucky reported using outcome measures as communication tools,[11,12] as objective data to justify payment by third-party payers[12,13] and as tools to guide selection of treatment interventions and determining appropriate intensity.[12,13] Additional evidence suggests that outcome measures may play a role in therapists' discharge recommendations from acute care and inpatient rehabilitation.[17]

The current study builds upon previous work on the role of outcome measures in therapist clinical decisions, encompassing a wider geographic distribution of therapists. It is more focused on the relationship among outcome measures, therapist decisions, and patient outcomes. The purpose of this study was to understand how physical therapists use the results of balance assessments when working with individuals with a history of ABI. The secondary purpose was to understand how therapists believe the interaction between balance assessments and clinical decisions impacts patient outcomes.

METHODS

Qualitative Tradition

A qualitative study was conducted using semi-structured phone conference and in-person interviews. The study design, data collection, and analysis were guided by the theories of ethnography and pragmatic theory. Professional and organization culture is a strong component of therapist beliefs and behaviors.[11,13,18,19] Thus, ethnography, the study of the implications of culture,[20] guided coding and interview questioning. Pragmatic theory, the examination of how practical applications of research findings can inform future actions,[20(p154)] influenced the line of follow-up questioning and data analysis.

Participants

Group characteristics sampling was the sampling strategy utilized; this strategy involves selecting specific cases purposefully to create an information rich group. Maximum variation sampling, a sub-type of group characteristic sampling, was utilized to document diverse answers. Because outcome measures use varies based on practice setting[10,21] and neurological rehabilitation varies across geographic region,[22,23] therapists from a heterogenous sampling of these variables were selected to participate. This strategy was chosen to test common themes and concepts across the dimensions of geography and practice setting and to improve understanding of the diversity of physical therapists' practices.[20(p267,283)] Therapists were invited to participate on a volunteer basis through direct email to individuals identified through contact with key informants, individuals whose social and professional positions give them special knowledge about other people or processes.[24] Key informants included presidents of the special interest groups of the APTA, ANPT, the board of directors of the Academy of Acute Care Physical Therapy, and leaders of the state chapters of the APTA. After completion of nine interviews, the majority of the participants held a specialization through the ABPTS or were a graduate of a PT residency program. In response, an additional recruitment avenue was added. An invitation was sent to alumni from TWU Houston and clinical instructors of current TWU Doctor of Physical Therapy students known to work in targeted settings and geographic regions.

Instrumentation

Data collection occurred through semi-structured interviews, with use of an interview guide technique (see Appendix D). Interview guide questions were focused on reported behaviors and beliefs and follow-up questions were formulated during the interview based on the research objectives.

Procedures

Prior to each interview, the institutional review board approved informed consent was sent through email to the participant for review. Participants returned signed informed consent through email or postal mail. The interviews were conducted one-on-one by the primary investigator or two-on-one with the primary investigator and research assistant in person or through telephone. Both the primary investigator and the research assistant were trained in qualitative interviewing. All interviews were audio recorded and transcribed verbatim. Analytic memos were recorded during the interview by the primary researcher and by a secondary researcher during playback of the video recorded interview.

Data Analysis

Computer-assisted open coding was completed on the transcribed interviews as described by Saldaña,[25] using an inductive approach with a priori determined focus on emic phrases and indigenous patterns and themes. Coding was completed without prior hypothesis and was guided by the words, phrases, and categories used by those interviewed.[20] Transcripts were first reviewed line-by-line and then an iterative process of coding was utilized. An evolving list of codes was maintained and updated until an exhaustive list was defined. Open codes were categorized into themes and sub-categories, with emic labels and grouped consistent with participant descriptions. This process was completed as each interview was coded and again once all interviews were reviewed. Direct quotes were then reviewed for each code within a category and data was visualized within the category with use of computer and hand drawn schematics. The word processor software Microsoft Word for Office 365 (2018) and the qualitative analysis software QSR International's NVivo 12 Pro (2018) facilitated data management, analysis, and visualization.

Verification Techniques

Trustworthiness was reached through a multi-modal approach including mixed-methods triangulation, triangulation of data sources, triangulation of analysis (member checking and peer examination during analysis), and interview techniques aimed at reducing threats to internal validity.[20,26] Interview strategies that enhance data credibility were used, including reframing of questions, indirect questions about the participants' experiences, and structured hypothetical situations.[26] To limit the influence of bias, interview questions were worded neutrally, for example, the terms "standardized balance assessment" and "balance test" were used rather than "outcome measure."[11] Data was verified through comparing results across the maximum variation sample[26] and investigating areas of convergence and divergence with the quantitative data[20] from previously completed survey research. Each participant was provided a copy of the transcribed coded interview and invited to provide feedback on the accuracy, fairness and validity of the analysis.[20] Impartial colleagues who have clinical and/or research experience with the concepts of the study were consulted during the analysis phase to check categories, look for disconfirming cases, and discuss working hypotheses to enhance analysis credibility.

RESULTS

A total of 23 participants were recruited and completed interviews; demographic variables can be seen in Table 1. Interviews were completed in-person for 2 participants and 21 through telephone. Participants included nine physical therapists practicing in inpatient rehabilitation/skilled nursing (IP), seven in acute care (AC), and seven in outpatient (OP) settings. The range of years of practice was 2-42.5 years, mean 11.3 (SD 11.5), years since entry-level degree ranged 3-43 years, mean 12.0 (SD 10.8), and years since most recent degree ranged 0-23 years, mean 8.1 (SD 8.2). The most common entry-level degree and most recent degree was the

Doctor of Physical Therapy, completed by 17 (73.9%) and 20 (87.0%) participants, respectively. Therapists reported primary populations of neurologic (n = 12, 52.2%), mixed (n = 9, 39.1%), general medical (n = 1, 4%), and orthopedic (n = 1, 4%) clientele. Therapists reported having a specialty certification in 69.5% of cases, with 68.75% (11) of those being from the American Board of Physical Therapy Specialties and 31.25% (5) being an APTA credentialed clinical instructor. Among participants, six (26.1%) were graduates of an American Board of Physical Therapy and Residency and Fellowship Education accredited neurologic residency program and 18 (78.3%) were APTA members. Major themes that emerged from analysis were the process of assessing balance, factors in choosing a standard outcome measure, use of results of outcome measures, and impact of outcome measure selection.

Table 6. Interview Participant Demographics

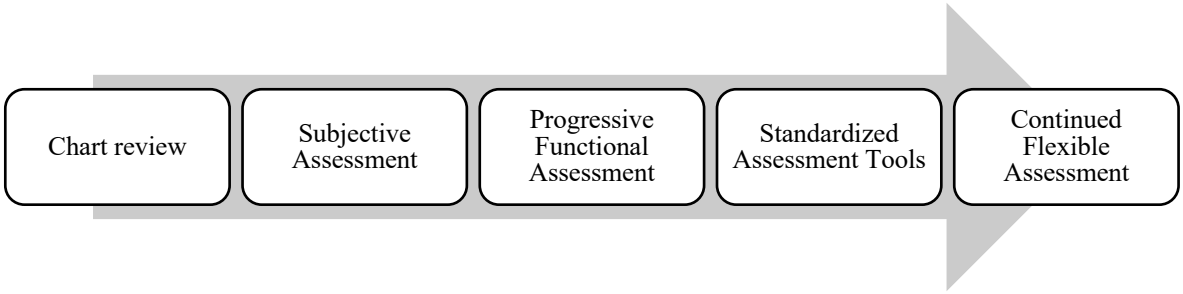
Subject Number	Region	Setting	Gender	Primary Population	Entry Level Degree	Entry Level degree	Most recent degree	Most recent degree	Years PT	Years in current specialty	Specialty certification?	Specialty certification	NCS?	Residency graduate?	APTA member?
NE IP 1	Northeast	IP/SNF	F	Neurologic	DPT	2013	DPT	2013	5	5	Y	NCS	Y	Y	Y
NE OP 1	Northeast	OP	F	Mixed	MPT	1996	DPT	2001	22	20	Y	NCS	Y	N	N
NE OP 2	Northeast	OP	F	Neurologic	DPT	2012	DPT	2012	6	6	Y	NCS	Y	N	Y
NE A 1	Northeast	Acute	F	Mixed, Neurologic	DPT	2012	DPT	2012	6	6	Y	NCS	y	y	y
NE A 2	Northeast	Acute	F	Trauma, Orthopedic, Neurologic	DPT	2015	DPT	2015	4.5	4	Y	NCS	Y	N	Y
NE A 3	Northeast	Acute	F	Mixed, geriatrics	DPT	2014	DPT	2014	5.5	5.5	Y	APTA CI, LSVT	N	N	Y
MW IP 1	Midwest	IP/SNF	F	Neurologic	DPT	2013	DPT	2013	5	5	Y	NCS	Y	Y	Y
MW IP 2	Midwest	IP/SNF	M	Neurologic, Geriatric	DPT	2012	DPT	2012	6	2.5	Y	APTA CI, CBIS	N	N	Y
MW IP 3	Midwest	SNF	F	Orthopedic, Neurologic	DPT	2010	DPT	2010	8	4.5	N		N	N	Y
MW IP 4	Midwest	IP/SNF	F	Neurologic	MPT	1998	MPT	1998	20	20	N		N	N	N
MW OP 1	Midwest	OP	M	Neurologic	DPT	2015	DPT	2015	3	3	Y	NCS	Y	Y	Y
MW A 1	Midwest	Acute	F	Mixed (Intensive Care)	Bach	1976	DPT	2011	42.5	30	N		N	N	Y
S IP 1	South	IP/SNF	F	Neurologic	DPT	2015	DPT	2015	3	3	N		N	N	Y
S IP 2	South	IP/SNF	F	Neurologic	DPT	2010	DPT	2010	8	4	Y	NCS	Y	Y	Y
S OP 1	South	OP	M	Neurologic	DPT	2013	DPT	2013	5	5	Y	NCS	Y	N	Y
S OP 2	South	OP	F	Neurologic	BS	1981	DPT	2008	38	32	Y	LSVT, NDT	N	N	Y
S A 1	South	Acute	F	General Medical	MPT	1996	MPT	1996	22	13	Y	APTA CI	N	N	N
S A 2	South	Acute	F	Neurologic	DPT	2013	DPT	2013	5	2	Y	NCS, Vestibular	Y	Y	Y
S A 3	South	Acute	F	Mixed	MPT	1996	DPT	2019	22	7	N		N	N	Y
W IP 1	West	IP/SNF	F	Neurologic	DPT	2012	DPT	2012	6.5	3	Y	NCS	Y	N	N
W IP 2	West	IP/SNF	F	Neurologic (Brain Injury)	DPT	2010	DPT	2010	8.5	8.5	Y	NCS, Neuro-ifrah, APTA CI, APTA CI Advanced	Y	N	Y
W OP 1	West	OP	F	Neurologic	DPT	2016	DPT	2016	2	2	N		N	N	Y
W OP 2	West	OP	F	Orthopedic	DPT	2012	DPT	2012	6	2	Y	Vestibular, APTA CI	N	N	N

NE=NORTHEAST, MW=MIDWEST, S=SOUTH, W=WEST
IP=INPATIENT, OP=OUTPATIENT, A=ACUTE, SNF=SKILLED NURSING FACILITY
DPT=DOCTOR OF PHYSICAL THERAPY, MPT=MASTER OF PHYSICAL THERAPY
NCS=NEUROLOGIC CERTIFIED SPECIALIST, APTA CI=CLINICAL INSTRUCTOR CREDENTIALING, LSVT=LEE SILVERMAN VOICE TREATMENT BIG, CBIS=CERTIFIED BRAIN INJURY SPECIALIST, NDT=NEURODEVELOPMENTAL TECHNIQUE
NEURO-IFRAH=NEURO-INTEGRATIVE FUNCTIONAL REHABILITATION AND HABILITATION

Process of Balance Assessment

The first theme to present from analysis was the process of balance assessment. Among the processes of assessing balance, categories that were revealed were progressive functional assessment, continued flexible assessment, assessing types of balance, and standardized outcome measures. The order of these processes is presented in Figure 3, as described by participants.

Figure 3. Process of balance assessment



Functional assessment. Assessing balance was described by many therapists as starting with a process in which the therapists quantified or described the level of assistance required when the patient completed a series of progressively more difficult tasks moving the body or holding the body stable in different positions. An initial focus on general functional assessment was reported by 21 therapists and a progressive functional assessment process was described by 16 interviewees (6 AC, 6 IP, 2 OP):

> It's all layered on top, if they keep doing well then I'll keep going but if they need anywhere from min[imal] to mod[erate] assist to perform the task then I'll stop there on eval. To set up kind of a baseline for them. (South Acute 1)

As described by this participant, progressing to more difficult tasks was terminated once a patient required a pre-determined amount of assistance. Observational analysis of a composite task was mentioned by six therapists as an alternative or augmentative balance assessment type:

> So, a lot of our balance and mobility assessment are just kind of in the hospital room so seeing how they are when they stand up off their bed, um, if they are getting to the bathroom. So, they are going to walk over to the sink…usually for that initial evaluation I am just looking at how they can get around in their hospital room. (South Acute 2)

The strategy used to describe balance based on these functional assessments was typically related to the number of times a loss of balance occurred, the level of assistance required to prevent a loss of balance, or the amount of external support required through the patient's upper limbs:

> Looking at again how they hold themselves are they…comfortable and relaxed in those positions or are they fixing somewhere to get some stability. Are they further to their side of course or are they reaching out for stability externally. (South Outpatient 2)

This process was preceded for three therapists by a review of medical history in the medical record and for four others by solicitation of information from the patient including prior level of functioning, living situation, assistive device use, patient's goals, and patient's perception of their balance abilities.

Continued flexible assessment. Balance assessment was also described as being a flexible process with the patient being constantly reassessed throughout the plan of care. Eleven therapists (six inpatient, five outpatient) explained that once a patient exceeded the ceiling effect or met a predetermined criterion on a measurement tool, a new more difficult measurement strategy or tool would be selected.

> I think we should be flexible enough that if someone is progressing really well, and you set a goal that they should meet this level and they are exceeding your expectations then we should either modify the goal to make it higher or more

aggressive or modify the test to say you know maybe this had a ceiling effect for this patient and we need to move on to something more challenging and they have potential for that. (Northeast Outpatient 2)

Types of balance. Types of balance was the next category that emerged in the process of balance assessment theme. The therapists described subcategories of balance and fall risk that included task, environment, and individual constraints. Task considerations included position of the person's body, including sitting versus standing or width of base of support, and stability of task, static versus dynamic balance. Dynamic balance was primarily described as self-generated, reaching, weight shifting, rotating, or changing directions while walking, and in two instances (SAC1, NEAC2) as automatic reactions required when presented with external perturbations. These categories were typically described using a layer classification system and assessed progressively. An example is illustrated in Figure 4.

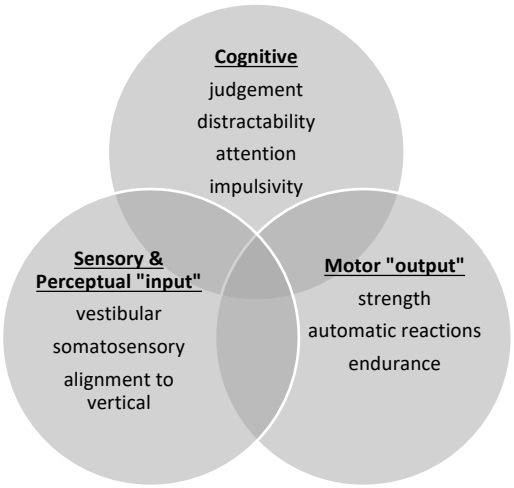
Figure 4. Classification System, Task Types of Balance

Body Position	**Task Demand**	**Base of Support**
Sitting	Static	Wide
		Narrow
	Dynamic	Wide
		Narrow
Standing	Static	Wide
		Narrow
	Dynamic	Wide
		Narrow

Complexity →

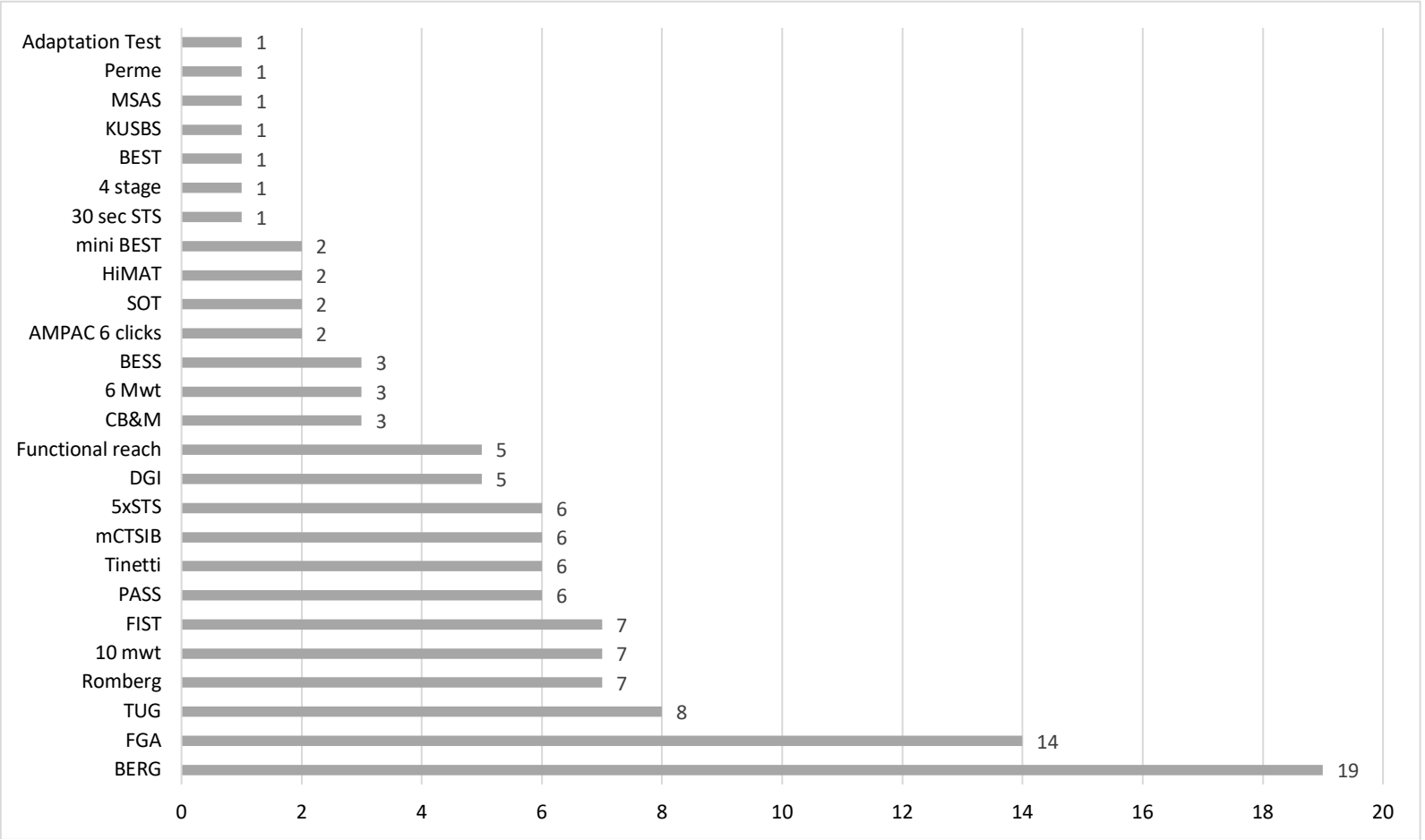
Environmental considerations included presence of obstacles, "home set-up," and level of assistance available to patient. Individual balance constraints included cognition, sensation and perception, and motor control, as shown in Figure 5. Vestibular sensory input, mentioned by six participants, was the most common concern among the individual systems of balance.

Figure 5. Individual Constraints on Balance



Outcome measures. The last major category that emerged within the theme of process of balance assessment was standardized measures. Of the 23 interviewed therapists, 22 reported using standard outcome measures regularly at initial evaluation or first subsequent visit with clients with ABI. There were 27 distinct outcome measures identified by therapists, with the Berg Balance Scale (n = 19), Functional Gait Assessment (n = 14), and Timed Up and Go Test (n = 8) most commonly cited. Therapists reported using the outcome measures shown in Table 2, presented in the order they were mentioned during the participant's interview. The measures are shown with the frequency mentioned in Figure 6.

Figure 6. Balance Outcome Measures Used, Frequency of Mention



Perme = Perme Intensive Care Mobility Score, MSAS = Mobility Scale for Acute Stroke, KUSBS = Kansas University Standing Balance Scale, BEST = Balance Evaluation Systems Test, 4 stage = 4 Stage Balance Test, 30 sec STS = 30 second Sit to Stand, mini BEST = mini Balance Evaluation Systems Test, HiMAT = High-level Mobility Assessment Tool, SOT = Sensory Organization Test, AMPAC 6 clicks = Activity Measures for Post-Acute Care 6 clicks, BESS = Balance Error Scoring System, 6 Mwt = 6 minute walk test, CB&M = Community Balance & Mobility Scale, DGI = Dynamic Gait Index, 5xSTS = Five time sit to stand, mCTSIB = modified Clinical Test of Sensory Iteraction of Balance, PASS = Postural Assessment Scale for Stroke, FIST = Function in Sitting Test, 10 mwt = 10 meter walk test, TUG = Timed Up and Go, FGA = Functional Gait Assessment,

Factors in Choosing Outcome Measure

The second major theme that emerged from analysis was factors that contribute to selecting outcome measures. These factors were categorized into institutional factors, patient factors, therapist factors, tool factors, and professional organization recommendations; see Figure 7 and Table 7.

Figure 7. Factors in Outcome Measure Selection

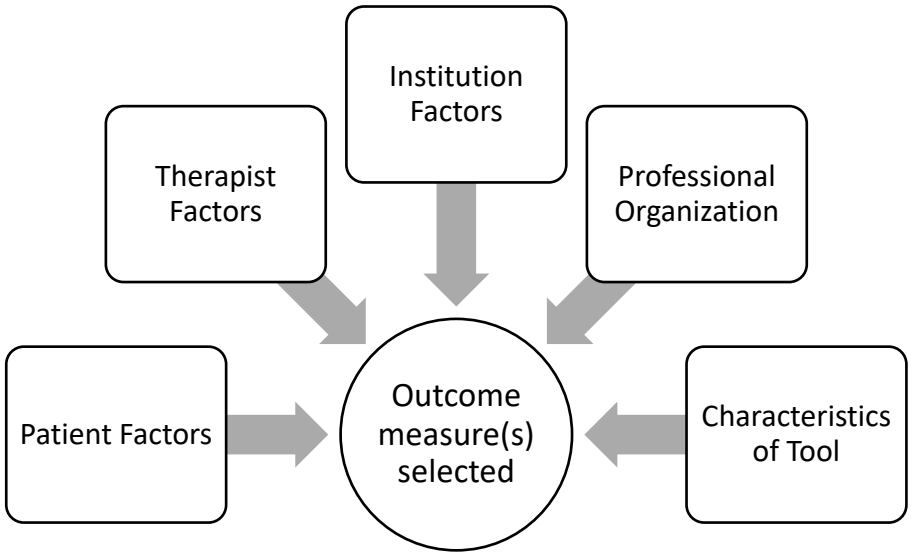


Table 7. Factors in Outcome Measure Selection by Category

Patient Factors	Therapist Factors	Institution Factors	Professional National Organization	Characteristics of Tool
• Age • Assistive device • Command following • Distractibility • Endurance • Functional level • Living environment • Medical stability • Strength • Diagnosis • Patient goals • Prognosis • Sensation & Perception	• Certifications • Residency training • Career phase • Outcome measure awareness • Outcome measure fluency	• Guidelines • Resources • Setting • Equipment • Space • Documentation system • Culture	• EDGE documents • CORE Outcome Measure CPG • Rehabmeasures. org	• Psychometric properties • Time to complete • Limitations of measure

Patient characteristics. Among the characteristics of the patient, the functional level of the patient was important in determining if an outcome measure would be completed and which measure was chosen. This was usually described as each patient occupying a place on a scale from "low level" to "high level" and supported with the level of assistance required to complete specific mobility tasks:

> I'm seeing how they're transferring, you know, if they're needing min[imal] assist or greater to do a stand pivot, then, you now, I know that the Berg is probably going to be pretty tough for them. We'll probably have a floor effect. And so, I might do something like the PASS [postural assessment scale for stroke], which you know, is a little easier for them to show progress with. (Midwest Inpatient 2)

Whether patients were described as "low" or "high" level was dependent on the setting and affected the balance assessment chosen. For example, for patient described as high level in the Neuro ICU, the Berg Balance Scale was most appropriate while for the outpatient setting, the assessment most appropriate for the high-level patient was the High-Level Mobility Assessment in the outpatient setting. Other important patient related factors included the patient's cognition, command following ability, distractibility, sensation, perception, and age:

> I don't have like, an area of the hospital that's quiet so if they're, a highly distractible frontal TBI or stroke, a lot of times I don't do any formal balance testing just because they're too distractible and I can only do the portions that I can in their room. (Northeast Acute 2)

Additionally, the patient's stated goals were reported to contribute to outcome selection by five participants, assistive device by three participants, and living environment was reported by two participants:

> I think the most important thing is to talk to the patient, learn about their challenges, learn about their goals and to try to base your test on that to meet them at the right level and to get information that's going to help you treat them. (Northeast Outpatient 2)

Patient goals could prompt a therapist to utilize a measure they deemed "higher level" or "lower level" based on the situation. If a patient's stated goal was to return to running, 2 outpatient therapists reported they would use a more difficult measure, like the High-level Mobility Assessment Tool. If a patient's goal was to return home rather than to maximize functional recovery, 1 acute care therapist said they would use a less difficult measure,. This therapist said that measurement and goals would focus on tasks performed from wheelchair rather than standing or walking tasks.

Institutional factors. Whether a therapist worked in the acute care, inpatient rehabilitation, skilled nursing, or outpatient setting played an important role in which outcome measures were utilized. The role of setting was mentioned by every interview subject.

Acute care setting

Therapists in the acute care setting typically reported patients were lower functioning and more medically fragile and therefore not appropriate for the majority of outcome measures they were aware of. They also reported their patients had shorter lengths of stay compared to other settings. These therapists voiced a desire to use a measure that could measure a change between initial assessment and repeat testing. This typically meant therapists either chose a measure they expected to see change in quickly or chose not to use an outcome measure. Also related to the short length of stay, choosing to use an outcome measure depended on how clinically useful a therapist felt the information gleaned from the measure was. So, if a measure could provide information that a therapist did not already know, could be used to communicate information to a physician or other provider, or could be used to justify a discharge location to a third-party payer,

that would influence whether an outcome measure was completed. If a therapist's view was that an outcome measure would quantify information they already knew and did not add value, it was unlikely that time with a patient would be dedicated to completing one. Therapists reported constraints on time, equipment availability, and space in the acute setting that led them to select measures that required less resources, like the Clinical Test of Sensory Interaction on Balance or the Timed Up and Go Test:

> So they [students] come out oftentimes thinking you do outcome measures on every single person. And in acute care that's just not feasible, so you would really need to use your clinical decision-making to determine does this person need an outcome measure for me to make the appropriate decisions for them? (Northeast Acute Care 3)

Inpatient rehab and skilled nursing setting

The major themes regarding using outcome measures in inpatient rehabilitation and skilled nursing were the competing demands on limited time, unnecessary use for reimbursement, and uncertainty with low functioning patients. Therapists in the Midwest, Northeast, and West described shortening lengths of stay for inpatient rehabilitation. They described stays of 7-21 days that they felt may not be sufficient to demonstrate measurable change on some measures. Additionally, with a pressure to discharge a patient to their home safely, they stated there typically were "bigger fish to fry" during that limited time. Time available to spend on outcome measures was also limited by the competing demand of completing the Functional Independence Measure with all patients, as described by all inpatient therapists. It was mentioned by therapist that certain outcome measures that require more space were not easily completed in the patient's room or hallway and so required additional time allotted for transport to a different region of the hospital, making measures that required less time, space, and equipment more likely to be completed:

> Length of stay is shorter and shorter. I think there's a sense of reservation to dedicate a treatment session to rendering measures…One thing that I would find myself thinking about a lot is, does it make any sense to use this measure in goal setting? Because I'm not sure they're going to be here for long enough to show a clinically meaningful change on this measure. (Northeast Inpatient 1)

Several therapists, in the Midwest and Northeast, mentioned that reimbursement is not linked to outcome measures, but instead depends on medical needs and functional independence measure. Like with AC therapists, this meant that outcome measures were more likely to be completed if the therapist felt they provided a clinical benefit in decision-making or communication. Lastly, all IP therapists related that their setting frequently involved working with patients at low levels of functioning and there was an uncertainty regarding which outcome measures were appropriate for these patients.

Outpatient setting

Therapists reported variables guiding outcome measure selection in the OP setting related to patient population and resources. They reported that patients in the OP setting were typically more functionally independent, medically stable, had more community or role participation goals, and had more needs for "fine tuning." These patient characteristics meant that the therapist felt they had a wider range of appropriate outcome measures to choose from:

> On an outpatient-based setting, I think it's a little bit more variable, there's a lot more that the patient has to ask for and people are going back to work or people are finding ways to be included in their children's lives or whatever it is. It's definitely a lot more dynamic of an environment, with less specific setting goals. And so we have a lot more to draw from and if we can get as much information as possible that is somewhat objective to pair up with some of the subjective

> information that they need, then we can track progress a little bit more consistently. (South Outpatient 1)

Resources, including equipment, access to medical history, environmental space, time, and easily available printed outcome measures also facilitated the ability to choose from a wider selection of outcome measures, according to those interviewed:

> In the outpatient setting it's like, we have everything set up right exactly how we want and that time with us is just our time. There's no doctor coming in in the middle of us talking to each other saying we need to send this person to get a CT…And I guess just access to equipment, we're in the same place every single day. (West Outpatient 1)

Other institutional factors

Factors at the institutional level unrelated to setting included organization outcome measure requirements or guidelines, facility culture, and the electronic medical record. Assessment requirements for patients with ABI varied. An employer mandate to complete at least one standard objective measure at evaluation was mentioned by 3 therapists (2 IP, 1 OP) and one individual reported a requirement to complete at least one at reassessment (OP). A requirement to complete the BBS at initial eval for patients after stroke was reported by 3 therapists (1 AC, 2 IP) reported and 2 IP therapists reported being required to complete the BBS weekly. A requirement to complete the stroke toolkit with patients after stroke was reported by one AC therapists and one AC therapist was mandated to complete the 6 Clicks, a shortened version of the Activity Measure for Post-Acute Care. An organizational guideline to complete a self-report measure was reported by 2 therapists, the stroke impact scale or WHO Quality of Life assessment (W OP 1) and an adapted version of the activities specific balance confidence scale (ABC) (W OP 2). Participants reported they typically complied with facility requirements or recommendations. Therapists reported their outcome measure use behavior typically matched those of their peers.

This was influence by formal in-service presentations and informal discussions that contributed to a "culture" of outcome measure frequency of use and selection of measures. Therapists typically stated they used measures that had been discussed or presented as they felt more comfortable with them and the psychometrics had been researched by a trusted peer. Presence of dedicated space in the electronic medical record for outcome measures was mentioned by nine participants as having an impact on which measures were chosen, with a preference for performing outcome measures that were available in the medical record.

Professional and national organizations. Those interviewed mentioned utilizing the ANPT outcome measure recommendations to select outcome measures for use with patients with ABI, with six individuals stating they relied on recommendations from the traumatic brain injury and stroke EDGE recommendations published in 2013 and 2018, respectively.[27,28] Of those interviewed, three reported using the 2018 publication "A Core Set of Outcome Measures for Adults with Neurologic Conditions Undergoing Rehabilitation: A Clinical Practice Guideline." The recommendations from this publication are to perform the Berg Balance Scale, Functional Gait Assessment, Activities Specific Balance Confidence Scale, 10-meter walk test, 6-minute walk test, and 5 time sit to stand with all patients with neurologic conditions.[8] Consistent compliance was reported by one therapist and two therapists reported they were currently considering incorporating the recommendations into practice. A therapist, who also reported consulting the EDGE documents, stated the rehabilitation measures database published online by the Shirley Ryan Ability Lab had "revolutionized the way…I've looked at patient care."[29]

Therapist characteristics. The therapist factors that reportedly drive outcome measure selection can be categorized into therapist awareness and fluency of outcome measure and therapist career phase. Participants reported that awareness and fluency were a product of neurologic residency training, studying for certification exams, or attending continuing education courses that offered certifications, per therapist reports. Therapists stated they were more likely to

use an outcome measure in which they had been trained or that they were exposed to while preparing for an ABPTS examination. Participants stated that whether a therapist was a "new grad" or a "more experienced therapist" had an influence on outcome measure use behavior, reporting they observed new grads using outcome measures more frequently. Some participants reported that they observed recent graduates using a smaller variety of outcome measures, particularly if they had limited experience working with patients with neurological conditions. It was also noted by participants that recent graduates demonstrated inefficiency, difficulty establishing a prognosis, and poor anticipation of the future needs of their patients when selecting outcome measures. This resulted in new therapists using a "large smattering" of measures to "glean every little piece of information that they can get" or testing "on too low a level." On the other hand, clinicians with 3-5 years' experience stated they found it easier to choose an appropriate measure so they used a larger variety overall, but used fewer with each patient. They also explained a specific change in their own behaviors and beliefs, reporting they continued to use outcome measures with the same frequency but placed less importance on the numerical score of an outcome measure as they gained experience. Instead, they described a greater number of factors with increasing importance influencing their decisions related to recommending services, discharge locations, and discharge timing:

> [Now] I think they're still important but I think that my appreciation for other variables has grown…thinking about the use of a measure in conjunction with their cognition, their family support. So, I think it's important to include, but not in isolation. (Northeast Inpatient 1)

The opinion expressed by participants regarding "very experienced" therapists was that they typically used outcome measures infrequently. The interviewees with greater than 10 years' experience did describe regularly using outcome measures, but reported that they had actively sought information regarding outcome measures, as they had limited exposure during their

physical therapy education and their early careers. They explained that students and recent graduate colleagues were a useful source of information regarding which outcome measures were most appropriate:

> As a department, we definitely have kind of turned the culture to seeing the importance of the standard practices and measures…some of us definitely [are] old school and talk about Tinetti and the Berg Balance Scale…[and the] newer grads that are like you know nobody likes Tinetti anymore and this is why. (South Acute 1)

Characteristics of tool. Therapists expressed a preference for tools that are "supported by the literature" and have "good research behind [them]." Tool reliability, validity, responsiveness to change, or minimally clinical important difference (MCID) were mentioned by eight therapists as a determinant in which outcome measure was chosen. Minimal detectable change and MCID availability were the most frequently touted tool factors. Predictive validity was also of particular interest, with tools that had documented cut-off values for prediction of falls having higher priority. Therapists consulted a variety of resources to find this information, including primary articles, systematic review, EDGE publications, and cheat sheets created by PT students. As mentioned regarding setting, two therapists reported a preference for tools that required less time to complete and were viewed as "efficient." This was mentioned by one IP and one AC therapist.

Use of Results of Outcome Measures

The third theme that emerged was the use of the results of outcome measures, the application of findings after outcome measures were completed. The categories of the reported uses included quantifying, predicting, justifying, deciding, and communicating (See Table 8).

Table 8. Reported Uses of Outcome Measure Results by Category

Quantify	Justify	Predict	Decide	Communicate
• Quantify deficit • Measure change • Document goal	• Justify need for therapy • Justify discharge location • Justify equipment • Support reimbursement	• Measure fall risk • Prognosis	• Determine need for therapy • Guide treatment intervention • Guide treatment intensity • Determine if plan of care is successful • Track institutional success	• Educate patient • Education family • Communicate with health care providers • Promote profession • Promote facility

Quantifying. Quantifying baseline deficit or change in deficit were the first use of outcome measures mentioned by 13 therapists and these uses were mentioned once during all but six interviews. Therapists explained that outcome measures were tools that provided objective data regarding the subtype of balance deficit, intensity of deficit, and degree of change from evaluation to post intervention. Similarly, outcome measures were used as an objective value to document therapist and patient determined goals and progress toward goals. This use was mentioned by six therapists and when asked, three of those interviewed endorsed using outcome measures to document goals:

> Standardized testing is becoming more and more relevant and more and more pertinent because it's a language that people are speaking as a more objective way to say these are the deficits this is hard data to show and not necessarily a subjective opinion of good, fair, or poor. (South Acute 1)

Justifying. Another common role of outcome measures was to justify reimbursement for PT services with third party payers in the current setting or after discharge. When participating therapists were asked during the interview about the primary use of outcome measure results, 13 mentioned using them to justify reimbursement of current or future services. In five interviews, justification for reimbursement was the first or second use mentioned. All participants who did

not mention reimbursement were asked if they used outcome measures in this way, one indicated they did and nine indicated they did not. Additionally, five therapists (2 IP, 1 OP, 1 AC) mentioned using outcome measures to justify equipment recommendations to payers as well.

> I describe the balance pretty in detail because I find that it helps, especially if I'm trying to qualify for an acute rehab placement…a lot of our patients are low income, some sort of history of drug abuse, homeless, difficult social situations, so to qualify for acute rehab…we really need to use a lot of objective findings to get them qualified based on their insurance levels. (Northeast Acute 2)

Predicting. Predicting a patient's risk of falling was mentioned as an important role of outcome measures by 14 of those interviewed. It was the first outcome measure use mentioned in one interview (MW IP 2) and was, on average, the third purpose presented by participants. An additional predictive role was to determine a patient's future prognosis based on presentation at baseline, reported by one therapist.

Deciding. A common theme presented in the interviews was the input from outcome measures in determining if therapy was needed, guiding appropriate therapy intervention, intervention intensity, and to determine if the current plan of care was successful or if modifications were needed. When asked what the primary role of outcome measures was in their practice, 14 therapists mentioned using the results to guide treatment intervention selection, determine intensity level, or both:

> Balance is something that we can have a profound impact on, so understanding what their balance deficits look like and stem from and using that to start guiding treatment is really important….what treatments might sort of have the most bang for your buck, or have the most impact or target the most impaired areas, is important. (Northeast Outpatient 2)

Outcome measures were described as tools that assisted a therapist in "honing" and "narrowing" the type of deficits patients presented with, using the types of balance terms as previously described:

> I often find it to be helpful for figuring out is it like vestibular, visual, you know somatosensory. How are they weighting their balance and what can I do to challenge that one specific aspect?…I think some of the higher-level balance tests can tease out that stuff that we might not see in our very controlled environment in the hospital. (West Inpatient 1)

Among those who did not volunteer that outcome measures play a role in guiding intervention selection, three endorsed using them in this manner when asked. Therapists reported using reassessments of outcome measures to assess patient's progress in balance performance to determine if the current frequency, intensity, and intervention selection was having the desired effect. If a patient's performance on a given outcome measure was improving, then typically the plan of care was not changed. However, if the patient did not demonstrate a previously determined change in score, then a modification would be made. This typically involved changing the type of activity performed during treatment sessions or recommended for performance outside of therapy:

> Outcome measures not only show you that the patient's improving they also show you how you're doing as a therapist, if you're doing an outcome measure over and over or you're doing it a couple of times and you're not seeing improvement, you're probably not…having the change that you thought you would on your patients or your intervention and so maybe you need to change how you're treating the patient. (South Inpatient 2)

Therapists also described using outcome measures to guide their recommendations on timing of discharge and setting after discharge from current facility. This was reported by four

therapists initially and when asked about this role in their decisions, an additional five endorsed a relationship between outcome measure results and discharge recommendations. This was described as a more important factor if the patient was functioning at a more independent or "higher" level, whereas scores on functional independence tasks had a higher importance for patients functioning at a more dependent or "lower" level. Using outcome measures to assess the quality of their program and facility, to determine if their facility was making the expected success on the aggregate was mentioned by one therapist.

Communicating. Balance measures were regularly cited as tools of communication. Therapists described using the results of outcome measures to communicate a patient's safety or level of balance deficit to other health care providers, including occupational therapists, speech language pathologists, nurses, and physicians. This was described by 10 therapists and was endorsed by an additional nine participants when asked. Typically, the cumulative score was presented to other health care providers, either during interdisciplinary rounds, verbally, through medical documentation, or in written communication. Therapists described an increased likelihood of using outcome measures in this way if the person receiving the communication understood the purpose and interpretation of results of the balance test or if the therapist felt they had a good rapport with the other provider. This was particularly apparent when therapists described using outcome measures to communicate with physicians.

Outcome measures were also used to educate the patient or their caregivers. The manner this was used varied and included education to patient and family regarding the patient's physical therapy goal, level of progress, likelihood of falling, and need for supervision once discharged from the hospital setting. Some therapists also described using outcome measure scores as a motivation tool to encourage patients. Those interviewed were split on whether they provided the exact numeric score on an outcome measure to a patient and their caregivers. Some reported that they preferred to provide education generally, explaining that a patient did well or not well on a

test and describing the tasks the patient struggled with. Other therapists described providing the numeric scores to patients.

Aggregate scores on outcome measures were also reported to be used as a tool to promote one's self at annual review or as data to promote the effectiveness of physical therapy in advertising for a facility. Additionally, some therapists interviewed reported that using outcome measure was a means to promote the profession of physical therapy within the health care field as evidence-based and effective.

Impact of Outcome Measure Choice

The final theme that emerged was the impact of outcome measure selection on decision-making and patient care. Therapists were not consistent in this final theme, expressing a variety of beliefs and perceptions. Six therapists reported they did not perceive any relationship between outcome measure selection and patient outcomes, citing the continued flexible nature of balance assessment. Therapists described that if an outcome measure that was "wrong" or "inappropriate" was used at initial evaluation or if an outcome measure become inappropriate during a patient's plan of care, a new measure would be incorporated.

Two therapists did indicate that improving patient outcomes was one of the purposes of using outcome measures in their practice. Ten therapists did report a belief that there is a relationship between outcome measure selection and patient outcomes in most situations. Five therapists reported that there was a link between which outcome measure a therapist selected and a patient's outcome in limited circumstances. These limited circumstances included in outpatient departments only, when the therapist in question had recently graduate, or if a therapist was not "good" at decision-making. Those who endorsed this idea supported it in two primary ways. Some stated that if the patient's deficits were not correctly defined with an outcome measure the therapist was likely to make an incorrect decision regarding the type or intensity of treatment. This could occur because the measure was too easy, too difficult, or it did not assess the specific

balance deficit of a patient. This was proposed to impact the patient during the plan of care while that therapist was working with the patient.

> After you're done with all the questions with all the subjective and the history taking in all of that then you choose your outcome measures and everything else that you do in that examination is based on that…and if you guess or if you choose incorrectly then you're going to waste everybody's time and money especially the patients they're going to get frustrated because they're not getting the improvements that they may want and you're going to lose credibility so that whole process is so vitally important that you choose correctly. (South Outpatient 2)

An alternate manner in which outcome measure selection impacted patient outcomes was reported by one therapist in the acute care environment. They proposed that if an outcome measure did not adequately communicate to an insurance provider the presence and intensity of a patient's balance deficit, that patient was less likely to be approved for inpatient rehabilitation. This therapist's perception was, among those with new ABI, the frequency of therapy services provided in inpatient rehabilitation would likely result in a faster and more significant improvement in function, resulting in more significant long-term gains in mobility and balance.

> In our setting it sometimes is the strongest component of their medical record that determines where they are going to. In a hospital setting they give you like a week max with a patient…using scores, you know someone is like a 45 [on the Berg Balance Scale] to me that's the strongest predictor of whether they're going to get into additional rehab then my documentation saying oh well you know they just lost their balance. (South Acute 2)

DISCUSSION

The factors affecting which outcome measure was selected were complex and multi-faceted. The information from this qualitative research could be utilized in the design of educational interventions. Namely, future educational interventions should incorporate an understanding of the impact of institutional setting, culture, available resources, individual clinician differences, and patient characteristics. Therapists in this study described their needs as dynamic and complex and thus tools and recommendations available to them should be dynamic, address complex deficits, and be accessible.[1,30,31] Past research has assessed the compliance of all therapists at one institution or in one country with global recommendations. Future research should incorporate a dynamic and pragmatic understanding of these factors, with individualized knowledge translation interventions or analysis of compliance responses within appropriate sub-groups.

Physical therapists' process of balance assessment was previously described by McGinnis et al.[32] McGinnis et al interviewed six physical therapists working in OP clinics and five physical therapists in the inpatient rehabilitation setting. Therapists participating in McGinnis et al's study described how and why they selected methods for assessing balance with patients with balance deficits. Therapists in the present study and McGinnis et al' study reported similar strategies and factors that impacted decisions. Namely, there was an impact of patient functional level, therapist awareness and fluency with certain measures, patient length of stay, availability of resources, limitations specific to given settings, and the perceived clinical value of performing an outcome measure. One notable difference in the present study is that more participants mentioned research or psychometric properties as determinants of outcome measure decisions. In McGinnis et al's study,[32] only 2 of 11 participants cited scientific literature as a factor in choosing an assessment method. Alternatively, in this study, six therapists mentioned the APTA EDGE documents and two mentioned the clinical practice guideline published by the ANPT, both of which are high

level secondary sources of evidence. Additionally, eight therapists cited psychometric properties of measures influencing their selection of assessment tool. This difference between studies may be related to the difference in participant demographics. Of the 11 therapists in McGinnis et al's study, 6 had a terminal degree of a master's degree and 5 of 11 a bachelor's whereas 21 of 23 in the present study held a terminal doctor degree.[32] Another consideration is that the APTA EDGE documents and ANPT clinical practice guidelines were both published and the rehabilitation measures database appeared online since publication of McGinnis et al's study.[8,27,28] There has also been an increase in attention on outcome measures in research within the physical therapy profession. In a search for the terms "outcome measures" and "physical therapy" on the cumulative index to nursing and allied health literature, 3109 articles were retrieved for dates 1999-2009. In contrast, 9851 articles met these criteria 2009-2019. Future research should consider the influence of therapist characteristics including past education and exposure to outcome measures in analysis of behaviors and beliefs. Another notable difference in the present study is the variations and complexity in the assessment process. In previous research, therapists reported reliance on movement observation and a therapist's expectation of a patient's presentation prior to seeing them.[32] Both themes were minimal in the present study.

A notable similarity between this study and past research is the description of progressive evaluation of functional independence, incorporating medical chart review and subjective interview, and progressing to standardized measures when appropriate. Participants in the present study described categories of balance with terms and constructs similar to those presented by Shumway-Cook and Woollacott.[33] The application of systems theory to human balance presented in that text incorporates similar environment, task, and person contributions with person attributes of cognitive, sensory, and motor.

The role of outcome measures in making discharge recommendations was consistent with previous work by Bland et al.[17] The authors of that study reported that patients could be clustered

into four groups based on the cumulative scores of performance based outcome measures. Patients in the highest performing group were referred home without services in 50% of cases and either discharged to home with services or to inpatient rehabilitation facilities in 49% of cases. Conversely, the three clusters that included individuals performing more poorly on balance outcome measures were referred to inpatient rehabilitation 74-80% of the time. This is consistent with the qualitative information gathered during the present study, where those interviewed stated that outcome measures played a very small role in making and justifying discharge recommendations for lower functioning individuals. Typically, these patients were referred to inpatient rehabilitation with the justification based on Functional Independence Measures scores instead. Therapists reported outcome measures played a larger role with individuals who were higher functioning because more work needed to be done to justify inpatient rehabilitation.

Outcome measures played a role in every physical therapist's clinical reasoning in the present study. All participants noted that outcome measures, to a varying degree, have an impact on decisions regarding type, intensity, frequency, and duration of physical therapy services provided to the patient. In the broader context of clinical reasoning, outcome measures can be seen as information gathering tools to support inductive or deductive clinical reasoning processes. Consistent with previous research on clinical reasoning in physical therapy, the role of outcome measures was different depending on the type of cognitive reasoning process used. It has been noted that novice and expert health care practitioners frequently utilize different cognitive process for decision-making and this pattern was noted in the present study.[30] More experienced therapists reported an inductive process, systematically analyzing history, patient report, movement analysis, and objective testing to arrive at a conclusion. Typically, outcome measures were used by these practitioners to document their conclusion and "express it better to the world." Less experienced clinicians followed a deductive approach, which they described as "hypothesis driven." In these scenarios, history, observational analysis, and patient report guided formation of

a hypothesis and outcome measures served as confirming or disconfirming evidence for each hypothesis. However, deductive and inductive reasoning approaches were noted to be utilized by the same practitioners for different decisions. For example, one therapist reporting decision-making regarding discharge location through an inductive approach, with outcome measures serving a documentation role. Selection of appropriate intervention type and intensity, however, was made through a deductive approach, with outcome measures serving a hypothesis testing role.[34-36] Future research should investigate what facilitates the shift from deductive to inductive clinical reasoning and the factors that contribute to this shift.

There was a trend of support for the relationship between outcome measures and patient outcomes, with more than three-quarters of participants voicing a belief that outcome measure selection did impact a patient's health related outcomes. There were three potential avenues proposed by those who believed a link existed, namely facilitating selection of appropriate treatment type, selection of appropriate treatment intensity, and supporting best discharge location after acute care. However, equally valid counter arguments were presented by the one quarter of participants who did not support this notion. The theory that outcome measures can impact the long-term health and functioning of patients participating in physical therapy has not been explored in previous published research. Future work should further examine therapist's beliefs and behaviors and the potential implications.

CONCLUSION

The role of outcome measures has evolved since Partridge encouraged their use in 1982, when quantifying deficits and measuring change were their primary purpose.[7] Changes are apparent since McGinnis et al[32] and Danzl and Hunter[12] conductive qualitative interviews in 2009 and 2011. The present study highlights an important change in PT practice. Over the last quarter century, outcome measures have evolved beyond simply tools that measure and have been integrated in the complex clinical reasoning process of patient management. Outcome measures

are now important tools that guide therapists in making decisions about care, communicating with patients, caregivers, and other providers, prognosticating, predicting outcomes, and promoting the profession. Some of these uses were mentioned in previous work, with McGinnis et al[32] and Danzl and Hunter[12] both citing the role in making decisions, Danzl and Hunter[12] reporting use for communication, and Bland et al[17] evaluating the role in discharge planning. The present study found these roles of outcome measures consistent temporally and spatially and further investigated the potential link between short-term and long-term patient outcomes.

CHAPTER V

AN ANALYSIS OF THE IMPACT OF A KNOWLEDGE TRANSLATION INTERVENTION FOCUSED ON BALANCE OUTCOME MEASURES ON DECISION-MAKING BEHAVIORS OF PHYSICAL THERAPISTS

INTRODUCTION

The goal of health care is to prevent death and disability and to maintain and improve quality of life. Health care providers participate in a clinical decision-making process to best achieve these goals. Clinical decision-making is a complex process by which providers integrate collected patient data, their own knowledge and skills, and the clinical context to determine the most appropriate course of action.[1] An essential part of clinical decision-making is working within the best practice parameters of a given environment and situation. Constant innovations provide the potential for care that is more effective, efficient, and safe. Educational interventions have shown potential at assisting clinicians with translating the knowledge from published literature to clinical practice.[2-4] When these interventions result in a change in clinical behavior, it can lead to improved patient health outcomes. A 2018 systematic review found that in 15 out of 18 studies, the patients of providers educated on evidenced-based practice principles demonstrated improved health outcomes.[5]

Measuring patient outcomes with standardized outcome measures is considered an essential principle of evidence-based physical therapy practice.[6,7,8-11] The APTA recommends that every patient be assessed with outcome measures early in the physical therapy episode of care, throughout the plan of care, and near the termination of the plan of care.[12] The APTA and some authors have proposed that there is a relationship between outcome measures and clinical

decision-making during the patient management process, including diagnosis, prognosis, intervention selection, and patient education.[7,9,11,13,14] No published study has objectively explored how therapists use the results of balance outcome measures in clinical reasoning, through investigation of beliefs, perceptions, or behaviors. Further, no published study has determined if there is a relationship between the use of outcome measures and patient outcomes. Previously published literature indicates that knowledge translation focused on general evidence-based practice can improve patient outcomes, but these previous investigations did not focus on any specific phase of the patient management process.

The primary purpose of this study was to examine the difference in functional outcomes for patients treated by therapists who did or did not participate in the education intervention. The secondary purpose was to examine the differences in the quantity of physical therapy services provided to patients treated by therapists who did or did not participate in an educational intervention focused on outcome measures.

METHODS

Participants

Physical therapists and physical therapist assistants (PTAs) at four SNFs within one health care system in the Houston metropolitan area were recruited for the study. Inclusion criteria for target facilities included: 75 or more beds, four or more full-time equivalent physical therapists or PTAs, a minimum of 10 patients with acquired brain injury admitted in the last calendar year, and department managers agreeable to participating in the intervention. Acquired brain injury included a cerebrovascular accident, traumatic brain injury, or infectious process of the brain. The department manager for each facility who met the inclusion criteria, as determined by the director of business development, was contacted through email and provided preliminary information regarding the study. The department manager had the option to participate, not to

participate, or to defer the decision to a later time. Three managers elected to participate with no further questions, and one manager accepted the offer for a meeting. After one in-person meeting focused on clarifying research procedures and purposes, the final manager elected to participate in the study. Physical therapists and PTAs working as a 0.5 to 1.0 full-time equivalent at each participating site who reported working with one or more individuals with an acquired brain injury in the last year were invited to participate. Invited therapists reviewed and signed a TWU institutional review board-approved informed consent form before data collection and education intervention. Data were collected on patients with a diagnosis of acquired brain injury residing in each participating facility. An a priori power analysis was conducted utilizing G*Power based on an alpha level of .05, estimated effect size of d = 0.5, and power of 90%, indicating that a total sample size of 146 patients was required for Mann-Whitney tests.[15]

Procedures

This study used a prospective interventional case-control design with a non-randomized quota sample. Facilities were assigned to a group in the order they agreed to participate, alternating between assignment to the experimental group or the control group. The first facility that agreed to participate in the study was placed in the experimental group, the second facility was assigned to the control group, and this pattern continued in alternating fashion for the four facilities. Of the four total facilities, two were assigned to the experimental group, in which all the physical therapists and PTAs who worked at that facility participated in an educational intervention. The remaining two facilities were assigned to the control group, in which no interventional involvement occurred.

After recruitment and group assignment, the primary investigator met with the department managers for the experimental groups in-person and also communicated through email. This communication focused on identifying knowledge or practice gaps related to outcome

measure use, assessing barriers and facilitators to knowledge implementation, and understanding the potential knowledge users, operational context, and decision-making practices at that facility. This step in the intervention design was modified from the Knowledge-to-Action framework and the Understanding-User-Framework, two KT models.[3,16] An outcome measure set with patient criteria was developed based on the input of the managers and published secondary and primary sources.[3,10,16-19] Published literature used to determine inclusion of measures in the outcome measure set included the ANPT endorsed clinical practice guidelines[20] and published recommendations from the Academy of Neurologic Physical Therapy task forces.[21,22] An additional three measures not included in these secondary sources were added, based on peer-reviewed psychometric analyses and the facility preference for tools that included cut-off values and minimal detectable changes. The recommended outcome measure set is shown in Figure 8, the algorithm and interpretation guide provided to physical therapists and PTAs are shown in Appendix E, and a detailed justification for inclusion follows.

Figure 8. Outcome Measure Set Recommendations

Independence Criteria:	**Outcome Measure Recommended**
Sit to stand 1-3*:	Berg Balance Scale, Function in Sitting Test
Walk 10 feet 1-3*:	Berg Balance Scale
Walk 10 feet 4-6*:	Timed Up and Go, Timed Up and Go-Cognitive, Functional Gait Assessment, 10-meter walk test
*from the Coding Section GG Self-Care and Mobility Activities Included in the Post-Acute Care Item Sets 06. Independent – Patient/resident safely completes the activity by him/herself with no assistance from a helper. 05. Setup or clean-up assistance - Helper sets up or cleans up; patient/resident completes activity. 04. Supervision or touching assistance - Helper provides verbal cues and/or touching/steadying and/or contact guard assistance as patient/resident completes activity. 03. Partial/moderate assistance - Helper does LESS THAN HALF the effort. 02. Substantial/maximal assistance - Helper does MORE THAN HALF the effort. 01. Dependent - Helper does ALL of the effort.	

The educational intervention was delivered to the experimental group facilities based on current evidence, which supports intensive multi-faceted educational interventions focused on a

single subject that incorporates active participation, in-person visits by experts in a content area, collaboration with local consensus leaders, and electronic reminders.[2,16,23-25] The principal investigator sent the outcome measure algorithm to the department managers of the experimental group facilities for review and feedback. Modifications to content and format were made based on manager suggestions, and a final draft was emailed to the managers before the educational visit. One week before the educational meeting at each facility, the principal investigator sent a document with the recommended outcome measure set and an interpretation guide to all physical therapists and PTAs at the experimental facilities along with an invitation to participate in the educational meeting.

Baseline data was collected for physical therapists and PTAs at all four facilities. On the day of the educational meeting, physical therapists and PTAs at all four sites were provided the informed consent form to review and were allowed time to ask clarifying questions. If they chose to participate in the study, the signed informed consent was collected, and each therapist or assistant was provided a data collection packet that included a demographic collection form (see Appendix F), a survey of outcome measure use (see Appendix B, Questions 3-47), and the context subscale of the Organizational Readiness to Change Assessment (see Appendix G). If they chose to defer deciding to participate, the principal investigator's contact information, the data collection packet, and a pre-addressed stamped document envelope were provided to the department manager.

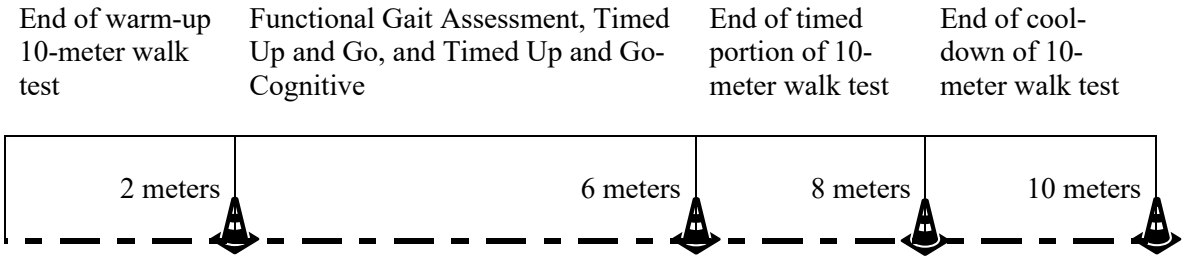
The educational meeting was 45 minutes at each of the two facilities in the experimental group. During the meeting, the principal investigator asked for each participant to share their professional history and history of using outcome measures. At both intervention sites, all of the physical therapists, PTAs, occupational therapists (OTs), and certified occupational therapy assistants (COTAs) from the department chose to participate in the educational meeting. The PI

reviewed the scoring and interpretation of measures in which the physical therapists and PTAs indicated they had less experience and answered questions posed by participants. The principal investigator then presented two case examples of patients and discussed how scoring and interpretation with each measure would differ. During the meeting, each intervention facility was provided paper copies of the recommended outcome measures, an interpretation guide, a summary of tool instructions, scoring sheets for each measure, and two physical instruments for mobile environmental set-up for measures with distance requirements.

The goal of providing physical instruments was to limit an identified environmental barrier. During the planning meetings with the department managers, an environmental barrier was identified that limited the clinical utility for the outcome measures that required measurement of a distance. Both facilities were designed with five wings, emanating for a central hub, like spokes on a wheel. The therapy gym was located at the end of one of these spokes. The gym had distance markings available that indicated where outcome measures should begin and end, making completion of these measures while in the gym more feasible. If a clinician was working with a patient at the end of a wing without the therapy gym, the physical therapist or PTA had to transport the patient to the central hub and back out to the end of another wing to complete the outcome measure. The physical therapist or PTA then had to transport them back to their room, down the length of two wings after completion of the measure. The other option was for the physical therapist or PTA to measure the distance required for each measure each time it was performed, which required they remember the correct measurement or look it up, count floor tiles or find a measurement tool, and locate an object to indicate a starting and ending point for the patient. Regulations did not permit the permanent marking of floors or walls within the facilities. Because environmental barriers are frequently cited in the published literature as a barrier to the utilization of outcome measures,[26-28] finding a solution was imperative to increasing the

likelihood of therapists utilizing the recommended outcome measures. The tools that were created to circumvent this challenge were a 33-foot by 1-inch tape measure with a nylon-coated blade with demarcations at 2 meters, 6 meters, 8 meters, and 10 meters and a braided rope with 7-inch height plastic cones attached along the rope at the same distance increments. The specific distance markings for each assessment tool are demonstrated in Figure 9.

Figure 9. Demarcations for Mobile Measurement Tools



One month after the educational visit, an email was sent to the physical therapists and PTAs in the two experimental facilities reminding them to utilize the recommended outcome measures, including an electronic copy of the outcome measure set, interpretation guide, and summary of tools instructions.

Data were collected for all patients with a diagnosis of ABI residing in the four facilities during the designated intervals. Baseline data were collected for the 90 days before the educational intervention, and post-intervention data were collected for the 90 days after the educational intervention. Data extraction was completed from the cloud-based Electronic Health Record software systems used by the skilled nursing facility network, Point Click Care and Simple LTC. Patient identifiable information was redacted by the Education and Program Resource Specialist at the health care system and delivered to the principal investigator through a cloud-based database. Patient demographic information collected included the date of admission

to physical therapy services, diagnosis, admission source, age range, gender, and functional independence with mobility and self-care at admission. Functional independence was rated using Section GG of the Self-Care and Mobility Activities Included in the Post-Acute Care Item Sets from the Center for Medicare and Medicaid Services.[29] Additionally, baseline and post-intervention data were collected on the number of falls while at the facility, length of physical therapy care, discharge location, minutes of physical therapy services provided, and functional independence with mobility and self-care at discharge from physical therapy plan of care. The scores and date of performance for any outcome measure documented with the included patients were also collected.

Outcome Measure Set Recommendations

Berg balance scale. The Berg Balance Scale is a 14-item performance-based, clinician-rated assessment battery that includes static and dynamic standing balance items.[30] This measure has excellent total score reliability (ICC = 0.95), individual item reliability (weighted $\kappa = 0.92$),[31] test-retest reliability with (ICC = 0.92),[32] and internal consistency (Cronbach $\alpha = 0.92\text{-}0.98$) in individuals with stroke.[31] Minimal detectable change and minimal clinically important difference are available for acute and chronic neurologic conditions, allowing for clinician interpretation and goal setting.[32-34] The measure requires less than 20 minutes to complete and uses commonly available equipment in the clinical environment.[30] The Berg Balance Scale was highly recommended for use with patients with stroke and recommended for use with patients with TBI by the ANPT task forces in 2011 and 2013, respectively.[35,36] This scale was also included in the 2018 Core Set of Outcome Measures clinical practice guideline developed by the ANPT, based on consumer survey and systematic review of peer-reviewed publications.[20]

Functional gait assessment. Like the Berg Balance Scale, the Functional Gait Assessment was included in the Core Set of Outcome Measures by the ANPT.[20] The Functional

Gait Assessment is a 10-item performance-based assessment battery that focuses on balance while walking. This measure demonstrates excellent test-rest reliability with acute and chronic stroke (ICC = 0.95). Minimal detectable change is available for this measure. The Functional Gait Assessment was found to have a floor effect with 0-6% of patients and a ceiling effect with 0-2% of patients with stroke in the outpatient setting.[37] The Functional Gait Assessment requires minimal equipment and requires less than 20 minutes to complete.[38]

10-meter walk test. Gait speed, typically reported in meters per second, is commonly measured with the 10-meter walk test. This test involves recording the time required to complete the middle 6 meters of a 10-meter walkway. This method incorporates a 2-meter warm-up and cool-down area. This test requires patients to be cued to walk at their comfortable walking speed or fastest possible walking speed.[39] Gait speed is measured in many patient populations. It has been proposed to be a vital sign of health status because of the strength of the relationship with fall risk, future hospitalizations, and functional independence.[40] Gait speed using the 10-meter walk test demonstrates good reliability. Data is available for interpretation of meaning, including minimal clinically important difference and minimal detectable change with patients with stable chronic neurologic conditions.[20] It requires minimal equipment, limited space, and typically takes less than 5 minutes to complete. The 10-meter walk test was also included in the Core Set of Outcome Measures clinical practice guideline.[20]

Five times sit to stand test. The Five Times Sit to Stand Test is the final measure recommended in this study that was included in the Core Set of Outcome Measures clinical practice guideline.[20] The clinical utility of this measure is excellent; it requires only a sitting surface and stopwatch and requires less than 5 minutes to complete. The Five Times Sit to Stand Test measures the time it takes a patient to complete five transfers from sitting to standing. This measure has excellent test-retest reliability (ICC = 0.994), inter-rater reliability (ICC = 0.97),

intra-rater reliability (ICC = 0.999), [41] and a cut-off score is available to indicate elderly patients at risk for falls.[42]

Function in sitting test. After meeting with the department managers, it was determined that a sitting balance measure would also be necessary to include in the recommendations. There were enough patients in the SNF expected to score poorly on the Berg Balance Scale and Functional Gait Assessment or were only able to complete one item on these tests. It was necessary to have a measure available for those patients who scored near the floor of these other measures. A sitting balance measure, the Function in Sitting Test, was added for these reasons. The Function in Sitting Test is a 14-item test battery that encompasses static and dynamic seated tasks scored on a 4-point ordinal scale. This measure has excellent internal consistency (Cronbach $\alpha = 0.98$) and has both a standard error of measure and minimal detectable change to guide interpretation.[43]

Timed up and go test and timed up and go-cognitive test. The rehabilitation managers reported that their needs included having measurement tools appropriate for neurological patients and elderly patients with medical comorbidities. Additionally, these managers preferred having a tool available that could assess balance ability and determine fall risk in less than 5 minutes. For this reason, the Timed Up and Go Test and the Timed Up and Go-Cognitive Test were added to the recommendation set. The Timed Up and Go Test is a measure of the time it takes for a patient to complete a stand from a seated position, walk 6 meters, turn 180 degrees, walk 6 meters to return to the chair, turn 180 degrees, and return to sitting. The Timed Up and Go-Cognitive Test includes the same physical task while the patient performs verbal serial three subtraction starting at a random number between 90 and 100. The Timed Up and Go Test has excellent test-retest reliability for the traumatic brain injury population (ICC = 0.86).[44] Cut-off scores indicating fall risk for elderly patients are available for the Timed Up and Go Test and the Timed Up and Go-

Cognitive Test. For those with a history of stroke, cut-off scores are available for the Timed Up and Go Test.[45,46] Additionally, minimal detectable change has been reported for the Timed Up and Go Test with those with stroke.[47]

Instrumentation

Organizational readiness to change assessment. The ORCA was developed by researchers at the Department for Veterans Affairs as a tool to identify barriers and measure a site's readiness to participate in a quality improvement project.[48] The instrument was constructed based on interviews with staff at six hospitals after implementing a novel intervention, or multiple interventions, to improve measurement and management of low-density lipoprotein cholesterol in patients with coronary heart disease. The ORCA consists of 77 items divided into three scales that measure the strength of evidence for the proposed change, the quality of the organizational context to support the change, and the organizational capacity to facilitate the change. These scales, labeled evidence, context, and facilitation, are grouped according to the PARIHS framework. There are six subscales that comprise the context scale: senior leadership culture, staff culture, leadership behavior, measurement, opinion leaders, and general resources.[48]

Hagedorn and Heidman[49] provided preliminary support of the ORCA's clinical utility at baseline and after behavior change intervention in a substance abuse clinic.[49] Additionally, this instrument has some psychometric support for use in the context of knowledge translation in health care. Cronbach alpha for scale reliability for the evidence, context, and facilitation scales was 0.74, 0.85, and 0.95 among 113 observations for three quality improvement initiates in health care, as reported by Helfrich, Yu-Fant, and Sales.[48] The context and facilitation scales met the standard threshold for internal consistency, which is typically considered a Cronbach alpha of 0.80 or greater. The Cronbach alpha for the context subscales, as listed above, were found by these authors to be 0.92, 0.90, 0.93, 0.88, 0.91, and 0.86. This data indicates that items within the

context scale have a reasonable correlation with each other, which is supportive of the general cohesiveness of these scales. Exploratory factor analysis on the aggregated subscales found that five of the six context subscales loaded on a single factor. The results of this exploratory factor analysis indicated that most items and subscales did cluster based on the PARIHS framework, as intended by the developers of the scale. Based on this evidence, there is moderate support for item summation for each scale.[48,50]

Outcome measure survey. The survey instrument used in this study was the same survey instrument used in the first study of this dissertation. The first study involved a nationwide online survey of physical therapists. The survey instrument used in both studies asks respondents to indicate their level of agreement with nine statements related to the rationale for choosing an outcome measure and 13 statements related to the frequency that balance measurement results impacted decision-making constructs. These survey questions were scored on a 6-point Likert Scale with descriptive anchors. Statements related to the rationale for choosing a measure or the relationship between balance measurement and decision-making were derived from qualitative studies or by professional organizations.[7-9,11-13,51,52]

In the first study of this dissertation, the survey instrument was assessed for sensibility and face and content validity with a pilot group of 10 physical therapists. Pilot data were used to modify the instrument for ease of use and included recurrent statements from free-response boxes within answer choices. Free response text boxes were included again in the online nationwide survey study. Of the 337 respondents in that study, 52 added comments on the reasons for choosing a measure, and 14 included comments on the uses of outcome measures. Of these comments, each was able to be categorized into one of the already available answers, provided details explaining why an answer was selected, or was distinct from all other free responses and thus not able to justify creating a new category in a further iteration of the survey. These results

indicated that changes to the response choices were not necessary. Thus, the survey used in the present study was the same survey instrument used in the first study of this dissertation.

Data Analysis

To test if any differences between groups of therapists existed at baseline, independent sample Mann-Whitney tests or chi-square tests compared groups on the following variables: years' experience as a physical therapist or PTA, years' experience in the current setting, entry-level degree, years since entry-level degree, terminal degree, years since terminal degree, specialty certification, APTA membership, and section/academy membership. Additionally, the baseline means of the context subscale for the ORCA and the subsections of the context subscale were compared with independent sample Mann-Whitney tests. The response frequencies on the outcome measure survey questions were transformed into ordinal data with a numerical code for each category "never," "rarely," "occasionally," "sometimes," "frequently," and "most of the time." The answers to the survey questions were compared with Mann-Whitney tests. The same was done for the baseline demographics of patients. The mean, median, and standard deviation of each of the parametric variables were calculated while the frequency distributions were assessed for the non-parametric variables, and visual analysis of the data was completed with histograms and box plots.

Independent sample *t* tests and Mann-Whitney tests were used to assess the differences in groups after the intervention for the following items (or variable): compliance, mean number of patient falls, minutes of physical therapy services provided, length of physical therapy episode of care, discharge location, functional independence with mobility, and change in functional independence with mobility.

RESULTS

Four SNFs were recruited for the study, with two control sites and two experimental sites. These facilities included 14 physical therapists and PTAs who consented to participate in the study, six in the control group and eight in the experimental group. Baseline demographic data for the participating clinicians are shown in table 8. Mean baseline ORCA context subscores were 4.30 for the control group and 4.32 for the experimental group. The highest mean score on this instrument was a 5, where a higher score indicates greater agreement with statements related to readiness to change. Scores for the subsection of the context subscore are shown in Table 9. Chi-square tests revealed no significant difference between groups for license ($p = .872$, $df=1$, $\chi^2=.026$), entry-level degree ($p = .626$, $df=3$, $\chi^2=1.750$), recent degree ($p = .656$, $df=2$, $\chi^2=0.843$), specialty certification ($p = .078$, $df=1$, $\chi^2=3.111$), or APTA membership ($p = .872$, $df=1$, $\chi^2=.026$).

Table 9. Baseline Demographic Characteristics of Physical Therapists and Physical Therapist Assistants (frequencies)

	Designation		**Entry-level Degree**				**Terminal Degree**				**Specialty Certification**		**APTA Member**	
	PT	PTA	Associate	Bachelor	Master	Doctorate	Associate	Bachelor	Master	Doctorate	Yes	No	Yes	No
Control	2	4	4	1	0	1	4	0	0	2	2	4	0	6
Intervention	3	5	4	1	1	2	5	0	1	2	0	8	0	8
Total	5	9	8	2	2	2	9	0	1	4	2	12	0	14

	Years Since Entry-level Degree	**Years since recent degree**	**Years working as Therapist/Assistant**
Control	13.8 (16.8)	5.7 (5.1)	13.8 (16.8)
Intervention	13 (9.1)	10.8 (7.2)	10.75 (7.2)
Total	14 (12.4)	14 (6.7)	14 (11.8)

Table 10. Baseline Organizational Readiness to Change Scores (mean scores)

	Context Subscore	**Senior Leadership Culture**	**Staff Member Culture**	**Senior Leadership Behavior**	**Measurement**	**Opinion Leader**	**Resource**
Control	4.30 (0.37)	4.56 (0.41)	4.58 (0.34)	4.29 (0.51)	4.29 (0.68)	4.54 (0.53)	3.58 (0.80)
Intervention	4.32 (0.56)	4.38 (0.76)	4.38 (0.65)	4.38 (0.64)	4.28 (0.70)	4.28 (0.47)	4.09 (0.67)
Total	4.31 (0.47)	4.45 (0.62)	4.64 (0.54)	4.38 (0.54)	4.29 (0.57)	4.40 (0.66)	3.88 (0.75)

Mann-Whitney tests found no difference between the control and intervention groups for years since entry-level degree ($p = .662$), years since most recent degree ($p = .181$), and years in clinical practice ($p = .755$). Mann-Whitney tests found no baseline differences in the Organizational Readiness to Change Context Subscale ($p = .852$) as well as the sections for senior leadership culture ($p = .852$), staff member culture ($p = .755$), senior leadership behavior ($p = .573$), measurement ($p = .950$), or opinion leaders ($p = .282$). Mann-Whitney tests found no significant differences at baseline between groups on survey questions related to beliefs and perceptions related to outcome measures. The survey items "when selecting an outcome measure, how important are each of the following when making your decision" and "how often do you use the results of standard balance measures for the following" were not significantly different between groups except for the statement "the measure is fast." Tables 11 and 12 show the test statistics and significance values for the baseline survey item answer along with the median and mode answer selection for each group.

Data were available for 84 patients in the 90 days before the therapists' educational intervention and 85 patients in the 90 days after the educational intervention. Of the patients treated in the intervention time before the intervention, data were available for 29 in the control group and 55 in the intervention group. Of the patients treated before the intervention 85% had a diagnosis of stroke, 14% encephalopathy, 1% anoxic brain injury, and 1% hydrocephalus. Among the patients treated during the time after the intervention, data were available for 30 patients in the control group and 55 in the intervention group. Of the patients treated after the intervention, 80% were diagnosed with a stroke, 14% encephalopathy, and 2% traumatic brain injury. Chi-square tests revealed no difference between groups for diagnosis during the pre-intervention time point ($p = .434$) or post-intervention time point ($p = .645$).

Mann-Whitney tests found no difference between groups for patients treated in the 90 days before the educational intervention on any scores of independence with mobility, as documented using the Section GG of the Self-Care and Mobility Activities included in the Post-Acute Care Item Sets. There was no difference at admission to physical therapy services in bed mobility ($p = .781$), transfers ($p = .537$), ambulation ($p = .453$), or stairs ($p = .494$). There was no difference at discharge on bed mobility ($p = .986$), transfers ($p = .557$), ambulation ($p = .404$), or stairs ($p = .395$). There was no difference in the change in independence with bed mobility ($p=.401$), transfers ($p = .107$), ambulation ($p = .280$), or stairs ($p = .687$) from admission to discharge. The sum of independence scores on all mobility items was not different between groups at admission ($p = .495$), discharge ($p = .198$), or the change in total scores ($p = .423$). Mann-Whitney test found no difference between groups for distance ambulated at admission ($p = .659$), discharge ($p = .754$), or change in distance ambulated ($p = .549$), number of stairs completed at admission ($p = .659$), discharge ($p = .395$), or change ($p = .500$).

Table 11. "When selecting an outcome measure, how important are each of the following when making your decision" Baseline Data

	Widely used	**Measure is fast**	**Comfortable with measure**	**Equipment is available**	**Facility requires measure**	**Taught in PT school**	**Strong psychometrics**	**MDC and MCID available**	**Captures specific construct**
Control									
Median	3.5	3	4	4	4	4	5	4.5	4
Mode	4	3	4	4	4	3,4	5	4,5	4
Experimental									
Median	5	6	5	6	4	4.5	5	4	4
Mode	5	6	6	6	3	4	6	4	4
U	24.50	39.50	33.50	27.00	22.50	33.00	23.00	13.50	23.00
Z	1.93	.007	1.87	1.68	.234	1.23	.296	-1.23	.387
p	.073	.005	.073	.180	.836	.282	.836	.295	.836
1 = not at all important, 2 = low importance, 3 = slightly important, 4 = important, 5 = very important, 6 = extremely important									

Table 12. "How often do you use the results of standard balance measures for the following" Baseline Data

	Guide treatment	**Identify risk for adverse outcomes**	**Estimate prognosis**	**Set goals**	**Objectify impairment**	**Evaluate change**	**Communicate with Health Care Providers**	**Educate patients**	**Justify services**	**Help with discharge decisions**	**Evaluate clinical programs**	**Assess own performance**	**Improve patient outcomes**
Control													
Median	5	4.5	5	5.5	4.5	5	5	5	4	4.5	4	3.5	5
Mode	5	3,6	5	6	4,5	5	5	5	2,6	4,5	4	3	5
Experimental													
Median	5	5	4.5	5.5	4	6	5.5	5	5	5	3.5	4	5.5
Mode	5	6	3,4,5	6	1,3,4,5	6	6	6	6	6	2,6	6	6
U	24.5	27.00	18.00	20.50	21.00	32.00	25.00	22.00	28.00	26.50	17.00	22.50	17.50
Z	.072	.400	-.814	-.486	-.399	1.09	.136	-.272	.541	.332	-.449	-.199	.476
p	1.00	.755	.491	.662	.755	.345	1.00	.852	.661	.755	.724	.850	.662
1 = Never (0%), 2 = Rarely (1-20%), 3 = Occasionally (21-40%), 4 = Sometimes (41-60%), 5 = Frequently (61-80%), 6 = Most of the time (>80%)													

Independent sample *t* tests found no difference between control (M = 1084, SD = 993) and intervention group (M = 777, SD = 619) for total minutes of physical therapy services during episode of care (t(80) = 1.726, p = .088). Length of physical therapy episode of care, in days, was not found to be different (t(87) = .737, p = .463) between control (M = 40.3, SD = 52.0) and intervention (M = 33.7, SD = 30.1) groups. Average minutes of physical therapy per day during episode of care for control (M = 31.5, SD = 11) and experimental groups (M = 28.8, SD = 17.9) was not found to be different (t(80) = .729, p = .468). Further, no difference was found between the control group (M = 13, SD = 4.58) and experimental group (M = 17.2, SD = 8.9) for total number of physical therapy sessions (t(19) = -1.008, p = .326) or between control (M = 46.4, SD = 7.6) and experimental (M = 49.8, SD = 5.1) for average minutes per session (t(19) = -1.172, p = .256). Chi-square tests revealed no differences between groups for discharge location (p = .262).

Mann-Whitney tests found a significant difference between groups for patients treated in the 90 days after the educational intervention independence for bed mobility at admission to physical therapy services (p = .004), transfers at admission (p = .039), independence with bed mobility (p = .035) and ambulation at discharge (p = .010), distance ambulated at discharge (p = .013) and change in distance ambulated (p = .036). The median independence score at admission to therapy services for bed mobility for the control group was 2 (maximal assistance, n = 30) and for the interventional group was 3 (moderate assistance, n = 48) and for transfers was 2 for control (n = 39) and 2 for the intervention group (n = 49). At discharge, median score for independence with bed mobility was 3 for control (n = 23) and 4 (supervision) for intervention group (n = 46), independence with ambulation was 3 for control (n = 15) and 4 for intervention group (n = 38). The mean distance ambulated at discharge was 23 ft (SD = 38.9) for the control group and 124 ft (SD = 95.8) for the intervention group, and the change in distance ambulated was 10 ft (SD = 23.5) for control and 79.23 (SD = 79.9) ft for the intervention group.

Mann-Whitney tests found no difference between groups at admission to physical therapy services for ambulation ($p = .107$), at discharge for transfers ($p = .104$), or on change in independence with bed mobility ($p = .565$), transfers ($p = .426$), or ambulation ($p = .062$). The sum of independence scores on all mobility items was not different between groups at admission ($p = .883$), discharge ($p = .270$), or for the change in total scores ($p = .160$). Mann-Whitney test revealed no difference for distance ambulated at admission to therapy services ($p = .423$). Mann-Whitney tests could not be calculated for independence with stairs at admit, discharge, or change, the number of stairs at admit, discharge or change, or distance ambulated at discharge or change in distance ambulated due to missing data for the control group.

Independent sample *t* tests found a significant difference between control ($M = 1412$, $SD = 1388$) and intervention group ($M = 918$, $SD = 698$) for total minutes of physical therapy services during episode of care ($t(87) = 2.235$, $p = .028$). Independent sample *t* tests found no difference for length of physical therapy episode of care, in days ($t(87) = .482$, $p = .631$) between control ($M = 47.38$, $SD = 57.62$) and intervention ($M = 42.21$, $SD = 42.56$) groups. Average minutes of physical therapy per day during episode of care for control ($M = 31.33$, $SD = 9.85$) and experimental groups ($M = 29.35$, $SD = 12.64$) was not found to be different ($t(87) = .767$, $p = .445$). Further, no difference was found between control group ($M = 10.4$, $SD = 9.81$) and experimental group ($M = 10.4$, $SD = 4.39$), for total number of physical therapy sessions ($t(4) = .874$, $p = .431$) or between control ($M = 46.27$, $SD = 10.0$) and experimental ($M = 30$, $SD = 0$) for average minutes per session ($t(3) = 1.456$, $p = .241$). Chi-square tests revealed no differences between groups for discharge location ($p = .384$).

Limited data were available on documented outcome measures. Documented outcome measures were available for five patients in the control group before the intervention, six patients in the control group after the intervention, 13 in the intervention group before the intervention, and 15 in the intervention group after the intervention. The outcomes are displayed in Table 12.

Chi-square tests revealed there was no difference between groups on documented outcome measures before the intervention (p = .099) or after the intervention (p = .098).

Table 13. Outcome Measures Documented for Each Group

	Before Intervention	**After Intervention**
Control Group	30-Second Chair Stand Test (1) Functional Reach Assessment (1) Timed Up and Go Test (3)	30-Second Chair Stand Test (2) Function in Sitting Test (1) Timed Up and Go Test (3)
Intervention Group	30-Second Chair Stand Test (8) Timed Up and Go Test (5)	30-Second Chair Stand Test (12) Timed Up and Go Test (3)

DISCUSSION

No differences were apparent between the control and experimental group for the baseline characteristics of the physical therapists and PTAs, other than the physical therapists and PTAs in the experimental group preferring measurement tools that can be completed more quickly. Therapists were similar for experience, education, beliefs about outcome measures, and self-reported use of outcome measures. The two intervention and two control facilities had similar readiness to implement an evidence-based change in practice, as measured by the ORCA. Additionally, no differences were found in baseline patient characteristics, patient participation in therapy, and patient functional independence changes in the 90 days before the educational intervention. These findings increase the confidence that differences noted in the post-intervention time were related to the educational intervention rather than baseline differences in practice or patient population between facilities.

Patients treated by therapists in the experimental group after the therapists participated in an educational intervention demonstrated significantly better improvements in ambulation independence and distance ambulated in significantly fewer minutes of PT. Patients in the experimental facilities received a mean 494 fewer minutes of PT but discharged PT requiring no

physical assistance from another person for ambulation. These results are in contrast to the patients in the control group who required moderate assistance from another person to ambulate at discharge from therapy services. Patients treated at the experimental facilities improved their distance ambulated by a mean of 1 foot after every 11 minutes of PT, compared to the control group improving 1 foot after every 141 minutes of PT. Patients treated by therapists in the experimental group received care that resulted in greater gains in independence and walking ability after receiving fewer minutes of PT.

Notably, the patients in the experimental group did demonstrate more independence than the control group with bed mobility and transfers at baseline. Greater baseline independence was considered as a possible contributing factor to the greater independence with ambulation at discharge. There is evidence that independence with bed mobility at admission to inpatient rehabilitation can be related to ambulation ability at discharge for those with neurological injuries. Kuys et al[53] reported that among 120 individuals with acute stroke, walking speed at hospital discharge was best predicted by admission walking speed and independence with moving from supine to sitting.[53] To test if the baseline differences in this study contributed to the gains in walking ability, Kendall tau rank correlation was used to test the strength of the relationship. Kendall tau rank correlation indicated that there was a significant weak correlation between bed mobility independence at admission and ambulation independence at discharge ($p = .003$, $\tau_b = .357$), significant and moderate correlation with distance ambulated at discharge ($p = .001$, $\tau_b = .624$), and significant and weak correlation with change in distance ambulated ($p = .023$, $\tau_b = .425$). Correlation between independence with transfers at admission to PT services was significant and moderate for independence with ambulation at discharge ($p < .001$, $\tau_b = .501$), significant and moderate for distance ambulated at discharge ($p < .001$, $\tau_b = .668$), at significant and weak for change in distance ambulated ($p = .016$, $\tau_b = .444$).

To test if patients at different baseline functional abilities received a different amount of PT services, Kendall tau rank correlation was used to test the correlation between baseline bed mobility and transfers with total minutes of physical therapy, average minutes per day, and length of care in days. Level of independence at baseline with bed mobility demonstrate an insignificant and weak correlations with days of physical therapy ($p = .186$, $\tau_b = -.114$), minutes of PT ($p = .139$, $\tau_b = -.126$), and average minutes per day ($p = .590$, $\tau_b = -.046$). Insignificant and weak correlations were also revealed between independence with transfers at admission and days of PT ($p = .466$, $\tau_b = -.063$), minutes of PT ($p = .461$, $\tau_b = -.063$), and average minutes per day ($p = .932$, $\tau_b = .007$).

This data demonstrates that a relationship did exist between baseline functional independence and discharge ambulation ability for the experimental group after the intervention. This relationship should be considered when interpreting these results. However, the relationship was not found to be strong. Further, the variance shared between baseline functional independence and discharge ambulation ability does not fully explain the differences between groups present after the intervention, and that was not present before the intervention. Despite no significant difference found between groups in the period before the intervention on baseline bed mobility, baseline transfers, discharge ambulation distance, or discharge ambulation independence, significant correlations also existed during that time. At the pre-intervention time point, Kendall tau rank correlation revealed significant moderate correlations between baseline bed mobility and ambulation independence at discharge ($p < .001$ $\tau_b = .646$) and ambulation distance at discharge ($p < .001$, $\tau_b = .680$). Baseline transfer independence had a significant moderate correlation with discharge ambulation independence ($p < .001$, $\tau_b = .690$) and a significant strong correlation with discharge ambulation distance ($p = .000$, $\tau_b = .717$). The role of baseline functional independence should not be ruled out as contributing to the measurable

improvements in ambulation independence and distance in that group. However, this relationship does not have strong support as the sole explanation for the noted differences between groups.

This study had several limitations. Because it was not a controlled trial, it depended on patients that were naturally admitted to and received PT in the selected facilities. The difference between groups in functional independence at baseline occurred as a result of this situation. This study revealed potentially clinically relevant information that should be further validated with a controlled design that decreases the complicating factors present herein. Compliance with outcome measure recommendations was not able to be calculated as planned in this study. The data aggregations systems were unable to extract outcome measures; significant data on outcome measures were missing. Thus, a direct relationship between outcome measure use and functional independence change could not be computed. Future studies should track outcome measure usage proactively. Tracking outcome measures would allow researchers to utilize correlation values to assess the relationship between outcome measure selection and any differences noted. Additionally, there was a moderate amount of missing data regarding admissions source, discharge location, independence with stairs, and the number of stairs completed. The number of stairs and independence with stairs was typical of the GG code independence rating system, as noted by the Center for Medicare and Medicaid services in their initial study of the tool.[54] However, admission sources and discharge locations are required to be recorded, as documented in the Center for Medicare and Medicaid guidelines. Bland et al[14] have previously reported on the relationship between physical therapists' clinical assessments and discharge recommendations. Future research could utilize an interventional approach as used in this study to examine the change related to discharge recommendations and eventual discharge placement.

CONCLUSION

Patients treated by physical therapists and PTAs who participated in a balance outcome measure educational intervention demonstrated greater independence with ambulation and a more

significant increase in distance ambulated. Patients in the intervention group achieved more considerable gains in independence after participating in 35% fewer minutes of PT than the patients treated by control therapists. This study supports the assertions of the APTA that outcome measures are an essential component of evidence-based clinical decision-making. This study demonstrates promising early evidence that educating physical therapists on the use of outcome measures could lead to more effective and efficient care. This study does not fully explain the mechanism for the relationships among outcome measures, delivery of PT services, and patient outcomes. Further qualitative work is needed to understand the underlying mechanisms. Further quantitative work is needed to validate these findings in other settings, patients, and regions.

CHAPTER VI

CONCLUSION

STATEMENT OF THE PROBLEM

Outcome measures are considered a foundation of evidence-based PT practice. Little evidence is available regarding the impact that standardized measures have on clinical reasoning and patients' health-related outcomes.

REVIEW OF METHODOLOGY

The three studies in this dissertation investigated the relationship between outcome measures and decision-making through a mixed-methods design, including online surveys, qualitative interviewing, and a case-control interventional study.

SUMMARY OF FINDINGS

Through a nationwide survey (Study One), therapists, independent of experience level, degree, APTA membership, or region of the United States, self-reported utilizing outcome measures to guide decision-making. In this survey, the majority (93%) of the 373 responding physical therapists reported using outcome measures to assess the balance ability of their patients. There was limited diversity in which outcome measures were used. Most therapists reported never or rarely using 15 of 18 listed measures, see Appendix B. Only three outcome measures scored a median frequency rating other than "rarely," the Berg Balance Scale, Dynamic Gait Index, and the Timed up and Go Test. Therapists indicated that the most important reasons for choosing a measure were that they are comfortable with using it, that they have access to the equipment required, that it has strong psychometric properties, and that a minimal detectable change and minimally clinically important difference are available for the measure.

Physical therapists reported using outcome measures for the following purposes with greater than 80% of patients: identify patients at risk for adverse events, estimate prognosis, set goals, describe impairments objectively, evaluate patient change, justify services to third-party payers, and guide discharge. Further, the majority of therapists indicated that outcome measure results are used for the following purposes during 60-80% of clinical cases: to select treatment interventions, communicate with other healthcare providers, educate patients and family, assess clinical programs, assess the effects of treatment, and improve patient outcomes.

In Study Two, one-on-one telephone or in-person interviews were conducted with 23 physical therapists, nine who worked in IP, seven in AC, and seven in OP. The range of years of practice was 2-42.5 years, mean 11.3 (SD 11.5), and the time since earning an entry-level degree ranged 3-43 years, mean 12.0 (SD 10.8). The purpose of the interviews was to explore the role of outcome measures in decision-making. There were four major themes revealed through the qualitative analysis of the interview transcripts: the process of assessing balance, factors in choosing balance outcome measures, use of results of outcome measures, and impact of outcome selection. Therapists reported that initial balance assessment typically involved assessing the stability of patients during progressively more difficult functional tasks, examining different types of balance, and frequently involved standardized assessment batteries. The manner and tools for measuring balance often changed through the patient's episode of care to adjust to their changing abilities. Therapists indicated that several factors influenced if and which outcome measure was used to examine balance. These included patient factors, therapist factors, institution factors, professional organization recommendations, and characteristics of the tool. All therapists noted that outcome measures, to a varying degree, have an impact on decisions regarding type, intensity, frequency, and duration of physical therapy services provided to the patient. Therapists identified other roles of standardized outcome measures in clinical reasoning and decision-making. The functions of outcome measures included: determining fall risk, estimating prognosis,

determining the need for therapy, determining if the current plan of care is appropriate, educating patients and caregivers, communicating with healthcare providers, quantifying deficits, documenting goals, justifying equipment, justifying discharge location, or justifying the need for therapy. There was a trend of support for the relationship between outcome measures and patient outcomes. Of the participants, 17 reported that outcome measure selection did impact a patient's health-related outcomes, through facilitating selection of treatment type, choice of treatment intensity, and supporting best discharge location after acute care.

Through a prospective interventional case-control study (Study Three), a link was established between the provision of an educational intervention to physical therapists and physical therapist assistants and the functional outcomes of patients at the sampled facilities. Fourteen physical therapists and physical therapist assistants from four different facilities, two that were considered "intervention" and two that were considered "control" facilities, participated in this study. Patients treated by physical therapists and physical therapist assistants who participated in a balance outcome measure educational intervention demonstrated greater independence with ambulation and larger increases in distance ambulated. Patients in the intervention group required less assistance with bed mobility and transfers when admitted to therapy service, but this was not found to have a strong and significant relationship with the ambulation improvements. Patients in the intervention group also achieved greater gains in independence though they participated in 35% fewer minutes of PT than the patients treated by control therapists. Patients treated at intervention facilities improved their maximal distance ambulated a mean of 1 foot for every 11 minutes of PT provided, compared to the control group improving 1 foot for every 141 minutes of PT provided.

These three studies demonstrate a consistent theme. Therapists believe that there is a relationship between outcome measure use and clinical reasoning. This relationship was shown through quantitative and qualitative methods and analysis. Greater improvements in walking

ability with fewer minutes of physical therapy was demonstrated by patients treated by therapists and therapist assistant educated on the use of outcome measures.

CLINICAL RELEVANCE

PT care is focused on reducing functional limitations and improving quality of life through the selection of interventions, patient and family education, coordination with other care providers, and recommendations for equipment, discharge, and future care. Standardized outcome measures serve as an essential data gathering tool during initial and ongoing examinations and impact each of these areas of patient management. The use of outcome measures that are supported by current evidence and provide useful clinical information to therapists may improve patient outcomes.

FUTURE RESEARCH

Continued research is needed to support these initial findings that patients treated by physical therapists educated on the use of balance outcome measures demonstrate more significant and faster improvements in walking ability. Future research should include patients in other practice settings and with other diagnoses. Additionally, the study of patients with similar baseline functional independence would clarify the impact seen in the current research.

The clinical reasoning process should also be further explored, focusing on the difference between deductive and inductive reasoning by physical therapists. These differences were highlighted in a few interviews during Study Two. Still, the different role of these two reasoning processes when considering the use of outcome measures was not pursued during these interviews.

The interventional study (Study Three) focused on the amount of PT services provided and the functional independence of patients. Physical therapists in the survey (Study One) and interviews (Study Two) endorsed additional areas of decision-making that were impacted by outcome measures that warrant further study. These areas include patient and family education

and communication with other care providers. Additionally, the impact of outcome measure documentation on third party reimbursement for therapy and equipment is worth further investigation. Finally, future work should continue to evaluate the effects of outcome measures on other patient health-related outcomes, including balance ability, balance confidence, falls, and the ability to participate in work and school.

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CHAPTER III

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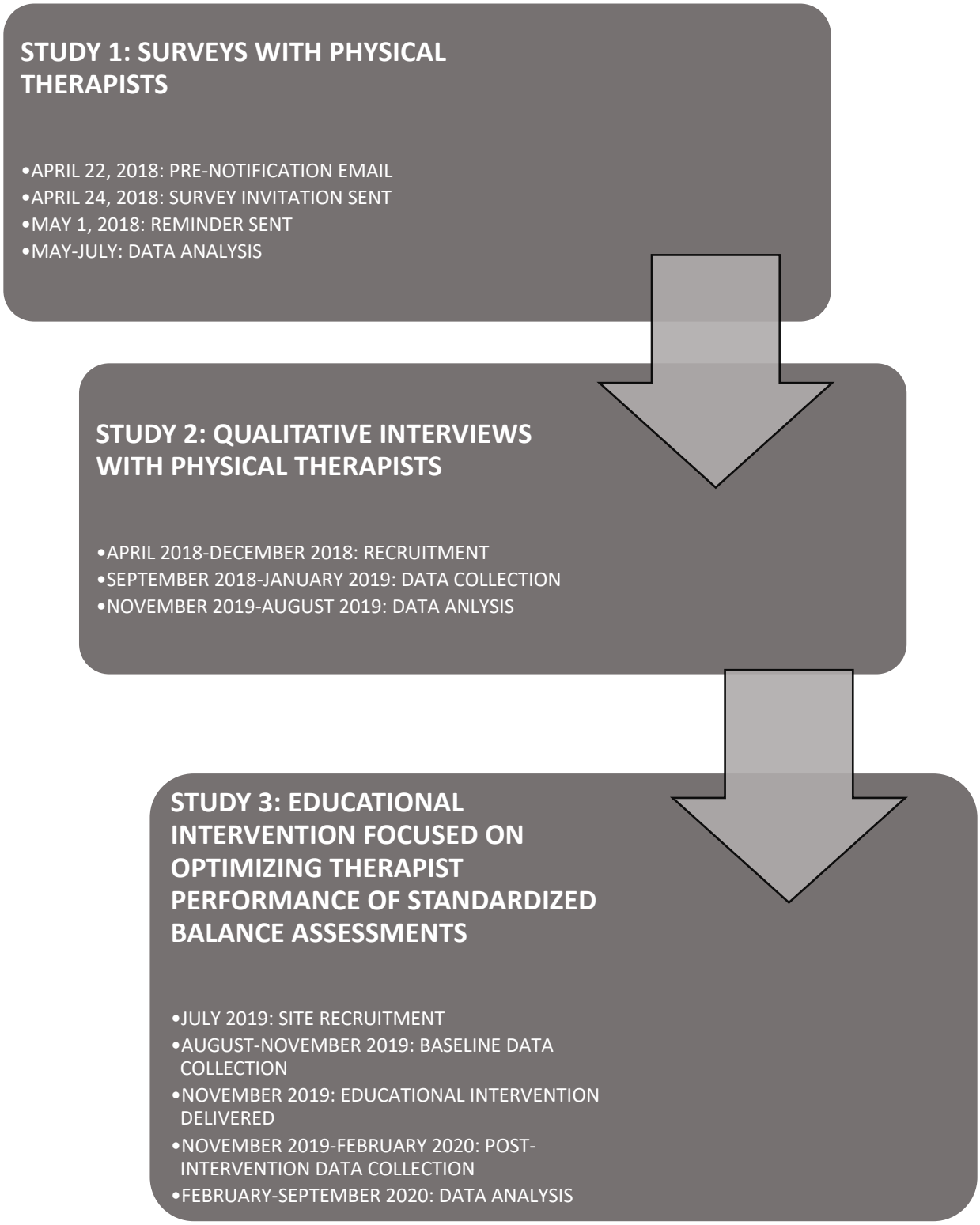
APPENDIX A

Schematic of the Order of the Studies


STUDY 1: SURVEYS WITH PHYSICAL THERAPISTS
•APRIL 22, 2018: PRE-NOTIFICATION EMAIL
•APRIL 24, 2018: SURVEY INVITATION SENT
•MAY 1, 2018: REMINDER SENT
•MAY-JULY: DATA ANALYSIS
STUDY 2: QUALITATIVE INTERVIEWS WITH PHYSICAL THERAPISTS
•APRIL 2018-DECEMBER 2018: RECRUITMENT
•SEPTEMBER 2018-JANUARY 2019: DATA COLLECTION
•NOVEMBER 2019-AUGUST 2019: DATA ANLYSIS
STUDY 3: EDUCATIONAL INTERVENTION FOCUSED ON OPTIMIZING THERAPIST PERFORMANCE OF STANDARDIZED BALANCE ASSESSMENTS
•JULY 2019: SITE RECRUITMENT
•AUGUST-NOVEMBER 2019: BASELINE DATA COLLECTION
•NOVEMBER 2019: EDUCATIONAL INTERVENTION DELIVERED
•NOVEMBER 2019-FEBRUARY 2020: POST-INTERVENTION DATA COLLECTION
•FEBRUARY-SEPTEMBER 2020: DATA ANALYSIS

APPENDIX B

Outcome Utilization Measure Survey

Use of Balance Measurement Tools by Physical Therapists

The return of your completed questionnaire constitutes your informed consent to act as a participant in this research.

This survey addresses your use of standardized assessments of balance with your patients or clients with acquired brain injury, including stroke, traumatic brain injury, and anoxic brain injury.

Specifically, we will be asking about how you choose which measures to perform and how you use the results of these measures.

The survey should take 10 minutes.

***1)** Are you a licensed physical therapist?

- Yes
- No

***2)** Have you worked with a client diagnosed with acquired brain injury (including traumatic brain injury, stroke, or anoxic injury) during the past year?

- Yes
- No

Section I: Use of Balance Outcome Tools

All questions below must be answered.

***3)** Do you use outcome measures or standardized balance measures with your clients with history of acquired brain injury (including traumatic brain injury, stroke, or anoxic injury)?

- Yes
- No

***4)** On average, how many different standard balance measures or outcome measures do you use during the plan of care (from initial evaluation to discharge) of one client/patient with an acquired brain injury?

- 0
- 1-2
- 3-4
- 5+

When you measure balance for individuals with history of brain injury, how often do you use the following standard measures?

		Never (0%)	Rarely (1-20%)	Occasionally (21-40%)	Sometimes (41-60%)	Frequently (61-80%)	Most of the time (>80%)
5)	Balance Error Scoring System (BESS)	☐	☐	☐	☐	☐	☐
6)	Balance Evaluation Systems Test (BEST)	☐	☐	☐	☐	☐	☐
7)	Berg Balance Scale (BBS)	☐	☐	☐	☐	☐	☐
8)	Clinical Test of Sensory Interaction and Balance (CTSIB)	☐	☐	☐	☐	☐	☐
9)	Community Balance and Mobility Scale (CB&M)	☐	☐	☐	☐	☐	☐
10)	Dynamic Gait Index (DGI)	☐	☐	☐	☐	☐	☐
11)	Four Square Step Test	☐	☐	☐	☐	☐	☐
12)	Fuller Advanced Balance Scale	☐	☐	☐	☐	☐	☐
13)	Functional Gait Assessment (FGA)	☐	☐	☐	☐	☐	☐
14)	Functional Reach Test (FRT)	☐	☐	☐	☐	☐	☐
15)	High Level Mobility Test (HiMAT)	☐	☐	☐	☐	☐	☐
16)	Mini-Balance Evaluation Systems Test (miniBEST)	☐	☐	☐	☐	☐	☐
17)	Sensory Organization Test (SOT)	☐	☐	☐	☐	☐	☐
18)	Timed Up and Go (TUG)	☐	☐	☐	☐	☐	☐
19)	Timed Up and Go Cognitive	☐	☐	☐	☐	☐	☐
20)	Timed Up and Go Manual	☐	☐	☐	☐	☐	☐
21)	Tinetti Performance Oriented Mobility Assessment (POMA)	☐	☐	☐	☐	☐	☐
22)	Unipedal Stance/Single Leg Stance	☐	☐	☐	☐	☐	☐

23) Please list any other balance measures you use that are not listed above:

(1000 characters remaining)

When selecting an outcome measure, how important are each of the following when making your decision:

		Not at all important	Low importance	Slightly important	Important	Very important	Extremely important	N/A
24)	It is widely used	☐	☐	☐	☐	☐	☐	☐
25)	It is fast	☐	☐	☐	☐	☐	☐	☐
26)	I am comfortable with the measure	☐	☐	☐	☐	☐	☐	☐
27)	I have the equipment available in my clinic	☐	☐	☐	☐	☐	☐	☐
28)	The measure is recommended or required by my facility	☐	☐	☐	☐	☐	☐	☐
29)	I was educated on it in physical therapy school	☐	☐	☐	☐	☐	☐	☐
30)	It has strong psychometric (reliability, validity) properties	☐	☐	☐	☐	☐	☐	☐
31)	It has available minimal detectable change (MDC) or minimally clinically important difference (MCID)	☐	☐	☐	☐	☐	☐	☐
32)	It captures a specific construct of balance	☐	☐	☐	☐	☐	☐	☐

*33) Do you have anything else you would like to share about how you choose which balance measure(s) to use with individuals with brain injuries?

(1000 characters remaining)

How often do you use the results of standard balance measures for the following:

	Never (0%)	Rarely (1-20%)	Occasionally (21-40%)	Sometimes (41-60%)	Frequently (61-80%)	Most of the time (>80%)
***34)** Guide treatment intervention decisions	○	○	○	○	○	○
***35)** Identify patients at risk for adverse outcomes (falls, hospitalization, etc.)	○	○	○	○	○	○
***36)** Estimate prognosis	○	○	○	○	○	○
***37)** Set goals	○	○	○	○	○	○
***38)** Describe impairments objectively and numerically	○	○	○	○	○	○
***39)** Evaluate patient change over time	○	○	○	○	○	○
***40)** Communicate with other health care providers (concerning safety or functional ability)	○	○	○	○	○	○
***41)** Educate patients and/or family (concerning safety, prognosis, change)	○	○	○	○	○	○
***42)** Justify services with third party payers (i.e. insurance providers)	○	○	○	○	○	○
***43)** Help make discharge decisions	○	○	○	○	○	○
***44)** Evaluate clinical programs	○	○	○	○	○	○
***45)** Assess my performance or the performance of other providers	○	○	○	○	○	○
***46)** To improve patient outcomes	○	○	○	○	○	○

***47)** Do you have anything else you would like to share about how you use the results of balance measures?

(1000 characters remaining)

Section II: Demographic Data

***48)** Gender

- ○ Female
- ○ Male
- ○ Other/Non-binary

***49)** What is your age?

***50)** In what state or territory do you currently practice as a physical therapist? If you currently work in the federal capacity rather than one particular state please respond "US"

***51)** In what setting do you currently primarily practice?

- ○ Acute care
- ○ Inpatient rehabilitation hospital or sub-acute rehabilitation facility
- ○ Nursing home/skilled nursing/extended care
- ○ Outpatient (orthopedic, neurologic, pediatric, or any other population)
- ○ Other (please specify)

*52) With what population do you primarily (>50% of individuals) work?

- Orthopedic
- Neurologic
- Pediatric
- Geriatric
- Oncology
- Other (please specify)

*53) How many years have you worked as a physical therapist?

*54) Are you a member of the APTA?

- Yes
- No

55) Select any of the APTA special-interest sections of which you are currently a member:

- Acute Care
- Aquatic
- Cardiovascular & Pulmonary
- Education
- Federal
- Geriatrics
- Hand Rehabilitation
- Health Policy & Administration
- Home Health
- Neurology
- Oncology
- Orthopaedic
- Pediatrics
- Private Practice
- Research
- Sports
- Women's Health
- I am not a member of any APTA sections

56) Please list any special certifications you currently hold:

*57) What is your entry level physical therapy degree?

- Associate's
- Bachelor's
- Master's
- Doctorate
- Other (please specify)

*58) In what year did you earn this entry-level degree?

*59) What is your most recently earned degree?

- Associate's
- Bachelor's
- Master's
- Doctorate
- Other (please specify)

*60) In what year did you earn this most recent degree?

Use of Balance Measurement Tools by Physical Therapists

Thank you!

APPENDIX C

Study 2 Sampling Distribution

	Acute care	Inpatient rehabilitation hospital/Skilled nursing facility	Outpatient
Northeast*	2	2	2
Midwest**	2	2	2
South***	2	2	2
West****	2	2	2

* CT, ME, MA, NH, RI, VT, NY, PA, NJx`
** IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, SD,
***DE, DC, FL, GA, MD, NC, PR, SC, VA, WV, AR, LA, OK, TX, AL, KY, MS, TN
**** AK, CA, HI, OR, WA, AZ, CO, ID, MT, NV, NM, UT, WY

APPENDIX D

Interview Guide

Subject number:

Gender:

Age:

Demographic questions:

1. In what setting do you work? Is the population you work with primarily orthopedic, neurologic, some other specialty, or varied?
2. In what state do you currently practice?
3. What is your entry level physical therapy degree and when did you complete that degree?
4. What is the most recent degree, related to physical therapy, rehabilitation, or health science, you have received and when did you complete that degree?
5. How many years have you worked as a physical therapist? How many years have you worked in your current area of specialty?
6. What specialty certifications do you hold?
7. Are you an APTA member? Are you a member of any APTA special interest sections?

Interview questions:

8. Think of when you are referred a new patient with a brain injury or stroke. Describe a typical first assessment of balance with this person.
    - Follow up if no standard measures/outcome measures are mentioned: You discussed many types of assessment tools, talk to me about any standardized measures of balance you may use.
9. In what ways do you use the results of balance measures in your clinical practice?
    - Talk to me about the relative importance of these measures in your clinical practice.
10. In what ways do the results of the balance assessments affect what treatment interventions that patient receives?
11. Tell me about how WHICH measure you complete with a patient will impact the treatments they receive.
    - Guiding: If for example you complete the BERG instead of the FGA, how will that impact which interventions you choose for that patient?
12. Talk to me about how WHICH standardized measures you select could or could not impact the patient's long-term outcomes?

APPENDIX E

Study 3 Outcome Measure Algorithm and Interpretation Guide

Standardized Measures of Gait & Balance

Neurologic and Geriatric Patients

	6	5	4	3	2	1
Bed mobility Items						
Roll right and left						
Lying to sitting on side of bed						
Sit to lying						
Transfer items						
Chair/bed-to-chair transfer						
Toilet transfer						
--Car transfer						
Standing items						
Sit to stand (*if performs without UE -> score 5 time sit to stand*) _____ seconds						
If 1-3 -> function in sitting test, berg balance test						
Picking up object						
Walking items						
Walk 10 feet *(if completes without assist -> score 10-meter walk test)* _____ *seconds*						
if 1-3 -> berg balance scale						
if 4-6 -> TUG, TUG-C, functional gait assessment						
Walking 50 feet with 2 turns						
Walk 150 feet						
Walking 10 feet on uneven surfaces (or sloping surface)						
Stair items						
1 step (curb)						
4 steps w or w/o rail						
12 steps w/ or w/o rails						

06. Independent – Patient/resident safely completes the activity by him/herself with no assistance from a helper.
05. Setup or clean-up assistance - Helper sets up or cleans up; patient/resident completes activity.
04. Supervision or touching assistance - Helper provides verbal cues and/or touching/steadying and/or contact guard assistance as patient/resident completes activity.
03. Partial/moderate assistance - Helper does LESS THAN HALF the effort.
02. Substantial/maximal assistance - Helper does MORE THAN HALF the effort.
01. Dependent - Helper does ALL of the effort.

	Meaning	Goal Setting
Berg Balance Scale	Older adults 56=functional balance, ≤45 ↑ fall risk -no history of falls <42 -history of falls <51) <40 = 100% risk for fall Stroke ≤45/56 ↑ fall risk	MDC Older adults in facility 8 points Stroke 4 points PD 5 points
Functional Gait Assessment	Older adults in community ≤22/30 = falls in next 6 months PD ≤18/30 = fall risk	MCID Older adults in community 4 points MDC PD 4 points Stroke 4 points (or 14.1%)
Five Time Sit to Stand	Older adults >15 s = fallers PD >16 s = fallers Health adults in community normal = 19-49=6.2 s, 50-59=7.1, 60-69=8.1 s, 70-79=10.0 s, 80-89=10.6 s	
Function in Sitting Test		MDC Stroke = 5.63 Adults with sitting balance dysfunction = 5.5 MCID Adults with sitting balance dysfunction = 6.5
Timed Up and Go (seconds)	Cut off elderly in facility – not recommend for falls <20 = Independent for basic transfer >30 = Dependent on transfers, needed help to enter tub, do no go out alone Community dwelling >13.5=falls Frail elderly >32.6=falls	MDC Alzheimer's 4.09 s Stroke 2.9 s PD 4.85 s
Time Up and Go – Cognitive (seconds)	Elderly in community >15 = falls PD TUG-C & TUG difference >4.5 = falls	
10-meter walk test (m/s)	≥1.0 independence in ADLs, less likely to be hospitalized or have adverse event <1.0 need intervention to prevent fall <0.6 dependent in ADLs, more likely to be hospitalized	MCID Older 0.5 = small meaningful, 0.13 = substantial meaningful change Stroke 0.14 = substantial change <0.4 household, 0.4-0.8 limited community, >0.8 community ambulators

APPENDIX F

Study 3 Therapist Demographic Collection Form

1. Is the population you work with primarily orthopedic, neurologic, some other specialty, or varied?

2. What is your entry level physical therapy degree and when did you complete that degree?

3. What is the most recent degree, related to physical therapy, rehabilitation, or health science, you have received and when did you complete that degree?

4. How many years have you worked as a physical therapist? How many years have you worked in your current area of specialty?

5. What specialty certifications do you hold?

6. Are you an APTA member?

7. Are you a member of a section of the APTA?

APPENDIX G

Organizational Readiness to Change Context Subscale

II. Context Assessment

For each of the following statements, please rate the strength of your agreement with the statement, from 1 (strongly disagree) to 5 (strongly agree).

(culture) Senior leadership/clinical management in your organization:	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know/not applicable
a. reward clinical innovation and creativity to improve patient care	1	2	3	4	5	99
b. solicit opinions of clinical staff regarding decisions about patient care	1	2	3	4	5	99
c. seek ways to improve patient education and increase patient participation in treatment	1	2	3	4	5	99

(culture) Staff members in your organization:	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know/not applicable
a. have a sense of personal responsibility for improving patient care and outcomes	1	2	3	4	5	99
b. cooperate to maintain and improve effectiveness of patient care	1	2	3	4	5	99
c. are willing to innovate and/or experiment to improve clinical procedures	1	2	3	4	5	99
d. are receptive to change in clinical processes	1	2	3	4	5	99

(leadership) Senior leadership/clinical management in your organization	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know/not applicable
a. provide effective management for continuous improvement of patient care	1	2	3	4	5	99
b. clearly define areas of responsibility and authority for clinical managers and staff	1	2	3	4	5	99
c. promote team building to solve clinical care problems	1	2	3	4	5	99
d. promote communication among clinical services and units	1	2	3	4	5	99

(measurement) Senior leadership/clinical management in your organization	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know/not applicable
a. provide staff with information on performance measures and guidelines	1	2	3	4	5	99
b. establish clear goals for patient care processes and outcomes	1	2	3	4	5	99
c. provide staff members with feedback/data on effects of clinical decisions	1	2	3	4	5	99
d. hold staff members accountable for achieving results	1	2	3	4	5	99

(readiness for change) Opinion leaders in your organization:	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know/not applicable
a. believe that the current practice patterns can be improved	1	2	3	4	5	99
b. encourage and support changes in practice pattern to improve patient care	1	2	3	4	5	99
c. are willing to try new clinical protocols	1	2	3	4	5	99
d. work cooperatively with senior leadership/clinical management to make appropriate changes	1	2	3	4	5	99

(resources) In general in my organization, when there is agreement that change needs to happen:	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know/not applicable
a. we have the necessary support in terms of budget or financial resources	1	2	3	4	5	99
b. we have the necessary support in terms of training	1	2	3	4	5	99
c. we have the necessary support in terms of facilities	1	2	3	4	5	99
d. we have the necessary support in terms of staffing	1	2	3	4	5	99

APPENDIX H

Study 1 IRB Approval

Institutional Review Board
Office of Research
6700 Fannin, Houston, TX 77030
713-794-2480 irb-houston@twu.edu
http://www.twu.edu/irb.html

DATE: January 29, 2018

TO: Ms. Marissa Lyon
Physical Therapy - Houston

FROM: Institutional Review Board (IRB) - Houston

Re: Exemption for A Mixed method Analysis of the Impact of Standardized Balance Measurement on Therapist Decision Making and Patient Outcomes: Study 1 (Protocol #: 19955)

The above referenced study has been reviewed by the TWU IRB (operating under FWA00000178) and was determined to be exempt from further review.

If applicable, agency approval letters must be submitted to the IRB upon receipt PRIOR to any data collection at that agency. Because a signed consent form is not required for exempt studies, the filing of signatures of participants with the TWU IRB is not necessary.

Although your protocol has been exempted from further IRB review and your protocol file has been closed, any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any adverse events or unanticipated problems. All forms are located on the IRB website. If you have any questions, please contact the TWU IRB.

cc. Dr. Peggy Gleeson, Physical Therapy - Houston
Graduate School

APPENDIX I

Study 2 IRB Approval

Institutional Review Board
Office of Research
6700 Fannin, Houston, TX 77030
713-794-2480
irb-houston@twu.edu
http://www.twu.edu/irb.html

DATE: February 16, 2018

TO: Ms. Marissa Lyon
Physical Therapy - Houston

FROM: Institutional Review Board (IRB) - Houston

Re: Approval for A Mixed method Analysis of the Impact of Standardized Balance Measurement on Therapist Decision-making and Patient Outcomes: Study 2 (Protocol #: 19956)

The above referenced study has been reviewed and approved by the Houston IRB (operating under FWA00000178) on 2/14/2018 using an expedited review procedure. This approval is valid for one year and expires on 2/14/2019. The IRB will send an email notification 45 days prior to the expiration date with instructions to extend or close the study. It is your responsibility to request an extension for the study if it is not yet complete, to close the protocol file when the study is complete, and to make certain that the study is not conducted beyond the expiration date.

If applicable, agency approval letters must be submitted to the IRB upon receipt prior to any data collection at that agency. A copy of the approved consent form with the IRB approval stamp is enclosed. Please use the consent form with the most recent approval date stamp when obtaining consent from your participants. A copy of the signed consent forms must be submitted with the request to close the study file at the completion of the study.

Any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any adverse events or unanticipated problems. All forms are located on the IRB website. If you have any questions, please contact the TWU IRB.

cc. Dr. Peggy Gleeson, Physical Therapy - Houston
Graduate School

APPENDIX J

Study 3 IRB Approval

Institutional Review Board
Office of Research
6700 Fannin, Houston, TX 77030
713-794-2480
irb-houston@twu.edu
http://www.twu.edu/irb.html

DATE: March 15, 2018

TO: Ms. Marissa Lyon
Physical Therapy - Houston

FROM: Institutional Review Board (IRB) - Houston

Re: Approval for A Mixed Method Analysis of the Impact of Standardized Balance Measurement on Therapist Decision Making and Patient Outcomes: Study 3 (Protocol #: 19970)

The above referenced study has been reviewed and approved by the Houston IRB (operating under FWA00000178) on 3/14/2018 using an expedited review procedure. This approval is valid for one year and expires on 3/14/2019. The IRB will send an email notification 45 days prior to the expiration date with instructions to extend or close the study. It is your responsibility to request an extension for the study if it is not yet complete, to close the protocol file when the study is complete, and to make certain that the study is not conducted beyond the expiration date.

If applicable, agency approval letters must be submitted to the IRB upon receipt prior to any data collection at that agency. A copy of the approved consent form with the IRB approval stamp is enclosed. Please use the consent form with the most recent approval date stamp when obtaining consent from your participants. A copy of the signed consent forms must be submitted with the request to close the study file at the completion of the study.

Any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any adverse events or unanticipated problems. All forms are located on the IRB website. If you have any questions, please contact the TWU IRB.

cc. Dr. Peggy Gleeson, Physical Therapy - Houston
Graduate School