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Integrating Neuro Technology into the Clinic: a proposed tool for promoting the clinical integration of neuro rehabilitation technology

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Doctoral Project

INTEGRATING NEURO TECHNOLOGY INTO THE CLINIC:

A PROPOSED TOOL FOR PROMOTING THE CLINICAL INTEGRATION

OF NEURO REHABILITATION TECHNOLOGY

by

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DEDICATION

I dedicate this project to my family.

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A PROPOSED TOOL FOR PROMOTING THE CLINICAL INTEGRATION OF NEURO REHABILITATION TECHNOLOGY

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ABSTRACT

Advanced neuro rehabilitation technology is becoming more common in upper extremity stroke rehabilitation. It uses the occupational therapy approach of restoration or remediation of function. Advanced neuro rehabilitation technology includes devices such as functional electrical stimulation, robotics, sensor-based technology and virtual reality gaming. Many of these types of devices are based on principles of neuroplasticity and motor learning, and as such, offer an intervention approach that involves high intensity repetitive movement training in engaging environments with performance feedback (Levin, Weiss & Keshner, 2015; Mehrholz, Hadrich, Platz, Kugler & Pohl, 2012); Winstein et al., 2016). Despite emerging evidence-based literature on the efficacy of using neuro rehabilitation technology for upper extremity rehabilitation post-stroke, there is very limited research on how to effectively implement and deploy technology into typical occupational therapy service delivery.

Integrating Neuro Technology into the Clinic is a resource tool and mentoring program informed by evidence and grounded in theory. It was designed to encourage clinics to take an active role in adapting the program and evolving the content to support

clinicians in using technology to meet their individual clinic goals as their needs change over time. The overall aim of *Integrating Neuro Technology into the Clinic* is to increase clinicians use of technology for clinically meaningful outcomes and to assist with improving perceived self-efficacy in the appropriate application of the technology. *Integrating Neuro Technology into the Clinic* consists of a resource binder of education modules and resources and a 13-week occupational therapist led peer mentoring program focusing on technology use and knowledge translation. *Integrating Neuro Technology into the Clinic* was created to encourage the use of advanced neuro technology in occupational therapy service delivery. The long-term outcomes of this project will contribute to emerging knowledge on technology use in occupational therapy practice and hopefully influence improved technology integration in occupational therapy practice.

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LIST OF ABBREVIATIONS

ADL .... Activities of Daily Living

AT ....Advanced Neuro Rehabilitation Technology

DTPB .... Decomposed Theory of Planned Behavior

FES.. Functional Electrical Stimulation

KT ....Knowledge Translation

KTA ....Knowledge Translation to Action Plan

ML..Motor Learning

MLRSI .... Motor Learning Rating Scale Instrument

OT ....Occupational Therapist

VR ....Virtual Reality

CHAPTER ONE: Introduction

The doctoral project *Integrating Neuro Technology into the Clinic* was designed for occupational therapists to help with increasing the use of advanced neuro rehabilitation technology in clinical practice. Current occupational therapy (OT) practice does not adequately support the clinical integration of advanced neuro rehabilitation technology. This doctoral project proposes a clinical tool to assist rehabilitation programs with incorporating technology into usual care for upper extremity stroke rehabilitation. Although the use of advanced technology is becoming more common in clinical rehab settings, it is not universally integrated.

Neuro rehabilitation advanced technology uses the occupational therapy approach of restoration or remediation of function. Restoration or remediation of function is described in the AOTA Occupational Therapy Practice Framework as “an intervention approach designed to change client variables to establish a skill or ability that has not yet developed or to restore a skill or ability that has been impaired” (AOTA, 2014, p. 33). Many neuro rehabilitation technology devices are based on principles of neuro plasticity and motor learning, meaning that these devices offer a treatment intervention that encourages high repetitions of intentional task-specific activities with performance feedback (Kwakkel, Kollen & Krebs, 2008; Levin, Weiss & Keshner, 2015; Mehrholz, Hadrich, Platz, Kugler & Pohl, 2012); Winstein et al., 2016). The technologies often promote a high level of repeated intentional volitional movements that are aimed at restoring functional movement patterns. In addition to encouraging high repetitions of motor movement, these technologies assist clients by providing real time biofeedback on their performance. The purpose of this type of intervention is to promote practice to develop the skills necessary for occupational performance.

The American Occupational Therapy Association (AOTA) created a centennial vision that stated: “we envision that occupational therapy is a powerful, widely recognized, science-driven, and evidence-based profession with a globally connected and diverse workforce meeting society’s occupational needs” (AOTA, 2006, p.1). Within this vision, a relevant element is that the profession promotes “science-fostered innovation in occupational therapy practice” (AOTA, 2006, pg.2). As such, occupational therapists need to find innovative ways to better treat occupational performance issues.

One area of concern for providers of healthcare is the cost and incidence of stroke. Each year, more than 795,000 people in the United States experience a stroke and the annual cost of stroke including the cost of health care services, medication, and missed days of work is estimated at $34 billion (CDC, 2017). There is opportunity for occupational therapists to treat impairments of the upper extremity following stroke by using advanced neuro technology. Advanced technology may include robotics, functional electrical stimulation (FES), the use of sensor-based technology and virtual reality (VR) gaming (Hughes et al., 2014; Kwakkel et al., 2008; Weinstein et al., 2016). Advanced neuro rehabilitation technology allows for intensive repetitive practice of motor movement and is thought to provide repeated practice based on principles of motor learning (Backus, Winchester & Tefertiller, 2010; Hughes et al., 2014; Kwakkel et al., 2008; Winstein et al., 2016). Advanced neuro rehabilitation technology encourages high repetitions of intentional task-specific activities with performance feedback (Levin, Weiss & Keshner, 2015; Pollock et al., 2014).

There is an increasing body of evidence based literature examining the various types of technology and compares the technology to traditional therapy methods or other technology (Krakauer et al. 2012; McCabe et al. 2015; Mehrholz et al., 2012). Despite this evidence based literature supporting the use of technology, there is limited research on how to effectively implement and deploy technology into usual care (Boninger et al. 2012; Backus et al., 2010). It is a significant shortcoming in present occupational therapy practice that although we have evidence supporting the use of advanced technology, it is not translating into wide adoption and use in a clinical setting.

Key factors Causing/Contributing to this problem

There are multiple factors that contribute to the lack of technology adoption. First, there is an expert high knowledge requirement. The use of technology requires very specific knowledge of the devices. According to Turchetti, Vitiello, Trieste, Romiti, Geisler and Micera (2014), the level of training is a barrier to technology adoption, while Glegg et al. (2013), reported that key barriers to use the system clinically included time to learn to use the system and knowledge of how to integrate it into clinical practice. Since these devices require specialized training, they are not available in traditional public gym settings (Backus et al., 2010). It is often the responsibility of the therapy department to ensure that therapists are trained beyond the initial time of purchase. Despite therapists initially being trained on the use of a device, they may not have regular use of a particular device. This could be due to lack of appropriate clients, change of responsibility within the therapy team or possibly due to the device being used by others and not getting the opportunity to use it regularly. Lack of use results in therapists feeling less confident using the device (Chen & Bode, 2011). In a study by Tetteroo, Timmerman, Seelan and Markopoulos (2014), clinicians identified that not having technology in the treatment area limited their motivation to use it. Tatla et al. (2015), recommend continuing education, professional development and mentorship from a clinical opinion leader as a means to increase the likelihood of clinical adoption of technology. Additionally, Glegg et al. (2013), found that increased educational opportunities were considered to be a facilitator. Given the multiple reasons for technology not being adequately used, a clinical integration tool is proposed to address the known barriers to clinical integration of advanced neuro technology.

Purpose of *Integrating Neuro Technology into the Clinic*:

The purpose of the doctoral project, *Integrating Neuro Technology into the Clinic* is to encourage the use of advanced neuro rehabilitation technology for the delivery of occupational therapy services. The program is designed to assist clinicians in integrating technology into upper extremity rehabilitation and to promote occupational therapists in developing the self-efficacy to use advanced technology as part of the restoration or remediation of function of upper extremity impairment in a clinically meaningful way that will assist adults in participating in their daily occupations. *Integrating Neuro Technology into the Clinic* is a resource tool that is grounded in theory and informed by evidence. The tool was created to evolve and change to meet the specific clinical practice needs of individual clinics for integrating technology in occupational therapy service delivery.

Occupational therapists providing upper extremity rehabilitation post-stroke are the target audience for *Integrating Neuro Rehabilitation into the Clinic.* It would be expected that the program will occur in stroke rehabilitation clinics that have already purchased advanced technology and are looking to better integrate the use of the technology into usual occupational therapy practice. The OT participants in the program will have a minimum of one year neuro rehabilitation experience and be interested in using technology to assist with meeting clinically relevant occupational performance goals involving the upper extremity post-stroke.

Conclusion

Integrating Neuro Technology into the Clinic was designed to help with increasing the use of advanced neuro rehabilitation technology into occupational therapists practice. The aim of the project is to help understand the barriers and facilitators to the use of advanced neuro technology and identify strategies to better implement technology. The following chapters will describe the theoretical basis and evidence that supports *Integrating Neuro Technology into the Clinic.* Chapter 2 will describe the problems identified in the literature that influence the adoption of advanced neuro rehabilitation technology, as well as the evidence related to clinical adoption of technology and knowledge translation for influencing clinical practice changes. Chapter 3 will describe the proposed tool and implementation program. An evaluation plan, funding and dissemination will be described in chapters 4, 5 and 6.

CHAPTER TWO: Theoretical and Evidence Base to Support the Project

Overview of the Problem

This chapter describes the theoretical basis and evidence supporting this doctoral project. First, an explanation of the problem is described, identifying the contributing factors for technology not being integrating into practice. The second section describes the clinical evidence of advanced neuro rehabilitation technology. The third section identifies the theoretical models explaining the nature of the problem and finally the last section identifies previous attempts to address the knowledge translation and practice changes for clinical adoption of technology.

Explanation of the Problem

Following stroke, clients often experience upper extremity motor impairment impacting their ability to participate in their daily occupations. In recent years, advanced neuro rehabilitation technology has become a treatment option for occupational therapists which allows for intensive repetitive practice of upper extremity motor movement (Mehrholz et al., 2012; Pollack, et al., 2014). Despite clinics acquiring the technology, clinical integration and adoption of technology has varied across clinical sites. Figure 2.1 illustrates that decreased neuro technology use is a result of low therapist self-efficacy for using technology in upper limb stroke rehabilitation to meet clinical therapy goals. The model outlines three contributors to the decreased self-efficacy for using technology. These include: 1) a lack of clear process outlining how to successfully integrate neuro technology in the clinical setting; 2) a number of barriers at the therapist and environmental level that impede effective clinical integration; and 3) therapists lack the

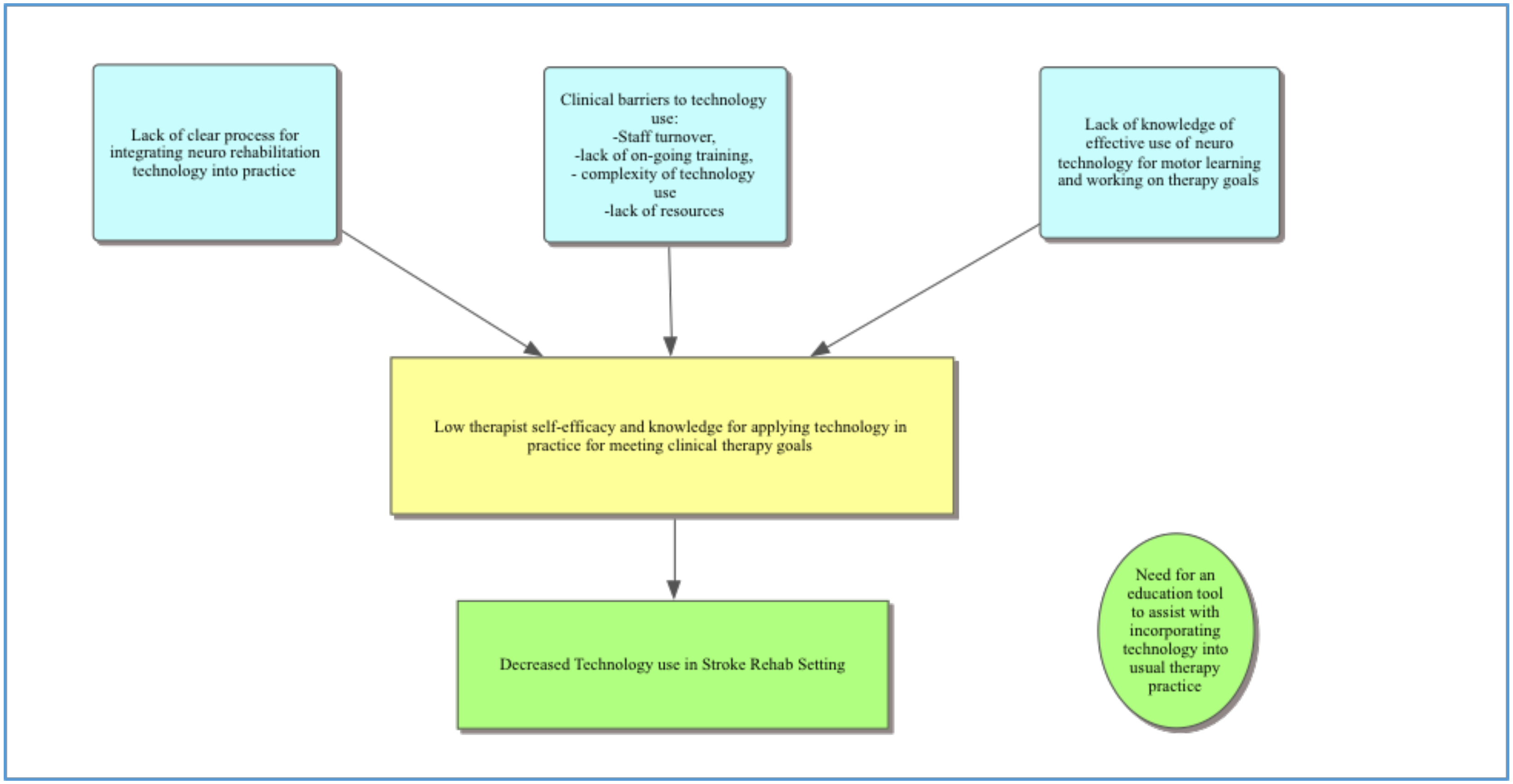

Figure 2.1: Model of the problem of decreased technology use in stroke rehabilitation setting.

knowledge of clinical best practices for using neuro technology for upper extremity rehabilitation post-stroke.

As such, a proposed solution is the creation of a technology integration tool and program designed to increase therapists' knowledge and self-efficacy of using technology for motor learning in neurorehabilitation, with the aim of increasing technology use within the clinical setting. A review of the evidence literature related to technology use in upper limb rehabilitation post-stroke was conducted to identify best practices for applying technology, outline the best process for clinical integration and identify barriers for successful clinical integration.

According to Winstein et al. (2016), in the American Heart Association and American Stroke Association Guidelines for health professionals, best practices for upper extremity rehabilitation post-stroke is focused on learning or re-learning a motor skill and should include training of task-specific, challenging, goal-oriented functional tasks. Specifically, these guidelines state: "Functional tasks should be practiced; that is, task-specific training, in which the tasks are graded to challenge individual capabilities, practiced repeatedly, and progressed in difficulty on a frequent basis" (Winstein et al., 2016, pg. e130). Neuro rehabilitation technology is cited as an intervention type that may increase the dose, intensity, or otherwise appropriately deliver upper extremity motor rehabilitation. Technology may include robotic assisted devices, neuromuscular electrical stimulation, or virtual reality (Hughes et al., 2014; Kwakkel, Kollen & Krebs, 2008; Winstein et al., 2016). Neuro rehabilitation devices allow for repeated practice based on principles of neuroplasticity and motor learning, meaning that these devices offer a treatment intervention that encourages high repetitions of intentional task-specific activities with performance feedback within enriched environments that are motivating and conducive for problem solving (Levin, Weiss & Keshner, 2015; Kleim & Jones, 2008; Mehrholz et al., 2012; Pollock et al., 2014). There is an increasing body of literature reviewing the various types of technology as it compares to traditional therapy methods or other technology (Krakauer, Carmichael, Corbett, & Wittenberg, 2012; McCabe, Monkiewicz, Holcomb, Pundik & Daly, 2015; Mehrholz et al., 2008). Despite more robust evidence that supports the use of advanced technology in clinical practice, there is limited research on how to effectively implement and deploy technology into usual care (Backus et al., 2010; Boninger et al., 2012; Pollock et al., 2014).

Given the lack of research evidence outlining best practices for integrating technology, its deployment varies between clinical sites. Additionally, clinical sites frequently do not receive additional device training beyond the time of the initial technology purchase. Consequently, it is left to the clinicians to implement the technology to optimize the potential of the technology, yet it is unclear what the best methods are to achieve the greatest outcomes (Krakauer & Carmichael, 2017). Given the lack of a clear process for integrating technology, the use of the technology decreases over time after the initial purchase. Additional contributors to the lack of use include: complexity of technology use coupled with a lack of familiarity; variable experience and limited training; and a lack of resources such as clinical tools and technical support (Glegg et al., 2013; Levac & Miller, 2013). As a result of these contributors, clinicians experience a lack of self-efficacy using the technology, which results in therapists choosing other treatment options, rather than technology (Glegg et al., 2013). As such, a proposed solution is the creation of a technology integration tool designed to increase therapists' knowledge and self-efficacy of using technology for motor learning in neurorehabilitation, with the aim of increasing technology use within the clinical setting.

Frameworks to Understand the Problem

Two theoretical frameworks were used in this project to better understand the problem and the approach to addressing the problem. The two theoretical frameworks are the Decomposed Theory of Planned Behavior (DTPB) and Adult Learning Theory. The DTPB provides a theoretical basis for outlining the problems that the project is seeking to address. The DTPB explains behavior based on a person's intention to carry out a behavior. It focuses on the determinants influencing a person's intentions (Taylor & Todd, 1995). The model further states that behavior is the result of behavioral intention and that behavioral intention is determined by the combination of a person's beliefs related to their attitude, subjective norms and their perceived behavioral control. The DTPB posits that an individual's attitude regarding their technology usage behavior is directly influenced by the perceived usefulness of the technology, the ease of use, and the technology's compatibility with their current needs (Taylor & Todd, 1995).

Additionally, within the DTPB, subjective norms are influenced by peer and superior's influence, while perceived behavioral control is determined by an individual's self-efficacy, resource facilitating conditions, and the technology's facilitating conditions within the environment of its intended use (Taylor & Todd, 1995).

Given the DTPB helps to understand the determinants of behavior, it is useful as a framework to identifying the components that contribute to technology disuse in clinical practice. According to the DTPB, a person's attitude towards technology adoption is influenced by the technology's perceived useful, ease of use and compatibility with their usual therapy practices (Taylor & Todd, 1995). Therefore, according to this model, understanding the components that influence behavior would be helpful in constructing an evidence-based education tool that provides information on how technology can be incorporated into the clinical site and address specific therapy goals would assist with technology integration. Additionally, the tool will address the behavioral determinants of subjective norms, including the influence of peers and superiors, as well as components that influence perceived behavioral control and self-efficacy. The clinical integration tool will address these additional components determined to be relevant according to rehabilitation technology use literature.

Once the component problems are identified and addressed using the DTPB, an Adult Learning Theory approach will be used to inform the education component of the tool. Adult Learning Theory is based on five assumptions on how adults learn and their attitudes and motivation towards learning including: 1) adults are self-directed and independent learners; 2) adults have rich experiences that can be a foundation for learning; 3) adults value learning that is readily applicable to their lives; 4) they are more interested in immediate problem based learning than subject based learning; and 5) they are internally, rather than externally motivated to learn (Kaufman, 2003). The specific application of these principles to this project will occur within the education tool development for the clinical integration tool by ensuring that the tool is problem-based and may be used in a self-directed manner that builds on prior knowledge (Kaufman, 2003). Adult Learning Theory was chosen to frame the content for *Integrating Neuro Technology into the Clinic* since it focusses on the learner taking an active role in learning, which is consistent with research evidence that indicates there is better knowledge translation (KT) when clinicians take an active role in developing the plan and objectives for clinical behavior change (Janzen, McIntyre, Richardson, Britt & Teasell, 2016; Levac, Glegg, Camden, Rivard & Missiuna, 2015).

In summary, the DTPB may be applied to address the component features of a tool that is designed at increasing clinician self-efficacy of technology use, as well as increasing the overall clinical adoption of advanced technology into neurorehabilitation, while the components of the education tool will be developed using an Adult Learning Theory perspective.

Evidence for Proposed Explanatory Model of Identified Problem

A review of the evidence literature related to post-stroke upper extremity rehabilitation identifies best practices for upper extremity rehabilitation. These include motor re-learning by providing practice opportunities that increase the dose and intensity of therapy, provide task-specific training in a motivating environment at a patient-specific challenge level with feedback to shape performance. According to a Cochrane Review by Pollock et al. (2014), the consensus in the literature is that technology is meant to be effective for upper extremity rehabilitation by providing or assisting movement, and promoting repetitive task training that “may augment the activity of neural pathways that underlie specific functions and promote acquisition of the tasks practiced (pg. 9). The mechanism of action intended when using technology is to provide task-specific and goal-oriented training in a motivating and enriched environment that increases the dose of repetitions that a client receives as compared to not using the technology (Henderson, Korner-Bitensky & Levin, 2007; Lam et al., 2015; Laver et al., 2017; Kwakkel, 2015; Merholtz et al., 2015; Pollock et al., 2014). Additionally, the technology is intended to be used to grade tasks to individually challenge a client according to their therapy goals (Hayward et al., 2010; Pollock et al., 2014). It is also intended to provide performance feedback as both knowledge of performance, meaning the effectiveness of movement, and knowledge of results, which is feedback on whether the outcomes were successful (Henderson et al., 2007; Pollock et al., 2014; Timmermans et al., 2009). Technology has been found to focus on both practice and meaningful outcomes at the impairment level, and has generated high quality of evidence of the efficacy of technology for impairment-based impact of technology use; however, interventions that impact at the participation level, or carry over to functional activities in an individual's activities of daily living are less well defined with little or low quality evidence addressing this aspect (Hayward et al., 2010; Laver et al., 2017; Merholtz et al., 2015; Tatla et al., 2015; Timmermans et al., 2009; Stein, 2012). Further, despite the promising potential of technology for upper extremity stroke rehab, the evidence literature also acknowledges that the true efficacy of technology in upper limb rehab has not been fully realized due to the lack of evidence translating the impairment based improvements to functional use of the affected limb in activities of daily living (Kwakkel, 2015; Mehrholz et al., 2015; Pollock et al., 2014; Stein, 2012).

The reason for the lack of translation from practice at the impairment level to practice at the participation level is not clearly defined in the literature; however, it is also not clear from a review of the literature that there is a clear process that clinicians can rely on for facilitating this aspect of clinical practice. Despite the lack of clear evidence regarding the best process for integrating neuro rehabilitation technology into practice, review of the literature provides an overview of some facilitators for clinical integration that are inconsistently implemented. These include factors relating to the clinician's attitude towards technology, technology specific features, the physical and social environment of use of the technology and knowledge regarding the application and efficacy of the technology. Cozens et al. (2013), Stein (2012), and Timmermans et al. (2009), all cite that clinical adoption and a clinician's attitude towards technology is influenced by a therapist's knowledge and understanding of how the device fits into a client's individual rehabilitation goals in a clinically meaningful way consistent with regular therapy practice. Timmermans et al. (2009), further states that training is required to ensure that therapists understand which exercises practice specific movements and how they relate to patient goals. Additionally, therapists' knowledge of how to select exercises according to therapy goals, and include clients in self-selection of exercise, will increase client's motivation (Timmermans et al., 2009). Another factor influencing a clinician's attitude to technology is client acceptance (Chen and Bode, 2011). There are also technology specific features that influence adoption including ease of set-up and whether or not a therapist is able to provide the therapy session without assistance (Chen & Bode, 2011; Ellington et al., 2015; Hughes et al., 2014; Tatla et al., 2015; Turchetti, 2014).

According to the evidence literature, the physical environment set-up may also influence the clinical adoption of technology. An organization that reorganizes and redistributes activities to promote technology use and considers factors such as scheduling is likely to have more successful integration of technology (Hochstenbach-Waelen & Seelan, 2012; Hughes et al., 2014; Turchetti et al., 2014). Locating the devices in an accessible area is also beneficial (Chen & Bode, 2011; Hochstenbach-Waelen & Seelan (2012). Ensuring a social environment conducive to device use was also cited in the literature as a means to promote clinical integration. Tatla et al. (2015), suggest that a facility should encourage continuing education and professional development, as well as mentorship from a clinical opinion leader.

In addition to the facilitators for integrating neuro technology into practice, there are a number of barriers to integrating neuro rehabilitation technology into clinical practice. According to the evidence literature, the barriers that appear to impact clinical integration of technology use in upper limb neuro rehabilitation include: clinician's attitude towards technology, technology specific features, the physical and social environment of use of the technology and knowledge regarding the application and efficacy of the technology.

According to Tetterroo et al. (2014), clinicians are hesitant to use technology in the absence of clinical evidence that clearly outlines its efficacy or when it has not been clinically validated. Additionally, therapists are less likely to use technology when they are unclear on how to properly use the features or adjust parameters of the technology or if they are not certain as to how the technology use supports the individual client rehabilitation goals, (Glegg et al., 2013; Hughes, et al., 2014; Tatla et al., 2015). Technology specific barriers include difficulty adjusting the technology to ensure that the clients using the technology are providing maximal effort, technical difficulties and maintenance issues (Chen & Bode, 2011; Glegg et al., 2013). The physical environment at a rehabilitation center is another potential barrier in times that access to the technology is a challenge, or the technology being located in an area without sufficient space to use it (Huges et al., 2014; Lam et al., 2015; Glegg et al., 2013; Tetterroo et al., 2014). Social environment is also a possible barrier and includes factors such as clients lack of interest using the device, lack of appropriate clients, logistics at the rehabilitation center not optimized for supporting use or allowing sufficient time to use, and lack of peer or superior support for using the technology (Chen & Bode, 2011; Glegg et al., 2013).

Summary

Individual studies within upper limb stroke rehabilitation and use of technology do not propose a clear process for the clinical integration of neuro rehabilitation technology. Compiling the available evidence supports the need for a technology integration tool designed to address the known facilitators and barriers to clinical integration, as well as to provide resources to increase therapists’ knowledge and self-efficacy of using technology as an integrated method of working on neuro rehabilitation goals for upper limb stroke rehabilitation. This tool would be used with the aim of increasing meaningful rehabilitation goal focused technology use within the clinical setting.

Evidence Base to Support the Project: A Synthesis of Current Approaches and Methods

Despite evidence-based literature supporting the use of advanced technology in clinical practice (Winstein et al., 2016), there is very limited research on how to effectively implement and deploy technology into typical occupational therapy service delivery; and clinicians are unclear of what the best methods are to achieve the greatest client outcomes (Boninger et al., 2012; Krakauer & Carmichael, 2017). The literature identifies a number of barriers to the successful clinical integration of neuro rehabilitation technology including: complex set up and changing of technology features coupled with variable experience, reduced familiarity to the technology; and limited training; and a lack of resources such as clinical tools and technical support (Glegg et al., 2013; Levac & Miller, 2013). As a result of these contributors, clinicians experience a lack of self-efficacy using technology, which results in therapists choosing other treatment options, rather than technology (Glegg et al., 2013). This author is proposing introducing a technology integration tool designed to increase therapists' knowledge and self-efficacy of using technology for motor learning in neurorehabilitation, with the aim of increasing technology use within the clinical setting.

Winstein et al. (2016), proposed best practice recommendations for upper extremity stroke rehabilitation in a review of the literature. The recommendations are based on a review of a large number of studies that found upper extremity impairment improvements as a result of intervention involving task-specific training that is repeated, challenging and encourages the practice of functional, goal-oriented activities. Although promising gains in function are found in acute stroke therapy intervention studies for the upper extremity, research shows that many of the studies are proof of concept with small effect sizes (Winters, Heymans, van Wegen & Kwakkel, 2016). The same is true for upper extremity stroke rehabilitation studies that focus on technology (McCabe et al., 2015; Winstein et al., 2016).

Additionally, individual studies within upper limb stroke rehabilitation and use of technology do not propose a clear process for the clinical integration of neuro rehabilitation technology. Compiling the available evidence supports the need for a technology integration tool designed to address the known facilitators and barriers to clinical integration, as well as to provide resources to increase therapists' knowledge and self-efficacy of using technology as an integrated method of working on neuro rehabilitation goals for upper limb stroke rehabilitation. This tool would be used with the aim of increasing meaningful rehabilitation goal focused technology use within the clinical setting.

A known barrier to the clinical integration of technology is that clinicians are unlikely to use technology unless they understand both how to apply it appropriately with clients and how it fits their rehabilitation goals (Cozens et al., 2013; Stein, 2012; and Timmermans, Seelen, Willmann, & Kingma 2009). Backus, Winchester and Tefertiller (2010) suggested the following steps to increase the successful integration of lower extremity technology into clinical practice: 1) clinician willingness to change their usual practice; 2) identify and educate the stakeholders by narrowing the audience as much as possible and providing education relevant to the audience; 3) present all aspects of evidence, including the benefits and barriers to technology use and ensure that there is a variety of strategies; 4) identify and provide support at point of care; 5) attempt to prevent mistakes by considering strategies to address readiness to use in clinic, type of appropriate client, continuum of care; 6) establish and keep guidelines or protocols up to date for easy reference for the clinicians; and 7) empower ownership of the evidence and implementation into practice.

Several studies agree with Backus et al. (2010) that clinicians are less likely to use technology in the absence of understanding the evidence of technology effectiveness (Cozens et al., 2013; Glegg et al., 2013). Further, Winter et al. (2016) noted that several systematic reviews and meta-analyses suggest that meaningful changes in functional or impairment outcomes when using evidence-based therapies for upper extremity paresis depend on an appropriate selection of patients at baseline. Additionally, therapists are more likely to use technology when they are clear on who the technology most likely to clinically benefit, studies show that use is more frequent among therapists who understand how it fits with therapeutic goals (Backus et al., 2010; Cozens et al., 2013). According to a systematic review, evidence suggests that technology is aimed at the impairment level, rather than the function and participation level (Pollock et al., 2014).

A systematic review of upper extremity stroke rehabilitation highlights that therapy integrates different modalities that target individualized programs for clients that are aimed at optimizing their outcomes (Pollock et al., 2014). The precise mechanism of action for improved upper limb function is not clear and clinicians use several approaches that address either reducing impairment or improving function and participation (Pollock et al., 2014). Some treatments are aimed at restoring function through practice or augmenting movement through compensation to promote acquisition of the tasks practiced (Pollock et al., 2014). One approach to increasing the practice dose of movement is by incorporating motor learning (ML) principles in task-specific training. For practice to affect motor learning, it must have a purpose and is goal-directed (Winstein, Lewthwaite, Blanton, Wolf & Wishart, 2014). Review of current evidence based literature examining upper extremity stroke rehabilitation has shown small, yet positive gains in upper extremity impairment when using interventions that incorporate motor learning strategies (McCabe et al., 2015). Few upper limb studies exist that either compare the use of motor learning strategies of mass practice to practice augmented by technology (McCabe et al., 2015), or utilize a combination of technology incorporating specific motor learning strategies within the intervention (Levac et al., 2015; Levac et al., 2016). McCabe et al. (2015) compared three practice conditions of a comparable high intensity dose of upper limb training for chronic stroke clients involving 1) a protocol using motor learning (ML) strategies along with functional electrical stimulation; 2) a protocol using ML strategies as well as robotic intervention; and 3) a protocol using ML strategies alone. All subjects received 5 hours per day of treatment, 5 days per week for 12 weeks. All three conditions resulted in a significant improvement in Arm Motor Ability Test (AMAT) and the Fugl Meyer (FM) coordination; however, there was not a significant difference across groups. One reason for the feasibility of this study was that it occurred in a research setting where it was possible that the treating therapist oversaw multiple clients at the same time, allowing for 5 hours of treatment per day. The author acknowledged that it would be challenging to replicate this in typical clinical practice in the United States.

Another example of ML strategies being incorporated into the application of technology use was examined by Levac et al. (2015), where they used knowledge translation interventions to determine if increasing a therapist's knowledge of ML would result in better use of applying ML strategies when using virtual reality (VR) as a treatment modality. They found that their knowledge translation increased the therapists' confidence level in applying ML strategies; however, it did not translate into greater virtual reality use. Qualitative data indicated that the therapists instead applied ML strategies more frequently in real life therapy tasks. The authors acknowledged that their sample size was small and that their limited increase in ML strategies during VR use may have been due to an on-going lack of knowledge regarding the proper use and application of the VR system. The other potential study difficulty that the authors acknowledged was that their intervention may have involved too much information in the education component of their knowledge translation, with insufficient practice of the skills, emphasizing the need for a carefully designed knowledge translation intervention.

With an aim towards increasing evidence based clinical outcomes in recent years, there has been a focus on how to best translate research findings into routine clinical practice. The United States National Center for the Dissemination of Disability Research (NCDDR) defines Knowledge Translation (KT) as "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, policy makers) for the purpose of improving the lives of individuals with disabilities" (NCDDR, 2005, pg.4). A roundtable discussion involving clinicians who had experience in KT identified best practice recommendations for developing, implementing and evaluating effective KT, including: 1) develop evidence-based, user-centered content; 2) tailor content to online format; 3) evaluate impact; and 4) share results and disseminate knowledge" (Levac et al., 2015), which is based on the Knowledge to Action Plan (KTA) by Graham et al. (2006). The KTA model is frequently cited in evidence based literature as model for creating and implementing KT in rehabilitation (Janzen et al., 2016; Levac et al., 2015; Walker et al., 2013). The KTA model is a process for moving knowledge into practice. The seven components of the action cycle include: 1) identifying a problem; 2) adapting knowledge; 3) assessing barriers; 4) implementing; 5) monitoring; 6) evaluating; and 7) sustaining (Graham et al., 2006).

In the case of technology adoption, the first step in the KT would be identifying the problem, which is the gap in knowledge that therapists have in effectively implementing technology use into usual occupational therapy upper limb rehab post-stroke. According to the cycle, the next step is to adapt the knowledge. Review of neuro rehabilitation evidence suggests that clinicians require user friendly information that relates directly to the assessment and interventions applicable to specific clinical settings (Walker et al., 2013). This may include providing a summary of key findings with a consensus document, as Walker et al (2013) stated that clinic buyers and providers do not have time to read all of the available evidence, while Janzen et al., (2016) state that guidelines should be "both comprehensive and prescriptive. Non-specific and vague have lower compliance and are difficult to apply" (Janzen et al., 2016, pg. 624). The findings suggest that the education methods for clinicians should be multimodal and involve active participation in the education (Levac 2015; Perry et al., 2014; Walker et al., 2013). The methods should be aimed at enhancing best practices through interactive learning programs, hands-on training, use of role-playing, client videos, case presentations and opportunities for feedback and discussions of successes and behavior change (Levac, 2015; Perry et al., 2014; Walker et al., 2013). To ensure on-going KT, there should be continuous opportunities for follow-up and retraining overtime to ensure maximum effectiveness (Levac, 2015; Walker et al., 2013). These events should be scheduled and promote knowledge exchange, collaboration between stakeholders and offer opportunities to consult with clinical experts (Walker et al., 2013).

Providing on-going support should also include on-going evaluation in the form of auditing progress towards goals and identifying barriers and facilitators (Janzen et al., 2016; Walker et al., 2013). The barriers and facilitators to be considered should be at the clinical and team level, and also at the organization level and include administrative, financial, resource, documentation and environment (Backus et al., 2010; Janzen et al., 2013). Potential barriers noted in the literature include: resistance from system or organization, payers, lack of time, staffing issues, training or education issues, as well as clinical decision making issues such as therapy selection, prioritization, equipment and team dynamics, understanding of the evidence, and resistance to change in practice (Backus et al., 2010; Janzen et al., 2013). The literature suggests that the barriers should be treated in a collaborative problem solving manner between stakeholders and may include group or individual discussions regarding successes, barriers and solutions, use of case studies or chart audits (Perry et al., 2014). Additionally, several researchers cite knowledge brokers or clinical champions as an important part of on-going knowledge translation (Levac et al., 2015; Perry et al., 2014; Walker et al., 2013). Knowledge brokers may take the form of clinical champions or peer mentors (Levac et al., 2015; Walker et al., 2013). Finally, it is critical that KT involves continuous feedback from one stage to another and is an on-going process (Graham, 2006; Janzen et al., 2013; Levac et al., 2015).

Summary

Although there is literature that identifies the barriers and facilitators to the clinical adoption of neuro rehabilitation technology, there is a clear lack of evidence in the literature outlining the best process to integrate technology into the neuro rehabilitation of upper extremity impairment post-stroke. Systematic reviews identify that upper limb neuro rehabilitation should incorporate high dose of task-specific and goal oriented training of the upper limb. It is proposed in the literature that this may be possible through the use of neuro rehabilitation technology; however, the research is mostly small sample size proof of intervention concept studies with very little to guide a clinician on how to best incorporate technology. Further neuro rehabilitation research points to the value of incorporating ML strategies into neuro rehabilitation practice; however, the research involving ML strategies and technology is extremely limited. These gaps in knowledge support the need for a technology integration tool designed to increase the use of technology in a meaningful rehabilitation goal focused way within the clinical setting.

A review of the KT literature identifies a KTA method that may be effective as a basis for this tool. The KTA is an on-going active and iterative process that seeks to bridge the gap of evidence knowledge into clinical practice. Since it addresses barriers and facilitators and allows for stakeholder participation in the process, it would be a useful framework for a clinical site. Additionally, the use of peer-mentors and knowledge brokers at a clinical site appears to be supported in the evidence as an effective strategy to enhance the success of a KT program.

CHAPTER THREE: Description of the Proposed Program

Introduction

Neuroplasticity and improved motor function is believed to be influenced by repeated practice of skilled movements (Pollock et al., 2014; Winstein et al., 2016). Advanced neuro rehabilitation technology has the potential to deliver more intense upper extremity rehabilitation for patients, as compared to usual occupational therapy intervention (Pollock et al., 2014; Stein, 2012). Despite emerging evidence for the use of technology, clinicians are unlikely to use technology unless they understand both how to apply it appropriately with clients and how it fits their rehabilitation goals (Cozens et al., 2013; Glegg et al., 2013; Stein, 2012; and Timmermans, Seelen, Willmann & Kingma, 2009). As such, this doctoral project is intended to provide a compilation of resources to assist with the clinical integration of technology. The program, *Integrating Neuro Technology into the Clinic* will provide clinics with a user-friendly reference tool to help manage known barriers to technology use. The overall aim is to increase occupational therapists' use of technology for clinically meaningful outcomes and assist with their self-efficacy in the appropriate application of technology in their clinical practice. Therapists are more likely to use technology when they clearly understand how to use and adjust the features and parameters of the technology, and when they are confident in their knowledge of how the technology supports individual client rehabilitation goals (Glegg et al., 2013; Hughes, et al., 2014; Tatla et al., 2015).

This chapter will focus on the program design including details of the clinical integration tool, delivery method, program activities, and potential barriers and challenges for implementation of the program. Examples of possible therapist application of the sections of the reference tool will also be discussed in this chapter.

Program Components and Participants

Integrating Neuro Technology into the Clinic is a resource tool for stroke rehabilitation clinics who have purchased advanced neuro rehabilitation technology such as robotics, FES, sensor based, and virtual gaming, and are looking to improve the clinical integration of their technology. The tool will involve two main components. The first component is a resource binder that includes education modules and resources, while the second part is an occupational therapist led 13-week program of technology use knowledge translation and support. The resource binder will include seven reference sections that will provide resources to assist a clinic with overcoming known barriers to clinical integrations and known facilitators. The program is designed for a stroke rehabilitation occupational therapy setting. The occupational therapist led knowledge translation (KT) program is designed for occupational therapists and consists of an on-site Super-User to assist with the on-going implementation of the program. The on-site Super-User is ideally an occupational therapist with a minimum of three-years clinical experience in neuro rehabilitation with a knowledge of motor learning principles. The content for the KT program is grounded in research evidence and thereby will promote increasing the practice dose of movement by incorporating motor learning (ML) principles in task-specific training. This supports evidence that in order affect motor learning, the practice must have a purpose and is goal-directed (Winstein, et al., 2014).

A search of the literature did not find any existing tools to promote the clinical integration of neurorehabilitation technology. As such, *Integrating Neuro Rehabilitation Technology into the Clinic,* was designed using known strategies for KT and adult learning. Participants in the program are occupational therapists and occupational therapy assistants working in stroke rehabilitation. The only exclusion criterion for a participant to this program is a lack of willingness to use technology in the provision of occupational therapy intervention. It is the expectation that the program participants will be self-motivated to reference the tool based on their own gaps in knowledge, and that they will adhere to the suggested schedule for regular contact with the Super-User.

The resource tool will be divided into seven sections based on known barriers and facilitators to technology integration found in literature. The participants will complete self-study sections on technology literature review and applying motor learning strategies. They will participate in three hours of direct occupational therapy instruction on reviewing the ML strategies with the OT consultant and the on-site Super-User. One hour of OT intervention will be used for reporting and consulting with other members on the team. Appendix A, Table 3:1, provides a breakdown of the sections to be included in the technology integration tool and Appendix B provides a detailed example of a section. Appendix C, Table 3:2, provides a schedule of the themes to be addressed during the 13-week program with the occupational therapy Super-User.

The goal of the resource module is that it will evolve and change over time in order to continue to meet the specific needs of an individual clinic. The clinic is expected to take an active role in completing the sections for their therapists to reference, as such the tool will have specific and relevant individualized content for a clinic. Consistent with Adult Learning Theory, the modules will have elements of self-directed learning, will readily be applicable to the unique needs of the clinical environment and use a problem-based learning approach (Kaufman, 2003). Research indicates that KT is more successful when provided as a multi-modal delivery method and the learners take an active role in developing identifying learning objectives (Levac 2015; Perry et al., 2014; Walker et al., 2013). *Integrating Neuro Technology into the Clinic* takes into account KT strategies identified in the literature, including by Graham et al. (2006)'s Knowledge to Action Plan (KTA). The KTA model proposes that regular review of facilitators and barriers should be completed to assist with on-going development of the program (Levac, 2015; Walker et al., 2013).

Another key component of *Integrating Neuro Technology into the clinic* involves a 13-week occupational therapist led peer mentoring. An external occupational therapist (OT) consultant will work closely with an on-site peer mentor to develop, implement and deliver the peer mentoring. This peer mentor will be referred to as a Super-User. The Super-User will have the responsibility of understanding the technology and clinical rationale of a specific device at a higher level of knowledge than would be expected for the other clinicians in the clinical setting. Ideally, the Super-User will have a minimum of 3-years of clinical experience as an OT working with clients with upper extremity impairment following stroke. The Super-User will be a resource for all therapists within the clinic, and it would be expected that the Super-User may not be the same for each advanced technology device within a clinic. The schedule of Super-User led mentoring support is outlined in Appendix C, Table 3:2, and a program example may be referenced in Appendix D. The mentoring will occur in the clinical setting with some support during client-care times, and much of the mentoring outside of client-care time. Over the thirteen weeks, the Super-User will gradually reduce their direct mentoring support and move towards observation and consultation outside of client care time in an attempt to increase the independence of individual therapists in the use of technology. The Super-User will continue to provide supervision to the clinicians for the period of thirteen weeks, however, it is hoped that the level of support will reduce to only verbal coaching. This approach of KT is aligned with research findings that adult learners are more successful in becoming proficient if they take an active role in learning (Kaufman, 2003; Levac, 2015; Walker et al., 2013).

In order to find appropriate participants, the OT consultant will work in partnership with a rehabilitation facility that has purchased technology and has concerns with the technology not being adequately used in routine clinical care for upper extremity rehabilitation post-stroke.

Delivery Method

The delivery of *Integrating Neuro Technology* into the clinic will occur in two simultaneous parts introduced by an OT consultant. This consultant is not an employee of the clinic and will act as a program facilitator for the clinic. The clinic will receive a resource binder at the outset that is intended to be further developed by their clinical team. Additionally, the thirteen-week peer mentoring program facilitated by a Super-User will be initiated. The OT consultant and the Super-User will meet with the clinical team manager and clinical team to identify known barriers or facilitators to using technology to assist with developing the relevant program specific to the clinical site. The meetings with the OT consultant will occur on-site; however, the OT will be accessible to the Super-User by email and telephone when not on-site. The OT consultant and Super-User will both have tablet computers available on-site for form completion and tracking the project data. The tablet computer will be password protected and on a secure network. Client personal identifiers will not be tracked to ensure confidentiality of the patient participants. A digital video camera will be used for recording the client interventions for reviewing the ML strategies. At the end of each recording, the Super-User will upload the videos to the tablet computers and delete them from the camera to ensure the confidentiality of the patient participants.

Program Personnel

There are two main professionals responsible for implementing *Integrating Neuro Technology into the Clinic.* Both professionals are OTs. The first OT will have extensive experience with the clinical integration of technology and will serve as a short-term consultant to the clinical site during the initial program implementation. There will also be an on-site occupational therapist Super-User who has been identified by the facility as a resource who will serve as an on-going technology champion responsible for the long term successful integration of neuro rehabilitation technology. The overall goal is to have the occupational therapist consultant available during the program implementation; however, the Super-User is expected to take over the primary responsibilities of the program as time progresses.

Program Activities

The barriers and facilitators for technology adoption identified in the literature will guide the program. The specific goals and objectives will be based on the initial meetings with the clinical manager and on-site therapists to ensure that the content of the weekly goals and objectives are tailored to the individual needs of the clinic. The program is designed in a way that the level of support from the occupational therapist consult should decrease over time, allowing the Super-User to become the primarily responsible person. The Super-User will have a framework to assist with implementing the weekly goals and objectives.

The following case scenario provides an example of how *Integrating Neuro Rehabilitation into the Clinic* may be implemented.

Case Scenario

An in-patient stroke rehabilitation program has recently undergone numerous staff changes resulting in very few therapists who know how to effectively use advanced neurorehabilitation technology within the clinic. The device that was observed to be most under-utilized was an upper extremity robotic rehabilitation device. The clinic's therapy manager was asked by the hospital administration to find out why the technology was not in use, and to determine a solution that would reintegrate the technology into usual practice. According to a therapist who had been with the rehabilitation clinic for several years, the robotic device was purchased five years prior when a wealthy family donated one million dollars towards the purchase of advanced rehabilitation technology. According to this therapist, the technology was initially utilized extensively; however, it has been used progressively less in recent years. The therapy manager asked the facility's occupational therapists to share their ideas on why the technology was not in use. The following reasons were identified: 1) staff turnover has resulted in clinicians not being properly trained to use the devices and no budget allocated for additional training from the technology companies; 2) therapists lack confidence in applying the technology to the rehabilitation goals of patients; 3) no specific reimbursement codes for use of technology and therefore no added financial incentive to use the technology; 4) confusion regarding scheduling of technology within the department.

The occupational therapist consultant initiated the program by meeting with the therapy manager and the on-site Super-User. Prior to this meeting, the clinical manager requested that the occupational therapists all track their use of technology and complete the self-efficacy questionnaire. Together, the clinical manager, Super-User and occupational therapist consultant decided on the priorities for the implementation of the program. They identified the following priorities: 1. therapists identified not feeling confident with how to use the technology; 2. therapists identified low self-efficacy for applying ML strategies and identifying appropriate exercises to meet their therapy goals; 3. scheduling of the robotic upper extremity training device was complex; 4. evidence for using the device was not being discussed with the team; and 5. facility peer and superior support for using the technology could be improved. Appendix E, Table 3.3, outlines the plan developed to address the priorities for implementing the priorities.

The Super-User and occupational therapist consultant met for a total of 10 hours to prepare the program goals and activities together. They met with four occupational therapists on-site weekly for 13 weeks, with the involvement of the occupational therapist consultant decreasing throughout the program. The occupational therapist consultant guided the Super-User in methods for mentoring the other therapists through in-person meetings, telephone and email throughout the program. The peer support for the on-site clinicians was individualized

Overall, the program implementation was viewed as successful by the clinic manager and Super-User and they reported intent to expand the program to the other therapists in the occupational therapy team. The clinic occupational therapists increased their use of technology and reported improved self-efficacy in using the technology, as well as using ML strategies during the treatment. The clinic has initiated monthly journal clubs to assist with sharing of the evidence related to the technology, neuroplasticity and motor learning. Additionally, issues with scheduling have been resolved. The Super-User has 2 hours per week that may be scheduled on an on-going basis to support and mentor other clinicians requiring peer support.

Barriers and Challenges to Implementation

There are a number of barriers and challenges to the implementation of *Integrating Neuro Technology into the Clinic.* These include: 1. funding; 2. complexity of technology; 3. on-going need to address the issue; and 4. lack of clear practice guidelines. First, since advanced neuro rehabilitation technology does not have specific reimbursement codes, any additional costs to implement the program are in addition to usual therapy department costs (Stein, 2014). Advocating for the program will require that stakeholders understand the potential benefit of technology and that initial investment in a clinical integration program may result in improved clinical outcomes, or increased referrals to the program.

The second potential barrier is the complexity of the technology. Since technology often requires additional training in order to effectively use it, it will require an on-going commitment from the facility to provide resources to overcome this barrier. This is closely linked to the barrier that technology integration is an ongoing an evolving need within the clinic. The program is designed to support ongoing changes to assist the program to evolve with changing clinical needs.

Lastly, the lack of practice guidelines relating to technology is also a barrier to implementation. *Integrating Neuro Technology into the Clinic* provides resources and encourages the clinical site to develop their own resources to assist with problem solving and sharing effectiveness within their team. This development of resources is in line with the AOTA strategic vision that supports "science-fostered innovation in occupational therapy practice" (AOTA, 2006, pg.2). It is hoped that successful implementation and dissemination of this program will help inform evidence that may address this barrier in the future.

Conclusion

Integrating Neuro Technology into the Clinic is designed to encourage clinics to take a proactive and involved role in ensuring the clinical integration of advanced technology. It was designed to be customized to meet an individual clinic's needs and empower a clinic to utilize technology in an evidence based and meaningful way. The program is designed as both a resource tool and a mentoring program. The intent is that the mentoring will be on-going, yet less intensive following the thirteen-week initial implementation at a clinical site. It is expected that the resource binder will continue to evolve over time.

CHAPTER FOUR: Evaluation Plan

Introduction

Integrating Neuro Technology into the Clinic will be evaluated at the level of the therapist participant and also at the program level. The following program evaluation is proposed for evaluating the effectiveness of a clinical integration tool and mentoring program designed to improve clinicians' self confidence in using advanced technology and increasing the overall clinical adoption of technology within the neurorehabilitation setting. Additionally, the program evaluation will determine if *Integrating Neuro Technology into the Clinic* will increase the overall clinical adoption of advanced technology into neurorehabilitation. Advanced technology may include robotic assisted devices, functional electrical stimulation (FES), the use of sensor-based technology and virtual reality (VR) gaming.

The program evaluation is designed to determine if the technology integration tool is effective at increasing therapists' knowledge and perceived self-efficacy of using technology for motor learning in neurorehabilitation, as well as determining if clinical adoption of technology increases as a result of *Integrating Neuro Technology into the Clinic*. The intended audience includes important stakeholders for the use of advanced technology in a neurorehabilitation clinical setting. These stakeholders include: the therapists using the technology at the clinical site, the site's therapy manager, clinical administrators responsible for making budget decisions for new technology, and potential consumers of the rehabilitation offered at the clinical site. The evaluation will be both summative and formative. The summative outcomes include data regarding the clinical adoption of the technology following the program, the perceived self-efficacy of therapists to use and integrate the technology into usual care, and their ability to translate technology use into motor learning goals. From a formative perspective, information will be collected regarding the experience of the clinicians and patients involved in the program in order to assist with further developing the tool for future use.

Logic Model

Refer to the Appendix F for details of the logic model describing the rational, inputs, outputs, and outcomes for the program evaluation. The logic model describes the relationship between the nature of the problem, theory and resources required and the program outcomes within the context of environmental factors influencing *Integrating Neuro Technology into the Clinic*.

Evaluability Assessment Overview

The evaluability assessment will have a collaborative approach with a small group of key and influential stakeholders, including the occupational therapist consultant (program administrator) at the clinical site, clinical therapy managers, therapists, and product Super-Users, to come to consensus regarding the readiness of the project for program evaluation. The Super-Users are therapists who use the technology and are highly knowledgeable and committed to integrating the technology into the clinic. Additionally, one or two patients using the advanced neuro technology will be included in the evaluability assessment in order to ensure that the perspective of the consumer of the therapy using the technology is also informing the evaluation. The group will be provided with several different types of information to provide background and context outlining the importance of the program and a logic model to visually convey the key elements, program goals and objectives, as well as including strategies for meeting the goals. Participants in the evaluability assessment will be provided with information regarding current usage of technology within the clinic, including budget and clinical information for the therapy programs using the technology. This would include information on billable clinical intervention using the devices and surveys of patient satisfaction with the devices. If available, information regarding the clinical team's training records and competencies, as well as clinical outcome data would also be shared. Additionally, the stakeholders would be provided with research evidence relating to technology use outcomes in similar clinical settings and case studies of clinical programs who have successfully integrated technology, including budget information.

Using the program logic model as a starting point for discussion, the inputs, resources, activities, outputs and outcomes, as well as program theory would be considered with the stakeholders. Dialogue encouraging the stakeholders to share their expectations and priorities for the program would be used and as a group decisions would be made to decide key program outputs and desired outcomes for the short term, intermediate, and long term. Collaboratively, program priorities would be determined, ensuring that the goals are realistic and feasible considering logistics and budget. Communication strategies would be settled to ensure that the stakeholders feel informed, while providing the opportunity to provide feedback during the program evaluation and have a voice in influencing the program. The objective for involving key stakeholders is to motivate them to feel ownership and accountability for contributing to the successful implementation of the program.

Core Purpose of the Evaluation

The core purpose of the evaluation is both descriptive and relational. It is descriptive in the sense that it was designed to inform the stakeholders of whether or not the desired results are achieved. Specifically, does *Integrating Neuro Technology into the Clinic* result in improved utilization of advanced technology, higher number of therapists trained to use technology, and increased perceived self-efficacy of the therapists in applying the technology for motor relearning with patients? The relational aspect of the program will determine the relationship between the educational aspects addressed by the tool and the resulting outcomes. This information will identify any shortcomings in the tool and may be used to further develop the program for future dissemination. These core purposes appropriately address the problem that the integration tool is designed to solve by determining if the program outcomes are effective and to further develop the program if the desired results are not achieved.

Scope of the Evaluation

The evaluation will occur in a stroke neurorehabilitation occupational therapy department over the course of six to nine months. This time period will allow sufficient time for the therapists and super-users at the site to learn how to effectively use the technology and determine the impact that the tool has on the integration of technology at the clinical site. Since *Integrating Neuro Technology into the Clinic* is novel, the initial number of participants will be kept low. Four therapist end-users will be recruited, providing a sample size used as a beta testing to collect further information on the tool and to determine its feasibility within the clinical setting, while providing the opportunity to collect information for improvement. This small sample size is not likely to provide statistically significant results; however, it should allow for an estimation of direction and size of change as a result of the program. With respect to inclusion and exclusion criteria, participants must be occupational therapists with a minimum of one year of clinical neurorehabilitation experience and not have prior knowledge of the advanced technology being used for implementing *Integrating Neuro Technology into the Clinic*. The Super-User will self-identify as having an interest in becoming the product champions and the on-site person responsible for organizing and collecting data for the program.

Evaluation Questions

By means of program evaluation the author seeks to answer questions from each of the stakeholders. From a facility administration and clinical manager perspective, the questions are: 1) Does the clinical integration education tool result in increased clinical adoption of the technology? 2) Does the use of the technology integration tool lead to more therapists using technology? From the therapist and Super-User perspective: 1) Does the tool increase the therapist's self-efficacy in applying advanced technology in usual clinical care? 2) From a formative program development perspective, are there skills that require developing beyond this program to better improve the clinical integration of the technology? From a patient stakeholder perspective, the question the program will answer is: What was patient experience participating in the program?

Research Design and Methods

The program evaluation will use both quantitative and qualitative methods. A prospective study using pre-test and post-test quasi-experimental design will be used, where each participant will receive the program and serve as his or her own control. Quantitative measures including pre-test and post-test of the number of therapists regularly using technology in the clinic. A pre-post self-efficacy survey of using the technology and a pre-post evaluation of the clinicians' ability to integrate motor learning strategies into their rehabilitation using the technology will also be administered. The surveys will consist of a combination of quantitative questions using a visual analogue scale to determine confidence in using the advanced technology, and qualitative questions to collect data regarding clinician experience. Please refer to Appendix G for sample survey questions. Additionally, the Motor Learning Strategy Rating Instrument (MLSRI) will be used with trained observers. The MLSRI is a standardized assessment consisting of 20-items that uses a five-point Likert scale to evaluate how therapists implement motor learning strategies during treatment sessions (Levac et al., 2016).

In addition to the quantitative methods, qualitative approaches will be used to gain insight into the experience of the therapist participants, the Super-User and the client end-users in order to further develop and improve the program. Each participant will have three patient sessions video-recorded at the beginning of the intervention, followed by three additional video recordings at the end of the intervention for the purpose of being rated with the MLSRI. Effort will be made to set up the video in a method that will not interfere or distract from the patient therapy sessions. Further qualitative information regarding the participant experience will be collected using a focus group and semi-structured interviews. The data will be used to gain a sense of participant experience with the program and to inform program development.

Planned Approach to Data Gathering

The on-site Super-User and the occupational therapist consultant will be responsible for collecting and managing the program evaluation data collected on-site. The occupational therapist consultant will provide the Super-User with additional training regarding his/her role in data collection and management. The Super-User will ensure that tablet computers are available to program participants in order to complete the surveys. The Super-Users will also ensure that technology utilization statistics are recorded weekly on the tablet. The tablet will be connected securely to the internet to ensure real-time uploading to the data management software being used to analyze the data. Participants will complete quantitative surveys pre- and post- intervention, directly on the tablet computers.

Qualitative data gathering will occur during the video recording of the patient sessions. These video recordings from the beginning and at the end of the intervention will be used for the purpose of being rated by a trained observer and using the MLSRI. Effort will be made to set up the video in a method that will not interfere or distract from the patient therapy sessions. The occupational therapy consultant will train the Super-User as an observer for administering the MLSRI. Although it is recognized that the Super-User is not completely unbiased in that they are treating clinicians within the facility, he/she is included as a trained observer to assist with minimizing the cost of the program evaluation and to further develop their skills in identifying motor learning strategies within advanced technology therapy sessions. The goal of this is to increase clinical knowledge and assist with further program development. As well as using a trained observer for the MLSRI to quantify the therapists' implementation of motor learning strategies, trained observers will make qualitative observations of the motor learning strategy types used and gather data on effectiveness of strategy implementation. The Super-User will have the opportunity to practice rating from videos to ensure their skill prior to rating within the program evaluation.

Further to the MLSRI data, qualitative information with be gathered from the group of therapist participants early in the program. This information will assist with developing relevant teaching content for the program. This will be achieved through a focus group. Participants unable to attend the focus group will be requested to participate in a semi-structured interview. In addition to pre-program and early program data collection, interviews or focus groups will be used post-intervention, to gather information on the content included in the educational tool design. Additional semi-structured interviews will be conducted to gather the experience of the Super-User. The focus group and semi-structured interviews will take place over 60-90 minutes and be structured in an open and relaxed format, where the researcher will encourage group participation and sharing of their experience by asking five to six probing and open-ended questions. The pre-post data will be compared and analyzed to evaluate themes surrounding the experience of the participants during program implementation, as well as to identify further program improvements.

Data Management Plan

The data collection will be managed on-site by the Super-User, who will be responsible for keeping the computers secure, password protected and ensure that all data is keep confidential. The pre-tests and post-tests of knowledge and self-efficacy will be collected, stored and analyzed using Qualtrics, an online data analysis and management company. Non-parametric statistics will be used to analyze the surveys and the MLSRI data. Qualitative data will also be collected in the pre-post surveys, as well as through a focus-group or semi-structured interviews with the participants. Qualitative data will be gathered using hermeneutic methods to collect information on participant experience in the program in order to identify or elicit deeper meanings and patterns. It will be collected, stored and analyzed using NVivo. The Super-User will be involved in analyzing the qualitative data to assist with coding themes that emerge regarding participant experience and suggestions for program improvements.

Program evaluation results will be shared with the stakeholders in the form of a ten-page report that outlines key findings and suggestions that offer options for improvement and considerations. A visually pleasing format will be used with clear suggestions and simple to understand charts and graphs. A two-page executive summary will be included with sufficient detail that it could be used as a stand-alone report.

Summary

The program evaluation will assess an education tool designed to evaluate *Integrating Neuro Technology into the Clinic*. The evaluation is both summative and formative, collecting both quantitative and qualitative data to measure the program effectiveness and to inform program improvements following the initial use of the tool. The evaluation was designed to provide information regarding *Integrating Neuro Technology into the Clinic's* effectiveness in improving the clinical integration of technology, therapist perceived self-efficacy in using technology, and evaluate the clinicians' abilities to apply motor learning strategies with technology during neuro rehabilitation.

CHAPTER FIVE: Funding Plan

Funding Plan

Integrating Neuro Technology into the Clinic focuses on improving the clinical integration of technology and assisting with facilitating conditions for the on-going use of technology at a clinical site. Although evidence exists regarding the feasibility and efficacy of technology use, there is limited research on how to successfully integrate the technology into usual occupational therapy practice. The purpose of this doctoral project is: 1) to outline possible barriers and facilitators to technology use; 2) provide an educational tool that will assist clinics with addressing these issues; 3) outline an implementation strategy; and 4) provide a method to evaluate the program. The goal of the project is to provide occupational therapy clinics with an educational tool that will assist therapists in clinically integrating technology into usual therapy practice and promote their involvement in ensuring that it remains integrated over time. This chapter will describe the proposed funding and resources required to support the program with a two-year outlook.

Available local resources

The clinical site involved in the project will have advanced neurorehabilitation technology within their facility. Other available resources include: computers and tablets with internet access. This writer will provide the occupational therapist program manager support time at no cost to the facility at the pilot test site, with salary paid by an industry technology company.

Resources needed: Budget

The funding plan will cover implementing the program into a clinical setting, evaluating the plan and costs for further disseminating the plan beyond the initial site of the program. The expenses of the program will estimate the costs for a single clinical site and include personnel costs for preparation, implementation, training and program evaluation; supplies; and dissemination costs following the initial program implementation which will include conference fees and associated travel. Program implementation expenses will be highest in the first year with an expected reduction in cost in the following year. The first year will also include expenses for further dissemination following a successful implementation at the first site. Appendix H, Table 5-1, provides an overview of the expenses of the project.

Potential Funding Sources

Typically, the funding required for a project such as *Integrating Neuro Technology into the Clinic* would be covered by the budget in an occupational therapy department. The project can be implemented in a variety of clinical settings including in- or out-patient rehabilitation departments. It would occur at a clinical site that has invested funding in advanced rehabilitation technology and has an operational budget that supports the use of technology for rehabilitation. Frequently, a therapy department budget allows for peer-mentoring and on-going continuing education as expected non-productive time included in the budgeting for therapists' salaries. It would be expected that much, or all, of the personnel costs would be covered by the department budget. Following implementation of the program, a more robust financial evaluation may be helpful to determine if the use of technology promotes increased productivity of treating therapists or increased referrals to the facility; however, this analysis is beyond the scope of the project. Table 5-2 lists some examples of potential funding sources that may assist with supporting the program.

Table 5-2: Potential Funding Sources

Type of funding	**Source**	**Requirements and Examples**
Fund	Boston University – Dudley Allen Sargent Research Fund	Grants of up to $5,000 per project are available. Request for any research project for students in Doctoral studies at Sargent College.
Fund	The Heart and Stroke Foundation Canadian Partnership for Stroke Recovery (CPSR) Implementation Science Grants	Grants of up to $50 000 are available to assist with research. Request for research implementation science grant to assist with cost of research. According to the website, an area of interest to the CPSR is research addresses increasing access to stroke rehabilitation services in rural and urban setting using technology. (CPSR, n.d.).
Fund	American Occupational Therapy Foundation (AOTF) Intervention Research Grant Program	Grants up to $50 000 are available to help with research costs. The AOTF grant is to promote implementation of intervention that is science driven and evidence based, and intended for use in proof of concept research (AOTF, n.d.)
Fund	Industry Technology Company	OT salary to be covered by a technology company for implementation of the program. ($1400 to cover salary cost).
Crowdfunding	MedStartr	A platform for individuals to bid and eventually provide enough funding to implement the program

Conclusion

Funding for *Integrating Neuro Technology into the Clinic* will occur primarily from within a clinical site's budget with external funding supplementing the costs that are additional to a typical therapy department budget. The expectation is that a clinical site that has invested money in the purchase of advanced neurorehabilitation technology will have the means to budget for the additional therapist hours to implement the program under their staff development budget. For the initial implementation of the program, an industry partner technology company would fund the occupational therapist salary and possibly a grant for post-doctorate research or crowdsource funding could be used to scale the program beyond the initial clinical site.

CHAPTER SIX: Dissemination Plan

Project Description

Integrating Neuro Technology into the Clinic is a two-part program designed to assist clinics in identifying the barriers and facilitators of technology use within their clinic, and assist the clinic with implementing strategies to ensure on-going use of advanced technology for stroke rehabilitation. The program consists of both a resource binder and a thirteen-week on-site peer mentoring program, led by an OT consultant and an on-site Super-User of the technology. The dissemination plan for *Integrating Neuro Technology into the Clinic* will target three main stakeholders: occupational therapist participants, clinic managers/administrators, and technology companies/potential funders. The overall objectives of the dissemination plan are to increase the translation of research findings into meaningful and goal focused use of technology within a clinic and later, expand the program to other clinical sites to eventually promote increased on-going use and appropriate clinical integration of advanced neuro rehabilitation technology across multiple clinical sites. The dissemination plan was designed to help inform stakeholders regarding the benefits and successes of this program implementation.

Dissemination Goals

The dissemination plan outlines long term and short term goals across stakeholders.

Long term goals:

- the program will be adopted at other clinical sites, resulting in increased clinical integration of advanced technology for treating upper extremity impairments.

- the findings from *Integrating Neuro Technology into the Clinic* will contribute to evidence based best practice guidelines on how advanced neuro technology may be used in a clinically meaningful way to address rehabilitation goals for upper extremity impairment.

Short term goals:

- the program outcomes will inform occupational therapists, clinical managers and administrators on strategies for successful clinical integration and on-going adoption of technology to meet rehabilitation goals.
- the project results will inform technology companies on strategies to increase clinical integration of technology that may guide the support they provide to clinics at the time of technology purchase and beyond.

Target Audience

There are two primary audiences 1) clinic managers and administrators working in a clinic that has either invested in advanced technology, or is considering purchasing advanced technology; and 2) occupational therapists who use advanced technology in their treatment of upper extremity impairments following stroke. The secondary audience is the advanced technology companies. Upon successful implementation of the of the program, this may serve as evidence for expanding the successful use of advanced neuro technology within the clinical setting and assist with establishing best practices for clinical integration of technology.

Key Messages

Key messages regarding the program to share with each of the groups for dissemination include:

All groups:

1. The program is a two-part tool designed to provide a resource that a clinic can adapt to meet their individual needs and is intended to evolve over time to ensure a continuous clinical integration of advanced neuro rehabilitation technology by addressing facilitators and barriers to technology use in delivering occupational therapy intervention for upper extremity impairment following stroke.
2. *Integrating Neuro Technology into the Clinic* is intended to support clinical staff in becoming confident in the appropriate use of technology. A known barrier to the clinical integration of technology is that clinicians are unlikely to use technology unless they understand both how to apply it appropriately with clients and how it fits their rehabilitation goals (Cozens et al., 2013; Stein, 2012; and Timmermans, Seelen, Willmann, & Kingma 2009).
3. To ensure maximum effectiveness and on-going knowledge transfer in a clinical setting, there should be continuous opportunities for follow-up and retraining over time and offer opportunities to consult with clinical experts. This should involve collaboration between stakeholders to identify facilitators and barriers to technology use (Janzen et al., 2016; Levac, 2015; Walker et al., 2013).

Considering the different groups separately, the following additional dissemination messages are important:

Clinical Managers/Administrators:

1. Therapists will become more productive using technology when they have a clear understanding of how and when to apply it to maximize clinical outcomes, thus reducing lost productivity when they attempt to use technology infrequently.
2. Clear integration of rehabilitation technology into usual care may influence patients when selecting a rehabilitation center (Stein, 2010).
3. Supporting use of rehabilitation technology at a facility and administrative level will result in greater use by therapists. Tatla et al. (2015), suggest that a facility should encourage continuing education and professional development, as well as mentorship from a clinical opinion leader.

Occupational Therapists and Super-Users:

1. Understanding the research and application of technology will assist in increasing self-efficacy for using technology (Glegg et al., 2013; Hughes, et al., 2014; Tatla et al., 2015).
2. Therapists' knowledge of how to select exercises according to therapy goals, and include clients in self-selection of exercise, will increase client's motivation (Timmermans et al., 2009)
3. Committing time to learning the technology will make it easier to apply the technology in daily occupational therapy practice.

Key Messengers

Successful dissemination of these messages will occur at three different levels. It will be important to have a messenger who is a clinical manager or administrator, an occupational therapist who has served as a Super-User and treating occupational therapist who has benefitted from participating in the program. First, the clinical manager or administrator will be an appropriate voice to convince other facilities at the clinical management or administration level of the benefits of the program and would be able to speak to improved overall use of technology within the clinic and speak to any potential changes to facility referrals or changes in therapist productivity as a result of the program. Additionally, the Super-User who has completed the program will be a key messenger to speak with clinical managers and other occupational therapists to convince them of the value of the mentoring aspect of the program. An occupational therapist who used the tool and has participated in the mentoring program will be able to convince other therapists on how the tool and program have increased their self-efficacy in appropriately applying technology to meet rehabilitation goals.

Dissemination activities

The first step in the dissemination plan would be to expand the program into other departments within the same clinical site, or other clinical sites within the hospital network. Person-to-person contact through informal conversations, inter-departmental meetings and planned presentations to review the experience. The clinical manager may share the outcomes with the other managers and the therapist or Super-User could present at other departments' meetings or lunch-and-learn meetings. Additionally, the clinical manager, Super-User and/or occupational therapy consultant may also provide in-services or presentations at other clinical sites to assist with informing the other sites of the potential of the program and resource tool.

In order to achieve a broader dissemination to other clinical sites, the Super-User, along with assistance from the occupational therapist consultant will use the data collected to put together a short course or poster presentation for the 2020 American Occupational Therapy Association Annual Conference in Boston, MA. Should the submission be accepted, preliminary information regarding the impact and changes observed at the initial site could be learned. Additionally, qualitative information regarding lessons learned and plans for further implementing the on-going clinical integration at the initial site could be shared. Potentially, the evidence collected could be used to either submit an article for publication in a peer-reviewed occupational therapy journal, or further research collaboration on a larger scale could be initiated to continue to build evidence surrounding the clinical integration of advanced neuro technology.

Lastly, if these efforts prove to result in interest beyond the initial clinical site, a webpage hosting the clinical integration tool could be created to allow for easier adoption at other clinical sites.

Budget

The dissemination activities require resources in terms of time, specifically in terms of salary cost. When the Super-Users and therapists are attending meetings in other departments and at other sites, there will be lost productivity in terms of their providing direct occupational therapy care. To minimize the lost revenue while promoting the program, it would be preferable if the dissemination activities occur during nonclinical hours, such as during lunch time. Additionally, there are costs associated with travel to the AOTA conference, and incidental costs for printing that are outlined in Chapter 5.

Evaluation

Adoption of the tool at other clinical sites will be the determinant of success of the dissemination plan. The number of sites interested in adopting the tool and program will be tracked. Additionally, metrics regarding how many therapists participated in the program and mentoring at the initial site and the number of departments that the tool and program have expanded to will be tracked. The number of conference posters or short courses accepted will be tracked, as well as the number of articles published. At the individual site level, metrics on the use and the self-efficacy reported by therapists will be tracked over time.

Conclusion

The dissemination of *Integrating Neuro Technology into the Clinic* has multiple approaches to dissemination at different levels of impact. The dissemination will occur at the level of a treating occupational therapist and at the clinical manager or administrator level. Additionally, efforts will be made to disseminate to the technology companies that create neuro rehabilitation technology. The messages delivered will be tailored and appropriate to the particular audience. Regardless of the audience, the overall goal of the program is to better integrate technology into upper extremity rehabilitation post-stroke. Efforts will be evaluated based on the adoption of the program at other clinical sites and feedback obtained from those sites with a plan to modify, if necessary.

CHAPTER SEVEN – Conclusion

Integrating Neuro Technology into the Clinic is an occupational therapy tool and mentoring program designed to assist with the clinical integration of advanced technology into upper extremity stroke rehabilitation. Advanced neuro rehabilitation technology includes devices such as functional electrical stimulation, robotics, sensor-based and virtual reality gaming. *Integrating Neuro Technology into the Clinic* provides clinics with a user-friendly reference tool to help manage known barriers to technology use. The overall aim is to increase occupational therapists' use of technology for clinically meaningful outcomes and assist with their self-efficacy in the appropriate application of technology in their clinical practice. *Integrating Neuro Technology into the Clinic* is aligned with the American Occupational Therapy Association's Centennial vision that occupational therapy "is a powerful, widely recognized, science-drive, and evidence-based profession with a globally connected and diverse workforce meeting society's occupational needs" (AOTA, 2006, p.1). This project is informed by science, based in research and grounded theory with the goal of providing clinical sites with the tools necessary for effectively integrating technology into routine occupational therapy provision.

The first chapter of the project outlines the key contributors that have led to the problem of advanced neuro technology not being implemented consistently across clinical sites. The factors contributing to the problem are briefly described with an overview of how *Integrating Neuro Technology into the Clinic* addresses the problem. The second chapter further explains the theoretical basis and evidence supporting the project. The chapter explains that decreased technology use and adoption results from clinicians experiencing a low perceived self-efficacy for using the technology. Two theoretical frameworks for understanding the problem and the approach to addressing the problem. The Decomposed Theory of Planned Behavior is used to better understand the contributors that influence a person's behavior around using technology, while Adult Learning Theory helps shape the intervention in a way that supports adult learning. Chapter two then reviews the literature related to technology use for upper extremity stroke rehabilitation, existing literature regarding technology adoption in rehabilitation, and evidence regarding best practices for knowledge translation to influence clinical practice changes.

There is a lack of clear evidence outlining the best practices for integrating advanced neuro technology, therefore the implementation is not consistent across sites. Despite the lack of evidence regarding best practices for clinical integration of technology, the literature identified both facilitators and barriers. Facilitators for technology adoption were identified and include: 1. knowledge of technology features and how the device fits with a client's individual rehabilitation goal in a clinically meaningful way (Cozens et al., 2013; Stein, 2012; Timmermans et al., 2009); 2. Training of therapists to ensure understanding of both the technology and the movement practice that it provides (Timmermans et al., 2009); 3. Patient acceptance of technology (Chen & Bode, 2011); 4. Ease of set-up and ability to use the technology independently (Chen & Bode, 2011; Ellington et al., 2015; Hughes et al., 2014; Tatla et al., 2015; Turchetti, 2014); and 5. A social and physical environment that promotes technology use

(Hochstenbach-Waelen & Seelan, 2012). Barriers to technology adoption identified in the research include: 1. Lack of understanding of clinical efficacy of technology (Tetterroo, 2014); 2. Lack of understanding of features and how to adjust parameters to meet client rehabilitation goals (Glegg et al., 2013; Hughes et al., 2014; Tatla et al., 2015); 3. Technical difficulties and maintenance issues (Chen & Bode, 2011; Glegg et al., 2013); 4. Physical environment factors such as space or accessibility to technology (Hughes et al., 2014; Lam et al., 2015; Glegg et al., 2013; Tetterroo et al., 2014); 5. Social factors such as clients not interested in using device, lack of appropriate clients, lack of peer or superior support and logistics at clinical site not optimized for supporting use, or sufficient time (Chen & Bode, 2011; Glegg et al., 2013). In addition to identifying barriers and facilitators to technology adoption, chapter two also reviews the knowledge translation evidence for influencing clinical practice changes, which helps to shape the intervention outlined in *Integrating Neuro Technology into the Clinic.*

Chapter three describes the program components of *Integrating Neuro Technology into the Clinic.* The program design includes two parts: a resource binder and a peer mentoring support program. The resource tool consists of seven sections that provide a clinic with resources to overcome the known barriers to technology adoption. It is designed as a tool that expects the clinic to contribute to building the content and evolving it over time to meet the clinic's individual needs. The 13-week peer mentoring program is described and includes an on-site Super-User and an occupational therapist consultant. The goal of the peer mentoring program is that the Super-User will become an on-site expert facilitator to provide on-going peer support. Examples of the resource binder sections and peer mentoring support are provided for reference. Delivery method, program personnel and program activities are outlined with a case scenario to provide concrete examples of *Integrating Neuro Technology into the Clinic.* The barrier and challenges to implementation are outlined.

A plan for evaluating *Integrating Neuro Technology into the Clinic* is provided in Chapter four. The evaluation plan includes program evaluation at both the therapist participant level and the program level. Success of the program is measured by improvement in clinician perceived self-efficacy for using technology and an overall improvement in clinical adoption of advanced neuro technology. A logic model is included that describes the program inputs, outputs and outcomes, as well as the relationships between the problem, the theory and the resources required to implement the program. The chapter outlines the design of the evaluation, the data collection and analysis methods and the overall logistics for implementing it. Additionally, chapters six and seven outline the budget and dissemination plan for *Integrating Neuro Technology into the Clinic.*

In summary, *Integrating Neuro Technology into the Clinic* is a novel program designed to improve the clinical adoption of advanced neuro technology into usual occupational therapy intervention of the upper extremity post stroke. Implementation of *Integrating Neuro Technology into the Clinic* has the potential for informing occupational therapy best practices for the clinical integration of advanced neuro technology.

APPENDIX A: Integrating Neuro Technology into the clinic - Resource Tool

Section Descriptions

Table 3:1: Resource tool sections description and goals

Section	Topic	Clinical Barrier or Facilitator	Goal of Module
1	Neuro rehabilitation and technology – review of literature	*Clinician Understanding of Technology Effectiveness* Research indicates that therapists are more likely to integrate technology when they understand the clinical effectiveness, perceived usefulness and compatibility with current practices (Backus et al., 2010; Cozens et al., 2013; Glegg et al., 2013; Levin, Weiss, & Keshner, 2015).	Provide a self-study module for clinic therapists to better understand technology use for their specific patient population. The module contains a framework for evidence review to assist the clinic in building easy to reference literature review of relevant studies using the format of a critically appraised template (CAT).
2	Applying Motor Learning Principles to technology	*Clinician Understanding of Motor Learning Principles and applications* Research shows added value for technology use in motor learning. For practice to affect motor learning, the practice must have a purpose and is goal-directed (Winstein, Lewthwaite, Blanton, Wolf & Wishart, 2014).	The goal of the module is to provide clinicians with an understanding of ML strategies and a framework for designing intervention than utilizes ML strategies.
3	Facility facilitators to technology integration	*Facility Integration* Review common barriers for clinical integration of technology at the facility level.	List of potential facility-based barriers and potential solutions for addressing the barriers.
4	Technology-specific training	*Technology-specific clinical competency training* A guide to developing and conducting hands-on clinical training and easy to use resources for quick reference. The guidelines should be	The goal of this section of the resource is to have a facility-specific protocol to train clinicians on the specific use of a technology beyond the initial training complete

		comprehensive and prescriptive to ensure they are not difficult to apply (Janzen et al., 2016). Glegg et al. (2013) identified that such resources assist with a clinician's perceived ease of use.	by the technology manufacturer.
5	Technology – specific competency evaluation framework	*Competency Evaluation framework* A framework for developing technology specific competency evaluation of knowledge of technology use and application.	To provide the clinic with a framework for creating competency evaluation for specific technology. The intent is that clinicians complete the competency evaluation on an annual basis.
6	Technical support	*Quick Reference for technical support* A framework for assimilating relevant technical support material and contact numbers.	To guide the clinic in how to have easy to use reference for common technical difficulties and provide clinicians with an easy to reference list of contacts for addressing technology equipment problems.
7	Super User Support	*Guideline for a 13-week Super-User led education* A guide for an on-site Super-User KT for the clinicians using the technology intended to increase the self-efficacy of the on-site clinicians in using technology for meeting therapy goals.	To provide a guide for activities the Super-User can apply within an on-site educational and clinical support program. Refer to Table 3.2 for goals and objectives of the Super-User involvement.

Appendix B: Integrating Neuro Technology into the Clinic - Resource Tool Section Example

Section 1: Neuro rehabilitation and technology - review of literature

Description and Purpose:

The purpose of the section is to provide a self-study module for clinic therapists to better understand technology use for their specific patient population. The module contains a framework for evidence review to assist the clinic in building easy to reference literature review of relevant studies in the format of Critical Review Form (Letts, Wilkins, Law, Stewart, Bosch, & Westmorland, 2007)

Clinical barriers or facilitators being addressed: *Clinician Understanding of Technology Effectiveness*

Research indicates that therapists are more likely to integrate technology when they understand the clinical effectiveness, perceived usefulness and compatibility with current practices (Backus et al., 2010; Cozens et al., 2013; Glegg et al., 2013; Levin, Weiss, & Keshner, 2015).

Resources:

It is recommended that clinics use this section to add research articles relevant to their specific practice needs.

Suggested Reading:

Kleim, J. & Jones, T. (2008). Principles of experience-dependent neural plasticity: Implications for rehabilitation after brain damage. *Journal of Speech, Language and Hearing Research.* 51, s225-s239.

International Industry Society in Advanced Rehabilitation Technology (2017). Slide deck 1: Basic knowledge – a movement therapy perspective. Retrieved on March 1, 2018 from http://www.iisartonline.org/services/education-material/.

Winstein, C. J., Stein, J., Arena, R., Bates, B., Cherney, L. R., Cramer, S. C., . . . Zorowitz, R. D. (2016). Guidelines for adult stroke rehabilitation and recovery: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke, 47*(6), e98. doi:10.1161/STR.0000000000000098

Tips for the clinic:

1. Choose literature that specifically addresses the type of technology available to the clinicians and the applications relevant for the clinic's specific patient population.
2. Ask technology manufacturer for any relevant research at time of training on the device.
3. Schedule monthly journal clubs for sharing research on technology use with team members. Use the Critical Appraisal Template (CAT) forms provided, which can be accessed here:

   For quantitative research:

   https://www.canchild.ca/system/tenon/assets/attachments/000/000/370/original/quantform.pdf

   Guidelines for quantitative research can be accessed here:

https://www.canchild.ca/system/tenon/assets/attachments/000/000/366/original/quantguide.pdf

For qualitative research:

https://www.canchild.ca/system/tenon/assets/attachments/000/000/359/original/qualform.pdf

Guidelines for qualitative research can be accessed here:

https://www.canchild.ca/system/tenon/assets/attachments/000/000/360/original/qualguide.pdf

Appendix C: Integrating Neuro Technology into the Clinic

Table 3:2: Super-User support description and goals

Week	Topic	General content	Example activities
Weekly	Review of clinician self-efficacy for using technology.	Completion and review of perceived self-efficacy for using technology use forms	Super-User to summarize the weekly use of technology by therapist participants.
Daily	Technology and ML strategy tracking.	Clinicians to complete forms of technology use and form to track use of ML strategy.	Complete technology usage tracking form, plus Motor Learning Rating Scale (MLRSI) (Levac, Missiuna, Wishart, DeMatteo, & Wright, 2011).
1	Introduction and review of program goals.	*Program Goals and Objectives* Review of program goals and objectives for the peer mentoring program.	The Super-User (with assistance of OT consultant) to review the 13-week plan for knowledge translation and program implementation with clinic therapists.
2	Review of Neuro rehabilitation and technology – review of literature from resource tool	*Clinician Understanding of Technology Effectiveness* Research indicates that therapists are more likely to integrate technology when they understand the clinical effectiveness, perceived usefulness and compatibility with current practices (Backus et al., 2010; Cozens et al., 2013; Glegg et al., 2013; Levin, Weiss, & Keshner, 2015).	Super-User (with assistance of OT consultant) to answer and/or discuss questions that the clinic therapists have following their self-study.
3 & 4	MLRSI instruction and guided practice	*Clinician understanding of MLRSI* Super-User facilitated instruction of MLRSI	Super-User (with assistance of OT consultant) to provide guided practice on selecting technology for ML practice and instruction on completing MLRSI.
3-10	Mentoring clinicians using a video	*Video Review of ML Strategies* *45-60 minutes bi-weekly*	The goal of the mentoring is to provide clinicians with an opportunity to discuss and

	review on applying Motor Learning Principles to technology	Super-User to meet with clinic therapists bi-weekly to review video recordings of sessions to discuss and identify appropriate use of ML strategies during use of technology.	further understand their personal application of ML strategies when using technology for intervention.
11-12	One-on-one meetings to discuss application of ML strategies	*ML Strategy Mentoring* *30-45 minutes bi-weekly* Super-User to meet with treating clinician to discuss use of ML strategies.	The goal is that the clinicians will be proficient at self-analysis of the ML strategy and have a high level of perceived self-efficacy in applying technology appropriately during therapy sessions.
13	Semi-structured interviews of clinic staff	*60 minutes* Semi structured interviews to obtain feedback on experience and collect information on knowledge gaps concerning use of technology for working on therapy goals.	

APPENDIX D: *Integrating Neuro Technology into the Clinic* Peer Mentoring Plan Example – Week 3 & 4

Week 3 & 4: Plan for Clinical Understanding of Motor Learning Rating Scale Instrument

Time commitment: it is expected that this will take 3 hours including practice

Description and Purpose:

The purpose of this week is to provide hands-on instruction for using the Motor Learning Rating Scale (MLRSI). Clinic therapists will receive instruction on how to score the MLRSI for incorporating motor learning strategies into their technology use.

Clinical barriers or facilitators being addressed: *Clinician Understanding of Incorporating Motor Learning (ML) Strategies into intervention using technology*

Research indicates that therapists are more likely to integrate technology when they understand the clinical effectiveness, perceived usefulness and compatibility with current practices (Backus et al., 2010; Cozens et al., 2013; Glegg et al., 2013; Levin, Weiss, & Keshner, 2015).

Resources:

The MLRSI is an observer-rated instrument that measures the use of motor learning strategies during therapy. For description of the instrument, please go to: https://www.canchild.ca/en/resources/106-the-motor-learning-strategy-rating-instrument

An example of the instrument:

MLSRI Instrument sample

Please rate the <u>extent to which</u> these strategies occur:	not at all	small	modera te	great	very great	Unable to rate
Practice is:						
1. Active	*0*	*1*	*2*	*3*	*4*	*X*
2. Repetitive	*0*	*1*	*2*	*3*	*4*	*X*
3. Whole (rather than part)	*0*	*1*	*2*	*3*	*4*	*X*
4. Variable (rather than constant)	*0*	*1*	*2*	*3*	*4*	*X*
5. Challenging	*0*	*1*	*2*	*3*	*4*	*X*
6. Progressive	*0*	*1*	*2*	*3*	*4*	*X*

Image retrieved from: www.canchild.ca/en/resources/106-the-motor-learning-strategy-rating-instrument

Suggested Reading:

Levac, D. (2012). The motor learning strategy rating instrument in brief. Retrieved on March 1, 2018 from: https://www.canchild.ca/en/resources/106-the-motor-learning-strategy-rating-instrument

Levac, D., Missiuna, C., Wishart, L., DeMatteo, C., & Wright, V. (2011). Documenting the content of physical therapy for children with acquired brain injury: Development and validation of the motor learning strategy rating instrument. *Physical Therapy, 91* (5), 689-699.

Appendix E: Table 3.3 - Example *Integrating Neuro Technology* into the Clinic Plan

Week	Topic	General content	Activities completed
Weekly	Review of clinician self-efficacy for using technology.	Completion and review of perceived self-efficacy for using technology use forms	Forms completed by all clinicians. Super-User summarized the weekly use of technology by therapist participants.
Daily	Technology and ML strategy tracking.	Clinicians to complete forms of technology use and MLRSI forms.	Forms completed by all clinicians. Super-User summarized the findings weekly.
1	Introduction and review of program goals.	*Program Goals and Objectives* Review of program goals and objectives for the peer mentoring program.	The Super-User (with assistance of OT consultant) to review the 13-week plan for knowledge translation and program implementation with clinic therapists.
2	Review of Neuro rehabilitation and technology – review of literature from resource tool	*Clinician Understanding of Technology Effectiveness* Clinic therapists completed self-study modules, and received hands-on device training.	Super-User (with assistance of OT consultant) to answer and/or discuss questions that the clinic therapists have following their self-study. 2 hours of hands-on technology training in a group setting. Included a pre-test and post-test of knowledge/competency.
3 & 4	MLRSI instruction and guided practice	*Clinician understanding of MLRSI* Super-User facilitated instruction of MLRSI during practice intervention with clients.	Super-User (with assistance of OT consultant) to provide guided practice on selecting technology for ML practice and instruction on completing MLRSI. Co-treating of clients using technology to assist in real time. Sessions video recorded to allow further mentoring and follow-up.

5	Journal Club	Participants in program reviewed article in CAT format. A journal club is being introduced to provide the clinicians in the clinic with a role in collecting evidence regarding the use of technology. Research shows that a clinician led dissemination of KT assists with technology integration (Levac et al., 2015).	Article reviewed: Kleim, J. & Jones, T. (2008). Principles of experience-dependent neural plasticity: Implications for rehabilitation after brain damage. *Journal of Speech, Language and Hearing Research.* 51, s225-s239. All department was invited to participate in journal club. Summary of article shared during a monthly department meeting.
3-10	Mentoring clinicians using a video review on applying Motor Learning Principles to technology	*Video Review of ML Strategies* *45-60 minutes bi-weekly* for co-treating with client participants. Super-User to meet with clinic therapists bi-weekly to review video recordings of sessions for 5-10 minutes, to discuss and identify appropriate use of ML strategies during use of technology. This meeting only occurs if time is not available during or after co-treating.	Co-treating clients occurring as needed with four clinicians participating in the program. Weeks 3 & 4: This occurred with each participant for two clients per week using technology. Weeks 5-7: co-treats with one client per week using technology. Weeks 9-10: video review only to discuss ML strategies used (this should take 5-10 minutes).
10	Journal Club	Participants in program reviewed article in CAT format.	Article reviewed: McCabe J., Monkiewicz., Holcomb, J., Pundik, S., Daly, J. (2015). Comparison of robotics, functional electrical stimulation, and motor learning methods for treatment of persistent upper extremity dysfunction after stroke: a randomized controlled trial. *Archives Physical Medicine Rehabilitation.* 96, 981-990.

			Entire department was invited to participate in journal club. Summary of article shared during a monthly department meeting.
11-12	One-on-one meetings to discuss application of ML strategies	*ML Strategy Mentoring* *30-45 minutes weekly* Super-User to meet with treating clinician to discuss use of ML strategies.	No co-treats occurred during this time. The Super-User met with four clinicians as a group to discuss and problem solve.
13	Semi-structured interviews of clinic staff	*60 minutes* Semi structured interviews to obtain feedback on experience and collect information on knowledge gaps concerning use of technology for working on therapy goals.	Super-User and occupational therapy consultant met with four participants to review and determine further needs.

Appendix F: Logic Model

Program Title: Integrating neuro technology into the clinic

Inputs Resources

Program Clients
Therapists practicing in a neuro rehab clinical setting that has Advanced Technology (AT).

Program Resources Staffing:
- **Staffing**: Clinical managers, therapists using AT and therapy aids.
- **Clients**: patients participating in therapy.
- **Funding**: from the clinic for therapy salaries, not directly billable.
- **Facility**: Therapy gym with AT.

Problem Theory

Nature of the Problem
- AT companies provide initial training, but seldom ongoing support.
- Staff turnover > lack of knowledge of how to integrate AT into clinical therapy goals
- AT use for enhancing patient outcomes declines.

Program Theories:
- Adult Education theory: involving therapists in learning goals and building on their knowledge (Kaufman, 2003)
- Decomposed Theory of Planned Behavior: recognizing the influence of peers and superiors in behavior (Taylor &Todd, 1995)

Activities Outputs

Interventions and Activities
- Manual for model of AT integration.
- Educational resources on AT and neurorehabilitation
- Therapist and super user training.

Program Outputs
- # of therapists using AT
- # of therapists at site able to train other therapists on use of AT.
- # of therapists trained in the AT evaluation and treatment approach.

Outcomes

Short-Term Outcomes
- Super-users will be identified for use of different types of AT at clinical site and to train other clinicians at site.
- Surveys will be completed that measure clinician's self-efficacy in using advanced technology.
- Surveys and skilled observers will be used to measure clinical competency applying technology and to inform program development.

Intermediate Outcomes
- Increased therapists' knowledge of AT application in clinical practice.
- Increased number of therapists at clinical site who have integrated AT into usual therapy practice.

Long-Term Outcomes
- Improved therapy outcomes for patients who have received AT therapy at clinic (increased participation in ADLs and IADLS).
- Organization has cutting edge technology program to market > increased patient referrals.

External/Environmental Factors
(facility issues, economics, public health, politics, community resources, or laws and regulations):
1) No specific reimbursement codes for use of technology and therefore no added financial incentive to use. 2) Clinician turnover leads to staff unfamiliar with the program. On-going training is necessary but not reimbursed. 3) AT needs space in the clinic. 4) Technology is common outside of clinical practice, resulting in openness by therapists and patients to use technology with patient expectations for using technology high.

APPENDIX G: Evaluation Questionnaires Examples

Occupational Therapist Questions:

1. I feel confident in the set-up and use of the neuro technology within my clinic.

1 2 3 4 5 6 7 8 9 10

Strongly Disagree Neutral Strongly Agree

2. I feel confident in applying motor learning principles when using technology.

1 2 3 4 5 6 7 8 9 10

Strongly Disagree Neutral Strongly Agree

3. I have an understanding of how the research evidence promotes technology use.

1 2 3 4 5 6 7 8 9 10

Strongly Disagree Neutral Strongly Agree

Patient Questions:

1. I felt the technology my therapist was using for my occupational therapy intervention helped me meet my therapy goals.

1 2 3 4 5 6 7 8 9 10

Strongly Disagree Neutral Strongly Agree

2. I was motivated to work on my therapy goals when using the technology in the clinic.

1 2 3 4 5 6 7 8 9 10

Strongly Disagree Neutral Strongly Agree

Appendix H: Proposed Project Expenses

Cost	**Description**	**Expense – Year 1**	**Expense – Year 2**
Personnel (program implementation and evaluation)	Occupational Therapist Program Consultant – to prepare the program and plan educational in-services for other staff. Occupational Therapist Super-User – work with consultant to plan program for implementation. 10 hours. Occupational Therapist (to collect data and track technology use) – 1 hour per week for 13 weeks Occupational Therapist Super User (to provide mentoring to other therapists) – 2 hours per week for 13 weeks Occupational Therapist Program Consultant – to review and evaluate program, as well as plan for further dissemination. 10 hours. Occupational Therapist Super-User – to review and evaluate program, as well as plan for further dissemination. 15 hours.	10 hours x $50/hr. = $500 Cost of super user covered within the OT department budget. 1 hour x $50/hr. x 13= $650 Cost of super user covered within the OT department budget. 10 hours x $50/hr. = $500 Cost of super user covered within the OT department budget.	No further consultant expense, as the Super-User will take over program implementation.
Equipment	The clinical site will already own the advanced neurorehabilitation technology and the program tracking will occur on the	N/A.	N/A

	facilities tablet computers that are used for patient care. A digital camera (plus tripod) may be required, if the facility does not already have one.	$119.99 + $19.99 = **$139.98**	No additional cost in Year 2.
Supplies	Printed materials, forms and reference material in binders.	$48.00 for copies plus $5.49 for binder x6 = $320.94	$48.00 for copies plus $5.49 for binder x6 = $320.94
Materials for Dissemination	Brochures/printed materials	$0.15/brochure – approximately $75/year	$0.15/brochure – approximately $75/year
Conference (AOTA)	Travel and conference fees	$451 conference registration fee $275 x 5 days for hotel and food = $1375 $500 flight = $2326	$451 conference registration fee $275 x 5 days for hotel and food = $1375 $500 flight = $2326
Total Expenses		$1650 – staffing $535.92 – materials $2326 - Conference ***Year 1 TOTAL: $4511.92***	$0 – staffing $535.92 – materials $2326 - Conference ***Year 2 TOTAL: $2741.94***

APPENDIX I: Executive Summary

Integrating Neuro Technology into the Clinic: An Occupational Therapy Tool and Mentoring Program to Assist with the Clinical Integration of Advanced Technology

Introduction

Current occupational therapy practice does not adequately support the clinical integration of advanced neuro rehabilitation technology. The doctoral project *Integrating Neuro Technology into the Clinic* is a clinical tool designed to assist rehabilitation programs with incorporating technology into usual care for upper extremity stroke rehabilitation. The American Occupational Therapy Association (AOTA) proposed a centennial vision that stated: "we envision that occupational therapy is a powerful, widely recognized, science-driven, and evidence-based profession with a globally connected and diverse workforce meeting society's occupational needs" (AOTA, 2006, p.1). Within this vision, a relevant element is that the profession promotes "science-fostered innovation in occupational therapy practice" (AOTA, 2006, pg.2). As such, occupational therapists need to find innovative ways to better treat occupational performance issues.

One area of concern for providers of healthcare is the cost and incidence of stroke. Each year, more than 795,000 people in the United States experience a stroke and the annual cost of stroke including the cost of health care services, medication, and missed days of work is estimated at $34 billion (CDC, 2017). There is opportunity for occupational therapists to treat impairments of the upper extremity following stroke with using advanced neuro technology. Advanced technology may include robotics, functional electrical stimulation (FES), the use of sensor-based technology and virtual reality (VR) gaming (Hughes et al., 2014; Weinstein et al., 2016). Advanced neuro rehabilitation technology allows for intensive repetitive practice of motor movement and is thought to provide repeated practice based on principles of motor learning (Backus, Winchester & Tefertiller, 2010; Hughes et al., 2014; Winstein et al., 2016). Advanced neuro rehabilitation technology encourages high repetitions of intentional task-specific activities with performance feedback (Levin, Weiss & Keshner, 2015; Pollock et al., 2014).

The Problem

There is an increasing body of evidence literature reviewing the various types of technology compared to traditional stroke rehabilitation therapy practices; however, there is limited research on how to effectively implement technology into clinical practice (Krakauer, Carmichael, Corbett & Wittenberg, 2012; McCabe, Monkiewicz, Holcomb, Pundik & Daly, 2015; Backus et al., 2010; Boninger et al., 2012). Given the lack of evidence regarding best methods for implementing technology, clinical sites are left to implement the technology without clear guidance (Krakauer & Carmichael, 2017). The lack of best practices for integrating technology into the clinical setting has resulted in technology not being effectively used in clinics. Low use of advanced neuro technology can be attributed to treating therapists' low perceived self-efficacy for using technology. There are three thematic contributors to this decreased self-efficacy, which include: 1) lack of a clear process outlining how to successfully integrate neuro technology into the clinical setting; 2) barriers to integration at the therapist and environment level; and 3) therapists' lack of knowledge of clinical best practices for using technology for upper extremity rehabilitation post-stroke.

Framework and Theory to Understand the Problem

Integrating Neuro Technology into the Clinic uses two theoretical frameworks to help understand the problem of technology integration and to frame the approach to addressing a solution. The Decomposed Theory of Planned Behavior (DTPB) was used to provide a theoretical basis for outlining the problems that *Integrating Neuro Technology into the Clinic* seeks to address. According to the DTPB, a person's attitude towards using technology is related to their attitude towards the technology, the influence of peers and superiors, how well the technology fits with their clinical needs, the ease of use, conditions that facilitate the use of technology and most importantly, their perceived self-efficacy, or ability to use, the technology (Taylor & Todd, 1995). Adult Learning Theory helps shape the intervention in a way that supports adult learning. Specifically, *Integrating Neuro Technology into the Clinic* incorporates the five assumptions of Adult Learning Theory, which include that adults are: 1) self-directed and independent learners; 2) build on their own rich foundation of knowledge; 3) value learning that is readily applied to their lives; 4) are self-directed learners; and 5) are internally motivated to learn (Kaufman, 2003).

Project Overview

Integrating Neuro Technology into the Clinic is a program designed for stroke rehabilitation occupational therapy departments to assist with the clinical integration of neuro technology for arm and hand rehabilitation. *Integrating Neuro Technology into the Clinic* provides clinics with a user-friendly reference tool to help manage research evidence-based barriers to technology use. The overall goal is to increase occupational therapists' use of technology for clinically meaningful client outcomes and assist with their self-efficacy in the application of technology in their clinical practice. *Integrating Neuro Technology into the Clinic* involves two main components: a resource binder of education modules and a 13-week occupational therapist led peer support program. The program is designed to occur in an occupational therapy stroke rehabilitation setting.

The education resource material is grounded in research evidence and addresses known barriers and facilitators to technology adoption. Themes include providing resources to increase understanding of how to use technology and understand the evidence regarding clinical effectiveness, and strategies for ensuring on-going clinical competence. The resource is structured in a way that is easy to use and encourages the clinicians at the clinic to be active participants in adding resources and materials to the binder to ensure that the tool evolves and changes with the individual needs of the clinical environment. Competency evaluation frameworks are included, as well as outlines for quick referencing solutions to common technology problems.

The 13-week peer mentoring program involves an occupational therapist consult and an on-site Super-User. The Super-User will have a minimum of three-years of clinical experience in neuro rehabilitation and will be motivated to ensure the on-going use of technology. The peer-mentoring will have a combination of self-learning followed by peer support, hands-on learning and collaborative problem solving. Written materials, hands-on demonstration and use of video will be used to actively engage the clinicians in the learning process. The skills that will be emphasized will be based on known best practices for upper extremity rehabilitation post-stroke. The approximate cost of implementing the program at the first facility is $2185.92, including the cost of materials and the occupational therapist consultant.

Key Findings

Integrating Neuro Technology into the Clinic has not yet been implemented and feasibility studies have not been conducted. Advanced neuro technology provides the opportunity for intensive practice, which is aligned with clinical best practices for upper extremity rehabilitation post-stroke that state that therapy should be focused on learning or re-learning a motor skill and should include training of task-specific, challenging, goal-oriented functional tasks (Winstein, et al., 2016). Initial feasibility studies will involve determining if the program results in improved clinical adoption of technology and also information regarding how to improve the program for further dissemination. It is hypothesized that if implemented, the use of technology will increase and this project may contribute to the knowledge of best practices for the clinical integration of technology.

Conclusion

The overall goal of *Integrating Neuro Technology into the Clinic* is to increase occupational therapists' use of technology for clinically meaningful outcomes and assist with their self-efficacy in the appropriate application of technology in their clinical practice. *Integrating Neuro Technology into the Clinic* is a novel program designed to improve the clinical adoption of advanced neuro technology into usual occupational therapy intervention of the upper extremity post stroke. Implementation of *Integrating*

Neuro Technology into the Clinic has the potential for informing occupational therapy best practices for the clinical integration of advanced neuro technology.

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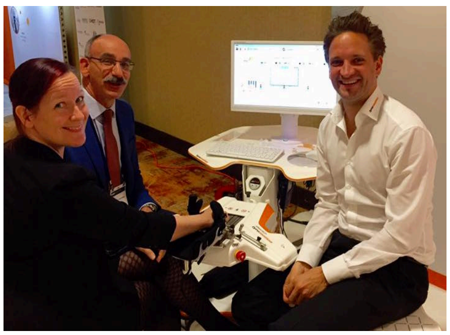
APPENDIX J: Fact Sheet

BOSTON UNIVERSITY

Integrating Neuro Technology into the Clinic: *An occupational therapy tool and mentoring program to assist with the clinical integration of advanced technology*

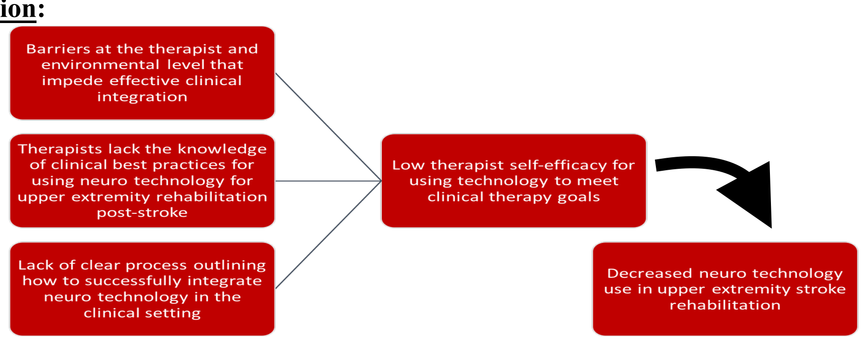


Stacey Woods, BKin, BHScOT, OTR/L, OT Reg., Ont
OTD Candidate

Background:

What is Advanced Neuro Technology? may include robotics, functional electrical stimulation (FES), the use of sensor-based technology and virtual reality (VR) gaming (Hughes et al., 2014; Winstein et al., 2016).
How does Advanced Neuro Technology Work? Technology is often based on principles of neuroplasticity and motor learning principles, meaning it offers a treatment intervention that encourages high repetitions of intentional task-specific activities with performance feedback (Levin, Weiss & Keshner, 2015; Winstein et al., 2016).

Problem description:



Purpose of *Integrating Neuro Technology into the Clinic:*

- **Encourage the use** of advanced neuro rehabilitation technology for the delivery of occupational therapy services.
- **Promote clinical integration** of technology into upper extremity rehabilitation
- Increase **OTs' perceived self-efficacy** for using technology as part of the restoration or remediation of function of upper extremity impairment in a clinically meaningful way that will assist adults in participating in their daily occupations.

The Solution - *Integrating Neuro Technology into the Clinic:*

- An evidence based **resource tool** and **mentoring support program** to assist with the clinical integration of neuro technology for upper extremity stroke rehabilitation.
- Research indicates that therapists are more likely to integrate technology when they understand the clinical effectiveness, perceived usefulness and compatibility with current practices (Backus, Winchester & Tefertiller, 2010; Cozens et al., 2013; Glegg et al., 2013.
- Grounded in theory:
    - Relevant components will be identified using the **Decomposed Theory of Planned Behavior (DTPB)**. The DTPB posits that a person's attitude towards technology adoption is influenced by the technology's perceived useful, ease of use and compatibility with their usual therapy practices (Taylor & Todd, 1995).
    - **Adult Learning Theory** (ALT) approach will be used to inform the education component of the tool. ALT is based on assumptions on how adults learn and their attitudes and motivation towards learning. This includes involving the therapists in developing learning goals and building on their knowledge (Kaufman, 2003).

Resource binder:

- Designed to evolve and change with the clinical needs and have the ability to be tailored to the unique needs of an individual clinic.
- Involves divided into easy to reference sections based on known barriers and facilitators to technology integration found in literature. The participants will complete self-study sections on technology literature review and applying motor learning strategies.

Peer mentoring:

- On-site peer mentoring with an occupational therapist consultant partnering with a facility identified Occupational Therapist Super-User.
- Hands-on learning with a problem-based and interactive learning experience.

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