HEALTHCARE PRACTITIONERS' PERSPECTIVES ON IMPROVING PEDIATRIC UPPER EXTREMITY DYSFUNCTION USING MEDITOUCH

A Thesis submitted to the faculty at Stanbridge University in partial fulfillment of the requirements for the degree of Master of Science in Occupational Therapy

by

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Dedication

To our friends and family who have supported us throughout this process and to our professors whose knowledge helped guide our work.

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Abstract

The limited use of robotic technology in healthcare, in comparison to its recent advances and individualized designs, warrants a further need to assess its feasibility, applicability, and potential in rehabilitative settings. We explore healthcare practitioners' views on using MediTouch, a robotic rehabilitation device, to enhance outcomes for pediatric patients with upper extremity dysfunctions. Pre- and post-test surveys were given to the five participants using a combination of Likert scale, multiple-choice, and open-ended questions regarding participants' perspectives before and after interaction with MediTouch. The four themes that were found included areas of repetition, functional improvements, pediatric engagement, and MediTouch features. Quantitatively, there was a significant positive correlation in responses from the participants between interactions with MediTouch and physical robotics impact in improving participation in the pediatric population, range of motion, and endurance. Our findings indicate that while practitioners see significant benefits for patient motivation, personalized treatment, and functional improvement, challenges such as cost, accessibility, and calibration remain. These insights highlight the potential of combining robotics with traditional therapy in pediatric care and suggest areas for future research and development in upper extremity dysfunction.

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Healthcare Practitioners' Perspectives on Improving Pediatric Upper Extremity Dysfunction Using MediTouch

Robotic-assisted technology has been emerging within the rehabilitative field and has shown promise in promoting functional gains for people with various disabilities. For those with mobility impairments, advanced robotic technology can assist in restoring functional skills and movement. Such assistance is provided through repetitive tasks, biofeedback, and stimulating neuroplasticity through active motor learning (Yadav, 2021). Although social robotics has been widely accepted, the integration of physical robotics can further enhance the development and functional capacity of children with disabilities. Children with physical disabilities may face limitations when performing meaningful, daily activities that consequently affect their development and well-being (Gonzalez et al., 2021). The use of robotic technology can be used to augment traditional therapies and provide practitioners with a foundation to build upon a child's functional capacity. With robotic integration in traditional therapy, practitioners can utilize robust data to further strengthen their intervention goals and target precise motor limitations such as range of motion, stability, and motor control.

Statement of Problem

While contributions to functional recovery and increased quality of life have been documented in numerous studies, the application of robotics in practice remains limited. Concerns of cost, difficulty of use, and/or noncomprehensive safety standards can cause current practitioners to refrain from integrating novel technologies within their practice (Oña et al., 2019). Additionally, many robotic devices have been geared toward adult populations and some concerns may arise due to inadequate considerations toward pediatric users (Gonzalez et al., 2021). Addressing these barriers can increase the acceptance of robotic rehabilitation and extend its utilization within current practice.

Our study seeks to understand the current level of exposure, knowledge, and experience of healthcare practitioners to determine if robotics is applicable and/or acceptable for use within pediatric populations. With advances in robotic-assisted technology, adoption of such systems in rehabilitation settings have not matched the output due to concerns of effectiveness, cost, and safety (Oña et al., 2019). Robotic-assisted therapy is relevant to occupational therapy practices because it has the potential to improve motor function and enhance practitioners' competencies in implementing robotic technology. Occupational therapists address various aspects that influence a client's occupation such as client factors, performance skills, performance patterns, and contexts (American Occupational Therapy Association, 2020). The integration of robotics will directly address the execution of occupations in that it may positively alter motor skills thus improving overall function. Robotics provides the opportunity for auditory and visual feedback resulting in adjustments in difficulty and resistance levels which function as pivotal influences in improving motor skills (Chen & Howard, 2016). The improvement of motor abilities depends on the participant's motivation and the occupational therapist's knowledge of how to appropriately utilize the technology. In addition, the American Occupational Therapy Association (2018) addresses learner characteristics and competencies as a crucial element in research for occupational therapists. Robotic interventions are an emerging practice in healthcare and to achieve proper execution practitioners must assess components such as their mastery, experience, and learning abilities to make meaningful impacts on function and occupations on clients' abilities (American Occupational Therapy Association, 2018). MediTouch is a comprehensive body control feedback training system that provides action motion feedback for multiple joints and the trunk of the body (https://www.meditouchusa.com/). The existing body of research reflects practitioners' hesitancy to integrate robotics due to a lack of comfortability and knowledge about this technology; therefore, the purpose of our research is to understand healthcare practitioners' perspectives in how they believe MediTouch can improve function in upper extremities in the pediatric population. We have chosen to focus on a wide variety of healthcare practitioners due to the increase of robotics in various healthcare settings and the direct influence they have on the potential for integration in rehabilitation. The increased opportunities for interdisciplinary interventions and co-treatments means that a shared knowledge and experience of such robotics would be significantly beneficial to the health care world. Our goal is to understand how robotics can be applied within various areas of pediatric care to support traditional rehabilitation and promote occupational engagement.

Literature Review

Argument on Social Significance

The social significance of integrating physical robotics for pediatric improvements in fine motor control creates a better outlook for children to interact within their environments. Children who present with conditions that impact upper limb function or postural control, such as cerebral palsy, will undergo a lifetime of significant challenges that compromise the ability to engage in activities of daily living (Roberts et al., 2021). Pediatric constraint-induced movement therapy (CIMT) has been recognized as a safe intervention to improve hand function in the pediatric population, but it does not produce long-term outcomes (Roberts et al., 2021, p. 151). By combining the precision and repetition of robotic devices with the structured practice of CIMT, the pediatric population can receive more comprehensive feedback and various levels of assistance. This tailored assistance targets specific areas that need improvement, such as fine motor skills necessary for writing, playing, and self-care tasks like dressing.

Improving motor function for children allows them to actively participate in their educational and social environments, while also supporting their overall independence (Roberts et al., 2021). Incorporating robotics into traditional therapy sessions can help engage children in interactive activities that target specific movements and coordination, but this population has not been explored as much with robotics. Understanding the benefits associated with implementing robotic therapy with repetitive tasks can lead to better, effective care to improve bimanual function in the pediatric population. Considering the qualitative dimensions of innovative technologies such as virtual reality (VR) and robotic-assisted therapy, research reveals the social implications for therapeutic outcomes. Online gaming facilitates opportunities for children to engage with peers who share similar diagnoses, thereby increasing relatability and willingness to participate in rehabilitation (Lam et al., 2015). Although most children experience inclusion in activities, some may encounter challenges in physical games due to restrictions from ailments such as hemiparesis or cerebral palsy. However, cultivating an online platform through rehabilitative technology allows for psychosocial improvement in children and reduces seclusion while increasing confidence (Phelan et al., 2021).

Theme #1: Repetition and Pediatric Constraint-Induced Movement Therapy

Several studies addressed the importance of repetition through robotics and Pediatric-CIMT to enhance movements in the upper extremities. This correlates to the topic of our study which focuses on the impact of robotics on the upper extremities in the pediatric population. In combination with standard occupational therapy interventions, using robotics can complement traditional therapy and continue interpersonal connections and engagement. A study by Roberts et al. (2021) focused on the impact of occupational performance and bimanual hand function using VR to engage children while using an exoskeleton and participating in Pediatric-CIMT. Frequent repetition was used to practice unilateral tasks with the assistance of shaping (Roberts et al., 2021, p. 156). In addition, Chen and Howard (2016) stated that children who participated in bimanual training or constraint-induced movement therapy while completing repetitive tasks showed an improvement in functional abilities for children with cerebral palsy. The different robotic systems used in this study, inMotion2 and NJIT-RAVR, both exhibited results demonstrating improvement in reaching kinematics.

Both articles focused on pediatric populations that were diagnosed with cerebral palsy and expressed how robotics may be more effective with severe cases. The study conducted by Roberts et al. (2021) was a cohort design, and participants ranged from 5 to 15 years old. The article written by Chen and Howard (2016) was a systematic review and included studies such as case series, single case, and randomized case design. In addition, the studies in the article contained a wider age range, which was 4 to 18 years old. Although the designs of the studies were different, they both provided evidence supporting the efficacy of robotic rehabilitation.

Theme #2: Motor Learning

Several studies have also emphasized components of motor learning and how repetitive practice in robotic-assisted therapies can be transferred to functional living skills. In relation to our research topic, analyzing the components of motor learning would guide our methodologies to include effective measures to assess motor improvements augmented by robotic-assisted therapies. Bishop et al. (2017) conducted a study to assess the effects of robotic-assisted therapy on the pediatric population with hemiparesis. This study emphasized how motor learning occurs with high-level intensity and practice. Kutner et al. (2010) examined the effects of repetitive task practice and active range of motion (ROM) achieved through robotic assistance. The study emphasized the importance of the intensity of interventions, task specificity, and making exercises challenging for the participants through spatial and temporal means. These findings show how repetitive practice can contribute to effective motor learning and functional gains.

In relation to occupational therapy, both studies advocated for the need of motor learning as a central component of rehabilitation for individuals with upper extremity (UE) impairments (Bishop, 2017; Kutner, 2010). Incorporating robotics with interventions that target motor function can help occupational therapists facilitate motor learning in a more time-efficient and precise manner.

Theme #3: Appeal of Rehabilitative Technology

Although the use of rehabilitative technology helps achieve functional outcomes, this mode of therapy is highly dependent on the users' experience. In a qualitative study that we evaluated, researchers analyzed the perspectives of parents, physiotherapists, and children with upper limb injuries to assess the appeal and effectiveness of immersive VR

(Phelan et al., 2021). The children stated that the rehabilitative exercises within the VR were more enjoyable and engaging than standard therapy. Additionally, the children's motivation increased due to the technology's ability to create challenging exercises that increased resistance/assistance levels without causing excessive pain or frustration. Parents expressed joy in seeing their children's prolonged efforts to complete the exercises. The therapists appreciated the ease in customizing appropriate difficulty levels for the children and the efficiency of examining their progress. Another study reported similar findings when examining the therapeutic use of technology in pediatric and adult focus groups (Lam et al., 2015). The adult participants also claimed that using rehabilitative technology was enjoyable due to the challenging and diverse movement-based exercises. Positive experiences were also reported by children with cerebral palsy when using a game-based robotic device for rehabilitation (Schladen et al., 2020). These studies stress the need for rehabilitative technologies to promote user engagement and be designed to enhance the user's therapeutic experience while also progressing toward functional gains.

Acknowledging these components would allow us to structure our research in a similar manner to support the psychosocial needs of the pediatric population when engaging in robotic-assisted therapy. Occupational therapy can also benefit from this knowledge, as treatment sessions should be individualized, support the needs of the client, and encourage participation to meet targeted outcomes.

Remaining Gaps

A common research gap that requires attention is the acquisition of further evidence regarding how robotic therapy can enhance the efficacy of improving UE function in children with cerebral palsy. Robotic therapy has great potential in benefiting the improvement in UE function in children with cerebral palsy, but more rigorous research is necessary (Chen & Howard, 2016). These researchers addressed that a potential mechanism for improvement in this area is to provide an environment that encourages children to consistently practice their arm movements with the implementation of a constraint-induced movement method for intensive training. This study emphasized that when CIMT was incorporated with robotic therapy, there were signs of improvement in participants' UE function. However, the researchers said that this method should be applied repeatedly to achieve consistent results of enhancement in UE function. Therefore, further research is necessary to establish the effectiveness of robotic therapy as a standalone intervention in improving UE function.

The researchers examined another gap regarding the exploration of the application of robotic therapies in pediatric hemiparetic individuals using a larger sample size, along with incorporating either home-based therapies or other therapeutic approaches targeting the entire affected limb, rather than focusing only on one segment (Bishop et al., 2017). This study mentioned that future efforts should be geared towards integrating impairment-specific and skill-based training into daily functional activities to improve carryover effects and facilitate more significant improvements in individuals with hemiparesis.

Multiple studies highlight a recurring research gap concerning the potential for increased social interaction among the participants through the utilization of VR and technology-based rehabilitation programs. The study conducted by Phelan et al. (2021) spoke about the future developments for improving the interactive aspects of head-mounted display VR to promote social engagement and decrease isolation by children who are experiencing long-term rehabilitation. The researchers noted that the head-mounted display VR can motivate children to participate in long-term rehabilitation therapy, while enhancing positive relationships in both clinical and nonclinical settings. Children have also expressed a desire for further peer interactions while engaging with therapeutic gaming technology (Lam et al., 2015). Participants mentioned their enjoyment of the multiplayer feature offered by therapeutic gaming technology. In the future, they hope to engage and play with other children facing similar disabilities. A child participant expressed that the opportunity to connect with other children facing similar challenges would be highly beneficial, particularly with someone who comprehends and empathizes with their situation.

Another consistent gap in the research pertains to the request for a home-based protocol with the aim of enhancing the time and cost efficiency of game-mediated robotics intervention. When considering this need on an individualized basis, a few challenges may arise in terms of clinic scheduling and travel time for the family or caregiver of the child participant (Schladen et al., 2020). The family or caregiver conveyed to the researchers a preference for a home-based robotic platform to minimize the time spent commuting back and forth. An additional study noted that parents recommended implementing the computer game-based rehabilitation platform as a home-based protocol to avoid additional expenses and time-consuming travel to the rehabilitation center (Kanitkar et al., 2021).

Argument on Clinical Significance

Based on studies provided by Chen and Howard (2016) and Roberts et al. (2020), there is strong evidence to support improvements in upper extremities in the pediatric population through robotics. Robotic therapy can be an effective intervention for adults in stroke recovery (Kutner et al., 2010). Although they did not produce significant results regarding the implementation of robotics, this study still highlighted the importance of bimanual activities (Bishop et al., 2017). The study suggests that incorporating interventions that evaluate the use of both hands, and not just the affected limb, would be a more accurate reflection of UE use in everyday life.

In the context of qualitative research, it is important to understand the clinical significance of employing VR and robotic-assisted therapy. These technologies address the discomforting nature of conventional therapy, which can impede patient compliance, restrict ROM, and potentially result in chronic pain (Phelan et al., 2021). An increase in ROM is a notable clinical outcome, suggesting that VR's interactive environment may facilitate motor learning and neuroplasticity. The immersive nature of VR allows pediatric patients to be more involved in a positive experience where they can fully enhance their mind-body connection (Phelan et al., 2021). More rigorous research is required to further assess long-term improvements in upper extremities in a larger population.

Overall, the literature identifies the potential benefits of robotics in rehabilitation and observational roles for clinicians but lacks the strength and structure to produce similar results across studies. From a clinician's standpoint, the use of VR and robotic-assisted technology allows for a more observational role, providing the opportunity to assess and monitor patient movements with greater precision. It offers effective strategies that adapt to each child for better engagement and therapeutic outcomes.

Theoretical Framework

When considering the use of robotics for rehabilitative purposes, applying a comprehensive framework helps to support the evaluation of independent needs and combining personal goals with functional outcomes. Robotic intervention tailored for pediatric populations must consider the child's development and be designed to accommodate different challenges, or limitations, as well as their environmental context. With this, the Person-Environment-Occupation (PEO) model can be incorporated within the rehabilitation process for children with upper limb dysfunction as it considers individual characteristics, interactions within the environment, and is aimed at promoting participation in meaningful occupations (Cole & Tufano, 2020). For children, occupations such as play, self-care, and education may be impacted by developmental challenges related to upper limb impairments. Integration of robot-assistive technology can augment motor abilities to facilitate effective engagement within their environment. Additionally, robots can adapt to individual needs by encouraging autonomous movements with guided support and control from the robot's programming while also accounting for the user's abilities (Van den Heuvel et al., 2022). These factors align with the theoretical base of the PEO model to serve as a desired outcome for robotic rehabilitation.

The PEO model prioritizes client-centered approaches that emphasize autonomy, therapeutic relationships, enabling participation, and contextual congruence (Cole & Tufano, 2020). When there is a misalignment between environmental demands and personal factors, there is a disruption in occupational participation. The "person" component of this model accounts for the physical capabilities and cognitive processes of the individual. For children with upper limb impairments, there are physical restrictions, such as strength and range of motion, that interfere with daily tasks. Robotic interventions can address motor planning and foster skill acquisition for children to apply within real-world contexts. This is achieved by the repetitive nature of robotic technology that stimulates functional movement while integrating feedback systems (Kutner et al., 2010). Additionally, robotic designs can include interactive and engaging games that promote the user's interest and commitment to interventions (Lam et al., 2015). Yet, the purpose of robotic rehabilitation should not conclude with improving motor abilities. To provide a holistic level of care, we must consider how these skills are further impacted by the child's environment. By addressing barriers and enhancing support systems within the child's life, robotic rehabilitation can enable caregivers to be more active in therapy while also providing a source of collaboration among health professionals to develop personalized, comprehensive interventions (Van den Heuvel et al., 2022). Addressing both the physical and environmental needs of the child shapes the need for robotic interventions and the inclusion of different contextual needs to achieve functional performance in all areas of living.

Another framework that is beneficial to strengthening the integration of robotics within rehabilitative settings is the Occupational Adaptation Model. This model is deemed to support the use of robotics intervention for children with upper limb impairment because of its focus on providing holistic care to tailor treatment based on a child's abilities, constraints, and goals (Cole & Tufano, 2020, p. 140). Adaptations of robotic interventions include adjusting the setting of robotics devices, modifying activities to be both stimulating and age-appropriate, and offering continuous support and encouragement when needed. The goal of these modifications is to assist the pediatric population in reintegrating into their community, allowing them to participate in social interactions, autonomously perform their activities of daily living, and enhance their overall quality of life. According to the Occupational Adaptation Model, these customizations aim to enhance a child's adaptability, subsequently increasing their functionality (Cole & Tufano, 2020, p. 139). Once a child becomes adaptive to their environment, they will desire to seek and achieve mastery in a skill. These components correspond with the Occupational Adaptation Model, establishing it as a fitting theoretical framework to support the results in robotic rehabilitation of UE impairments in the pediatric population.

The primary focus of the Occupational Adaptation Model is the interactive process between individuals and their environment, as well as the internal adaptive process that occurs during occupational engagement (Cole & Tufano, 2020, p. 140). This interaction involves how the environment influences the person's actions, behaviors, and experiences, while the internal adaptive process refers to the cognition, emotional, and behavior adjustments that individuals make within themselves as they engage in their meaningful occupations. The central concept of the Occupational Adaptation Model aims to understand and facilitate individuals' ability to adapt and participate fully in their daily lives despite challenges or limitations. It is proven that adequate stimulation of cognitive, perceptual, and motor factors is critical for improving a patient's movement recovery when utilizing robot-aided interventions (Oña et al., 2019). In other words, individuals can more readily adjust to the challenges they face during occupational engagement when these factors are considered. Another significant aspect of the Occupational Adaptation model involves recognizing the environmental contexts as essential for achieving successful outcomes when implementing robotics interventions. Due to the frequent demand of highly repetitive tasks in robotic-aided therapy, children tend to become unengaged or bored (Jouaiti & Dautenhahn, 2023, p. 2). In that case, an occupational therapist should make modifications such as increasing the level of difficulty, offering a variety of gaming programs, and integrating real-life elements that make the game more relevant to the client's daily life. Therefore, a sustained effort is required to ensure that the prototypes involved in robotics intervention are being translated into actual products that have meaningful impact on the real-world (Jouaiti & Dautenhahn, 2023, p. 11).

Methodology

Our thesis utilizes a mixed methods approach to explore the integration of robotics, specifically MediTouch, within healthcare contexts. Qualitative data was gathered through surveys to capture the perspectives of practitioners before and after interacting with MediTouch. This subjective insight will illuminate barriers, motivations, and the likelihood of adopting robotics in healthcare settings. Quantitative data was collected via Likert scale questions in pre- and post-surveys to measure the effectiveness of MediTouch implementation. We want to understand different interpretations of the applicability of robotics as a co-intervention in healthcare.

Measures

Using Likert scale and open-ended questions, we created a pre- and post-test survey to assess healthcare practitioners' perspectives before and after their engagement with MediTouch. Before participation, a consent form was provided and collected to ensure participants were comfortable with the dissemination of their responses. We then sent a survey to collect their current standing on robotics in a pediatric setting before engaging with MediTouch. The Likert scale questions had participants rate their familiarity with robotics in rehabilitation on a scale from 1-5, where 1 indicated no experience, and 5 represented extensive experience. In addition, they were asked to rate how often they engaged or were exposed to robotic technology in practice. A score of one represents little exposure and five is the most. The open-ended questions were designed to elicit a variety of responses based on individualized experiences, such as inquiring about the practitioners' opinions on the value they believed robotics brings to the rehabilitation process. The post-survey questions were created to reflect a similar design to the pre-survey.

To ensure the safe and proper execution of MediTouch, we provided a demonstration for the participants. We explained how to adjust the straps correctly and choose the appropriate sizing for the sensory controller. We further explained how the device's location is significant in receiving the exact scores of the intended joint's ROM. The robotic device contains several games that were chosen by the practitioners and influenced by their clinical judgment on what would best benefit a future client. We provided the participants with personal space while engaging with MediTouch for more freedom of movement when interacting with the games. The results of the surveys were then analyzed using Jamovi (https://www.jamovi.org/) via t-tests, ANOVAs, and post-hoc tests.

Population

The study involved a targeted population of healthcare practitioners specializing in various fields such as occupational therapy, physical therapy, nursing, and speech therapy. Our initial aim was to recruit 10-15 participants to include a diverse population of healthcare practitioners; however, due to time constraints, our sample size consisted of one occupational therapist and four physical therapists for a total of five participants. Inclusion criteria included practitioners with a foundational knowledge of robotics or related technologies such as VR or exoskeletons, a significant background in pediatric care, and a minimum of one year of experience in their respective fields. The participants' diverse backgrounds and current employment statuses were expected to enrich the study by providing varied perspectives and insights into the integration of robotics into rehabilitation practices. Their extensive experience in healthcare, particularly with pediatric patients, offered valuable perspectives on the potential benefits and challenges of incorporating robotics into therapeutic interventions. Exclusion criteria were limited, as practitioners with minimal prior exposure to robotics or unfamiliarity with its rehabilitative applications provided valuable perspectives as they engaged with the MediTouch platform, potentially offering fresh insights and new perspectives. Therefore, practitioners who lacked prior exposure to robotics were excluded, as their experiences with MediTouch contributed to the study's objectives of assessing its appeal and efficacy within the rehabilitation context.

Procedure

Our study received approval from Stanbridge University's Institutional Review Board on August 6th, 2024 to recruit participants and begin conducting our study. We approached the process of recruiting relevant participants by contacting local clinics and giving them a brief description via email about our study's purpose. We ensured that participants met the proper inclusion criteria to ensure appropriate data can be gathered to meet the study's requirements. In the email, we informed the interested practitioners about an upcoming questionnaire before initiating the study. We created a flyer containing detailed information about the study to hand out to local healthcare facilities. After sending out flyers, we demonstrated the proper safety measures to ensure that participants were knowledgeable of the procedures involved in carrying out the study. We created an online Google Form and sent pre-test surveys to gather background information from the participants. During recruitment, we informed the participants that, as part of the study, they would be requested to attend a 30-minute demonstration of MediTouch at Stanbridge University's Irvine campus. Additionally, we instructed participants on how to use robotics and had each healthcare practitioner interact with MediTouch. We guided practitioners through the technology and answered any questions. The participants were allotted time to engage with MediTouch and examine its features, functions, and purpose. Following the demonstration, participants received a follow-up survey to answer questions regarding their experience engaging with MediTouch. The goal of the study was to reduce any biased responses and remain neutral during each demonstration. We administered a post-survey after participants interacted with robotics to ensure responses were equal and comparable to pre-survey responses. We allowed participants to fill out the post-survey Google Form independently.

Data Analysis

We used a statistical software, Dedoose (https://www.dedoose.com), for qualitative data analysis. The software was used to identify themes and key concepts that emerged from participants' survey responses. To ensure our data was comprehensive, we examined each survey question and further refined our organization to determine the overarching themes while considering any variation in responses. With these themes/codes, we aimed to develop a narrative that showcased any praise or concerns regarding the use of robotic technology within pediatric rehabilitation.

The participants' demographics and responses to Likert items were computed using Jamovi, to provide quantitative analysis. Additionally, we employed a variety of t-tests and/or post-hoc tests to further enhance our findings as we explored the relationship between variables and correlating perspectives from various healthcare practitioners.

The integration of both our qualitative and quantitative findings helped facilitate efficient and extensive analysis to connect how physical robotics can enhance pediatric care and engagement in the therapy process.

Ethical and Legal Considerations

In conducting this study on integrating robotics in therapy settings, several ethical considerations have been meticulously addressed to safeguard the welfare, rights, and privacy of all participants involved. First and foremost, the practitioners' information is being maintained through a de-identification process. They are being referred to by their profession to ensure confidentiality and protect their identities. To promote discretion, we had the participants receive the demonstration and engage with MediTouch individually. The remaining participants waited in a separate room until it was their turn. Furthermore, private information concerning the participants will not be disclosed to any individuals outside the study, maintaining utmost confidentiality. We obtained approval from Stanbridge University's Institutional Review Board underscoring our commitment to adhere to ethical principles, including respect for persons, beneficence, and justice, throughout the study. To further establish transparency with the participants, we provided informed consent forms consisting of the components of the study, how it will be assessed, duration, and procedures. We provided guidance for only three out of the five participants when reading the form and the remaining two reviewed the information without our assistance. We explained the benefits of using MediTouch such as improvements in ROM and increased engagement during therapy due to the collaboration of games and intervention. We also provided our participants with information regarding the risks and alterations this would bring to the rehabilitation process. The practitioners must possess knowledge about robotics and develop an understanding of what populations would benefit from this intervention. In addition, practitioners must be competent when implementing this technology in the future and ensure patients will experience greater benefits from its usage (American Occupational Therapy Association, 2018). As participants interacted with MediTouch, they were reminded that they had autonomy to withdraw from the study if they felt uncomfortable due to the absence of human interaction. Additionally, future clients may feel a sense of detachment or lack of warmth from robots, which could affect their receptiveness to this alternative form of care. Therefore, practitioners must ensure clients are aware of possible impacts prior to participation. Healthcare practitioners must maintain safety and promote the best interests of clients; therefore, they must be properly trained to facilitate the use of this technology and execution of MediTouch. For instance, to ensure the safety and comfort of the participants, we asked on which extremity they preferred to have the 3Dtutor and hand tutor. These devices calibrate the range of motion and provide visual feedback when an individual is performing certain movements. This reduced the risk of injury and improved their interaction with MediTouch. Although the integration of robotics may further enhance rehabilitation, it is imperative to emphasize that the goal of incorporating robotics into therapy settings is not to replace or diminish the role of therapists. Instead, the objective is to facilitate collaboration between practitioners and technology, enhance therapeutic outcomes, and provide valuable assistance to therapists in their clinical practice.

Results

Quantitative Results

Tables 1.1 through 1.6 summarize the participants' demographics. There was a mixed range of ages and ethnicities. Most participants were 30-39 and 50+ years of age (n=4, 80%). In addition, Asian/Pacific Islander (n=2, 40%), Black/Latino (n=1, 20%), White (n=2, 40%). The majority of participants reported having no prior experience with robotics (n=5, 100%), and all participants had at least 6+ years of experience in healthcare (n=5, 100%). The predominant professional role among participants was physical therapist (n=4, 80%), and all participants worked in pediatrics (n=5, 100%). As presented in Table 2.2, there was a significant positive correlation between satisfaction with the overall experience of exploring the features of MediTouch and the perception that technological advancements in physical robotics enhance range of motion, endurance, and participation in the pediatric population ($r_s=1.000$, $p<.001$). However, no other significant correlations were found between the remaining variables of interest. See tables 2.1 and 2.2 for further information.

Qualitative Results

We determined four recurring themes after coding survey responses and analyzing the study findings: (1) repetition, (2) functional improvements, (3) pediatric engagement, and (4) MediTouch features (see Figure 1). We found that pediatric engagement and MediTouch features were mainly coded from our qualitative questions, which address components of MediTouch for addressing UE impairments, the effectiveness of performing intended tasks, and any limitations after interacting with MediTouch.

Pediatric Engagement

Regarding the effectiveness of engaging the pediatric population, participants noted the engaging nature of MediTouch when answering the question, *"Following the use of MediTouch, how do you think this technology can aid in improving range of motion?"* One participant responded to MediTouch's ability to engage a child in therapy: "It is definitely engaging for a preschool-aged child with good focus and cognition and can follow simple directions." This implies that MediTouch's interactive features can lead to increased engagement and improved participation in therapy. Another participant emphasized the appeal of the technology, stating, "MediTouch can provide some alternative methods for improving range of motion…Methods that kids would be drawn to…same game can be used multiple times without seeming too repetitive to the child." This suggests that MediTouch can sustain engagement and allow use of the same game with variable settings to mitigate boredom from repetition.

Effectiveness of MediTouch

The second common theme was evaluating the effectiveness of MediTouch when asked, *"*From your point of view, how effective was MediTouch in performing the intended tasks during your session?*"* One participant acknowledged that it was "Pretty effective. I like the customization that is available within most of the games, allowing the therapist to cater to a variety of needs." This highlights the importance of meeting a variety of therapeutic needs in the pediatric population. Another participant noted, "It was effective with getting ROM…. may have limitations if the child takes a longer time to respond." However, the participant pointed out some limitations of MediTouch in hopes that "it can be adjusted to the users' level to get 'the just right challenge'."

Concerns and Recommendations

Despite the positive feedback from our participants, there are concerns regarding programming and usage, which provides us with valuable insights for future improvements. The child codes related to concerns indicate that while MediTouch has potential, there is a need for ongoing adjustments and enhancements to its programming. These insights from our participants will cater to future research in understanding the purpose of integrating physical robotics into healthcare as an adjunct to traditional therapy.

Discussion

Our findings reflect the potential benefits for robotic-assisted technology within pediatric upper limb rehabilitation. As reported by the participants, the use of MediTouch can support traditional therapy by promoting repetition, range of motion, pediatric engagement, and functional improvements. These underlying themes support our research objectives as we anticipated positive perspectives on integrating robotic-assisted technology as an adjunct to current therapeutic practices. However, our findings also revealed the potential concerns of using technology in rehabilitation settings such as calibration issues, user error, and cost limitations. When considering these factors, we gained valuable knowledge on the practicality of robotic rehabilitation and the improvements that can be made to support its implementation in a pediatric setting.

One positive contribution was the potential for motor learning through repetition and addressing range of motion. Although MediTouch can address a variety of movements, our study focused on flexion and extension of the upper extremity. Participants believed that the games offered on MediTouch can adequately address these movements and enhance a child's range of motion through repetition. Many participants reported that children are more likely to repeat intended movements when they are gamified through a platform like MediTouch. Additionally, providing a "just-right challenge" was deemed imperative for ensuring that tasks promote skill development and cognitive engagement. These factors showcase the positive attributes of MediTouch as it offers modifiable game settings to decrease or increase skill demand based on individual improvements in range of motion. Additionally, interactive feedback from MediTouch allows users to monitor their performance and make necessary adjustments to support motor learning and motor control. This feature, combined with a variety of games available on MediTouch, would further enhance pediatric engagement.

When reviewing the participants' input on the games, a few notable features were mentioned that facilitated user engagement. Customizable game settings were key components as it promoted a "just-right" challenge for the participants and altered the intensity of their experience. For one participant, the need to anticipate the changing speed and location of incoming targets promoted sustained attention. This also implied an increase in motivation to complete the necessary range of motion for the game. One setting also required that participants hold a flexed or extended position which increased the challenge in completing the task. With practice and repetition, this may promote functional use of the upper extremity as users gain skills related to motor control. Other features included the dynamics and color complexity of each game that made the experience engaging and fun for the participants. Participants also emphasized that the background music created a calm and soothing environment while playing the games. These components create a multisensory experience that can enhance the overall therapy session and retain user motivation. While interest in games may vary based on each child's preferences and challenges, participants believed that all games would likely engage children, with different options suitable for different individuals.

Despite positive qualitative findings, participants expressed various challenges when using MediTouch which contributed to our low correlations within our quantitative results. Some challenges that the participants experienced were calibration errors of the MediTouch attachments which prevented them from successfully completing the game. These errors took away from the overall gaming experience as MediTouch did not accurately reflect the participants' movements even when they completed the required end-range motion. This led to concerns about children becoming frustrated or impatient while waiting for the game to respond. Another concern that arose was the potential of damaging the attachments and the cost of repair if a child were to misuse them. As participants noted, MediTouch could be a more effective rehabilitation tool if the calibration and accuracy of the attachments were improved. It was also suggested that maximum range of motion should be achieved during initial calibration. In consideration of these factors, improvements can be made to MediTouch to provide a more consistent and therapeutic gaming experience while mitigating the possibility of maladaptive behaviors within a pediatric population.

Limitations

Several limitations were present within this study. The small sample size limits the study's generalizability and may not accurately reflect the perspectives of a broader range of healthcare practitioners. Additionally, most participants were physical therapists (n=4) and potential bias may arise as their experiences and expertise differ from other healthcare professionals regarding the use of robotic-assisted therapy in pediatric UE rehabilitation. The use of convenience sampling further reduces the study's generalizability and may imply potential response biases as all participants were acquainted with at least one of us. MediTouch also performed inconsistently for each participant, with some experiencing minimal technical issues and others experiencing more, which potentially impacted the data collected. For instance, participants encountered calibration errors with the MediTouch attachments which impacted their performance in the games and overall experience with MediTouch. Additionally, for both pre- and post-survey questions, many participants did not elaborate on their responses which made it challenging to identify comprehensive themes and extract a deeper understanding of their perspectives. Thus, the low correlations from our data analysis may have been due to the several brief and limited responses to our survey questions.

For future research, additional measures should be taken to increase the external validity by allowing more time for recruitment, using random sampling, and expanding the sample to include a wider range of healthcare practitioners. To increase reliability, more time should be dedicated to ensuring MediTouch performs consistently, and technical issues should be resolved prior to participation. Member checking may also be beneficial in enhancing the credibility of future qualitative findings. Since our study had to accommodate limited responses, member checking can help ensure that the themes derived from the results can more accurately reflect the participants' perspectives. Future studies may also want to consider recruiting pediatric participants to gain direct feedback on the compliance and interest level of the targeted population.

Implications for Occupational Therapy

After conducting our study, we found that our results and discussions reinforce the theoretical frameworks of the Occupational Adaptation model and the PEO model. The OA model encourages adapting or tailoring a treatment based on a child's abilities, limitations, and goals (Cole & Tufano, 2020, p. 140). The participants noted that the customizable game settings facilitated user engagement by establishing an optimal level of challenge. Providing the option to adjust the game settings is intended to enhance a child's adaptability, thereby improving their overall functionality (Cole & Tufano, 2020, p. 139). In relation to the PEO model, qualitative findings indicated that MediTouch can enhance a child's range of motion through repetition, increase engagement within the rehabilitation process, and promote skill acquisition. These areas are supportive of the PEO model as it establishes a path to holistic care by addressing individual needs and desires, environmental barriers, and enabling occupation (Cole & Tufano, 2020, p. 167).

After seeing the participants in action with MediTouch, there could be multiple ways to use this system in improving occupational therapy practices. For one, the interactive nature of MediTouch can facilitate pediatric engagement while targeting functional use of the UE such as through reaching and grasping tasks. To achieve motor learning, repetition-based exercises can be enhanced through games personalized to the user and reduce the potential of boredom in traditional rehabilitation. Most children struggle to engage and participate in therapy without motivation or a defined goal (Jouaiti & Dautenhahn, 2023, p. 11) As an adjunct tool, MediTouch can enhance holistic approaches to therapy by addressing individual needs and goals while adapting the therapeutic experience through gaming and environmental modifications. MediTouch also offers a records system that can allow practitioners to track progress and functional improvements over the course of therapy. By applying the skills and motor control gained from robotic rehabilitation, occupational therapists can target meaningful occupations that require use of the UE and facilitate effective participation for a pediatric population.

Conclusion

Past research has identified the benefits of robotics in combination with traditional therapy. When utilizing robotics, researchers must consider how technology can be used to engage participants, guide repetitive tasks, and promote feedback to facilitate motor learning. In addition to functional outcomes, implementing rehabilitative technologies to complement traditional exercises is dependent on the users' experience. Several studies highlighted the importance of engaging users in fun, yet challenging game-based motor exercises (Lam et al., 2015; Phelan et al., 2021; Schladen et al., 2020).

These components contribute to the appeal of using rehabilitative technologies as standard therapy was deemed less enticing.

Despite existing research gaps concerning integrating robotics into conventional therapy for UE impairments, we believe the pediatric demographic will benefit from a synergistic approach that includes CIMT, robotic therapy, and repetitive task training. Furthermore, providing children with opportunities to engage in game-based exercises would increase their compliance and motivation to engage in therapy (Jouaiti & Dautenhahn, 2023). This becomes achievable by designing robotic technology to provide customized challenges and creating an immersive experience that would be enjoyable for a pediatric population. The adaptive nature of robotic intervention can integrate children with UE impairments into society, enabling them to participate in daily activities and social interactions with improved motor function.

Given the evidence discussed in our study, further research must be assessed to formulate a broader understanding of robotics in healthcare. While our study faced limitations due to a smaller participant pool and a short data collection period, the information we collected still offers valuable insights into how interactions with MediTouch can influence perceptions of robotics' effectiveness in rehabilitation. Based on the results of our study, robotics are positively viewed as an adjunct tool, highlighting its beneficial impact on future care in upper extremity dysfunction in pediatrics. The use of robotics in conjunction with traditional therapy assists therapists in executing appropriate and beneficial activates to improve overall function (Oña et al., 2019). However, further improvements in the accuracy and calibration of MediTouch must be addressed to ensure precise results.

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Participant Characteristics

Table 1.1

Age

How old are you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	30-39 years old	2	40.0	40.0	40.0
	40-49 years old	1	20.0	20.0	60.0
	50+ years old	2	40.0	40.0	100.0
	Total	5	100.0	100.0	

Table 1.2

Ethnicity

What is your ethnicity?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Asian or Pacific Islander	2	40.0	40.0	40.0
	Black/Latino	1	20.0	20.0	60.0
	White	2	40.0	40.0	100.0
	Total	5	100.0	100.0	

Table 1.3

Experience with Robotics

How much experience do you have with robotics in a healthcare setting?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - No experience	3	60.0	60.0	60.0
	2 - Limited experience	2	40.0	40.0	100.0
	Total	5	100.0	100.0	

Table 1.4

Years of Practice

How many years have you been a healthcare practitioner?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10+	3	60.0	60.0	60.0
	6-10	2	40.0	40.0	100.0
	Total	5	100.0	100.0	

Table 1.5

Profession

What is your current occupation? (e.g. occupational therapist, physical therapist, nurse, etc.)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Occupational Therapist	1	20.0	20.0	20.0
	Physical Therapist	4	80.0	80.0	100.0
	Total	5	100.0	100.0	

Table 1.6

Specialized Setting

What population do you specialize in? (e.g. pediatrics, geriatrics, adults, other)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Pediatrics	5	100.0	100.0	100.0

Correlations

Table 2

Correlations between Variables of Interest

Items	Spearman's rho	p	95% Confidence Intervals (2-tailed)	
			Lower	Upper
How effective do you think physical robotics are in the rehabilitation process? - The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.	-0.408	0.495	-0.953	0.759
How effective do you think physical robotics are in the rehabilitation process? - How comfortable did you feel while using MediTouch during the session?	0.408	0.495	-0.759	0.953
How effective do you think physical robotics are in the rehabilitation process? - After engaging with MediTouch, how effective do you think physical robotics are in the rehabilitation process?	0.761	0.135	-0.404	0.984
How effective do you think physical robotics are in the rehabilitation process? - How interested are you in continuing to use physical robotics for rehabilitaiton?	0.167	0.789	-0.851	0.921
How effective do you think physical robotics are in the rehabilitation process? - How satisfied were you with the overall experience of exploring the features of MediTouch?	-0.167	0.789	-0.921	0.851
How effective do you think physical robotics are in the rehabilitation process? - The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.	-0.167	0.789	-0.921	0.851
The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population. - How comfortable did you feel while using MediTouch during the session?	0.250	0.685	-0.825	0.933
The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population. - After engaging with MediTouch, how effective do you think physical robotics are in the rehabilitation process?	-0.559	0.327	-0.968	0.661
The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population. - How interested are you in continuing to use physical robotics for rehabilitaiton?	-0.408	0.495	-0.953	0.759
The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population. - How satisfied were you with the overall experience of exploring the features of MediTouch?	0.408	0.495	-0.759	0.953
The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population. - The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.	0.408	0.495	-0.759	0.953

Items	Spearman's rho	p	95% Confidence Intervals (2-tailed)	
			Lower	Upper
How comfortable did you feel while using MediTouch during the session? - After engaging with MediTouch, how effective do you think physical robotics are in the rehabilitation process?	-0.186	0.764	-0.924	0.845
How comfortable did you feel while using MediTouch during the session? - How interested are you in continuing to use physical robotics for rehabilitaiton?	-0.612	0.272	-0.973	0.613
How comfortable did you feel while using MediTouch during the session? - How satisfied were you with the overall experience of exploring the features of MediTouch?	-0.408	0.495	-0.953	0.759
How comfortable did you feel while using MediTouch during the session? - The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.	-0.408	0.495	-0.953	0.759
After engaging with MediTouch, how effective do you think physical robotics are in the rehabilitation process? - How interested are you in continuing to use physical robotics for rehabilitaiton?	0.761	0.135	-0.404	0.984
After engaging with MediTouch, how effective do you think physical robotics are in the rehabilitation process? - How satisfied were you with the overall experience of exploring the features of MediTouch?	0.304	0.619	-0.805	0.940
After engaging with MediTouch, how effective do you think physical robotics are in the rehabilitation process? - The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.	0.304	0.619	-0.805	0.940
How interested are you in continuing to use physical robotics for rehabilitaiton? - How satisfied were you with the overall experience of exploring the features of MediTouch?	0.667	0.219	-0.553	0.977
How interested are you in continuing to use physical robotics for rehabilitaiton? - The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.	0.667	0.219	-0.553	0.977
How satisfied were you with the overall experience of exploring the features of MediTouch? - The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.	1.000	<.001		

Figure 1

Coding Themes Derived From Dedoose

Media \ Codes	Functional Improvements	MediTouch Features	Concerns for Programming	Pediatric Engagement	Concerns Related to Usage	Repetition	Totals
P1, Post Q-1	1						1
P1, Post Q-2		1	1				2
P1, Post Q-3	1			1			2
P1, Post Q-5		1					1
P1, Post Q-7		1	1				2
P1, Post Q-8	1	1	1				3
P1, Pre Q-13				1			1
P1, Pre Q-7				1			1
P2, Post Q-1				2			2
P2, Post Q-2		2	2				4
P2, Post Q-3		1		1		1	3
P2, Post Q-5		1	1				2

P2, Post Q-7		1	1	1	1		4
P2, Post Q-8		1					1
P2, Pre Q-13		2					2
P2, Pre Q-7		1		1			2
P3, Post Q-1	1						1
P3, Post Q-2		1	1				2
P3, Post Q-3				1	1		2
P3, Post Q-5		1	1				2
P3, Post Q-7		1	1				2
P3, Post Q-8		1					1
P3, Pre Q-13						1	1
P3, Pre Q-13						1	1
P4, Post Q-1				1			1
P4, Post Q-2		1	1				2
P4, Post Q-3	1						1
P4, Post Q-5		2	2				4
P4, Post Q-7		1	1				2
P4, Post Q-8		1					1

P3, Pre Q-13						1	1
P4, Post Q-1				1			1
P4, Post Q-2		1	1				2
P4, Post Q-3	1						1
P4, Post Q-5		2	2				4
P4, Post Q-7		1	1				2
P4, Post Q-8		1					1
P4, Pre Q-13	1						1
P4, Pre Q-7		1					1
P5, Post Q-1	1						1
P5, Post Q-2		1	1				2
P5, Post Q-3	1						1
P5, Post Q-5		2	2				4
P5, Post Q-7		1	1	1	1		4
P5, Post Q-8		1					1
P5, Pre Q-13		1		1			2
P5, Pre Q-7	1						1
Totals	9	29	18	12	3	3	

Appendix A

Institutional Review Board Approval

Dear Dr. Eddie Chu and Students,

The Stanbridge University Institutional Review Board has completed the review of your application entitled "Healthcare professionals' perspectives on improving upper extremity dysfunction of the pediatric population through the use of MediTouch." Your application (#05MSOT013) is approved and categorized as Expedited.

IRB Application Number	#05MSOT013
Date	08/06/2024
Level of Review	**Expedited**
Application Approved	X
Conditional Approval	
Disapproved	
Comments	The requested Minor changes have been reviewed and confirmed as completed by the IRB. (08/06/2024)
Signature of IRB Chair	

Please note that any anticipated changes to this approved protocol requires submission of an IRB Modification application with IRB approval confirmed prior to their implementation.

Sincerely,
Julie Grace, M.S., M.A.
IRB Chair

Appendix B

Site Approval Forms

Research Site Agreement Form
Stanbridge University

AGREEMENT

Research Site: Stanbridge University

Research Site Address: All 3 locations: Irvine, Alhambra, Riverside

Title of Proposed Research: Healthcare professionals' perspectives on improving upper extremity dysfunction of

RESEARCH STUDY INFORMATION

Student Investigator(s) Name(s):

1. Vanessa Huynh
2. Annette Rendon
3. Katherine Tran
4. Mari Wada

Principle Student Investigator Name: Annette Rendon

Email address: annette.rendon@my.stanbridge.edu Phone Number: 1-(562)-371-4431

Duration of the study: 5 months (June 20, 2024 to November 20, 2024)

Authorization Effective Date: ______ Authorization Expiration Date: ______

Allowed Number of Contact Hours: ______ The study will be completed by (date): November 20, 2024

Description of Research:

With advances in robotic-assisted technology, implementation of such technology in rehabilitation settings have not matched the output due to concerns of effectiveness, feasibility, and limited experiences of robotic use in direct services. However, past research has provided evidence regarding the benefits of integrating robotics to improve the motor function of the pediatric population. By gathering healthcare professionals' perspectives, we can advocate for the contributions of robotic technology and encourage an increase in use to facilitate functional outcomes for the pediatric population.

STANBRIDGE UNIVERSITY AGREEMENT SIGNATURES

I/We accept the terms of this agreement.

Student Investigator 1: Vanessa Huynh Title: Occupational Therapy Student

Signature Date: June 5, 2024

Student Investigator 2: Annette Rendon Title: Occupational Therapy Student

Signature Date: June 5, 2024

Student Investigator 3: Katherine Tran Title: Occupational Therapy Student

Signature Date: June 5, 2024

Student Investigator 3: Mari Wada Title: Occupational Therapy Student

Signature Date: June 5, 2024

Faculty Thesis Advisor: Dr. Eddie Chu Title: OTD, OTR/L

Signature Date: June 5, 2024

Program Director: Dr. Myka Persson Title:

Signature Date: 6/6/24

Dr. Kelly Hamilton
Vice President of Instruction, Stanbridge University

Kelly Hamilton
Digitally signed by Kelly Hamilton
DN: cn=Kelly Hamilton, o=Stanbridge University, ou=Vice President of Instruction, email=khamilton@stanbridge.edu, c=US
Date: 2024.06.06 13:52:33 -07'00'

Signature Date

Appendix C

Consent Form

Appendix C – Consent Form

Consent to Participate in Research
Stanbridge University Institutional Review Board

Title of study: Healthcare professionals' perspectives on improving upper extremity dysfunction of the pediatric population through the use of Medi-touch

PARTICIPANT'S RIGHTS

You are invited to take part in a research study conducted by graduate students in the MSOT program at Stanbridge University. Your participation is voluntary. You may choose not to participate at any stage of the study. You may choose not to answer specific questions or undergo procedures that may make you feel uncomfortable without penalty or repercussions. Your identity will be kept confidential and it is important we emphasize participation is strictly voluntary.

WHAT IS THE PURPOSE OF THIS STUDY?

We are current occupational therapy graduate students at Stanbridge University, Irvine. Our study seeks to expand the current research on robotic technology by contributing healthcare practitioners' perspectives on robotic rehabilitation for the pediatric population. MediTouch is a robotic-assistive device that will be utilized in this study. This device can be used within the rehabilitation process to promote functional gains for individuals with mobility impairments. Participants will have the opportunity to use three different attachments of MediTouch (i.e. 3DTutor, HandTutor, and ArmTutor) and interact with different gaming features of the device to better understand its purpose in supporting arm and hand movements.

WHAT ARE THE BENEFITS INVOLVED IF I CHOOSE TO PARTICIPATE IN THIS STUDY?

There will be no physical benefits to the participants. However, exposure to Medi-Touch may benefit you through gaining a deeper knowledge of robotic technology and its potential use in practice. You can benefit from this study as your perspectives can contribute to the potential implementation of MediTouch for improving upper extremity impairments among the pediatric population, as well as overall improvements in research for the healthcare field.

WHAT ARE THE RISKS INVOLVED IF I PARTICIPATE IN THIS STUDY?

During the study, you will be provided with a demonstration of how to use MediTouch. However, there may be physical risks due to discomfort if you incorrectly use the physical robotics. Additionally,

STANBRIDGE UNIVERSITY

Appendix C – Consent Form

participants may be exposed to psychological risks. You will be questioned about your viewpoints on robotics in healthcare and it may become an additional stressor if you perceive this technological advancement as a threat to your career. To minimize this possibility, researchers will emphasize that MediTouch would act as an addition to traditional forms of therapy rather than replacing practitioners. Furthermore, the study may pose social risks as it might impact participants' commitments to social engagements scheduled for the day of the study. If interested, researchers will address this issue by providing you with the study date in advance and reiterating that you are not obligated to participate if you have prior engagements or cannot attend. You have the right to withdraw from the study at any time.

WHAT DOES THIS STUDY INVOLVE? (TIME COMMITMENT, THE DURATION OF STUDY)

You will be asked to travel to Stanbridge University, Irvine to spend about 1 hr and 15 mins to 1 hr and 45 mins in the robotics lab. The following outline of your participation will be completed in one session:

Pre-survey (15-30 minutes)

Researcher Demonstration (15 minutes)

MediTouch Trial (30 minutes)

Post-survey (15-30 minutes)

WITHDRAWAL FROM THE STUDY

You may choose to stop participating in this study at any time. It will not affect the confidentiality of your identity and autonomy to freely remove yourself from the study.

COMPENSATION FOR PARTICIPATION

No compensation will be provided to participants.

CONFIDENTIALITY

We will obtain informed consent to protect your confidentiality and privacy and ensure all collected data is stored using data protection standards. Strict confidentiality agreements and ethical guidelines will restrict access to the data, shared only in the form of de-identified datasets, via Google Drive. The researchers will use pseudonyms instead of the participant's names and remove identifiers. Records will remain active for three years if another group wants to continue our research. Student researchers, faculty advisors, and Stanbridge Occupational Therapy faculty will have access to the study. However, the student researchers will permanently delete the records after this designated time frame.

WHO SHOULD YOU CALL WITH QUESTIONS OR CONCERNS ABOUT THIS STUDY?

Appendix D

Survey Questions

Pre-Test

Q1) How many years have you been a healthcare practitioner?

- 1-3 years
- 4-5 years
- 6-10 years
- 10+ years

Q2) What is your ethnicity?

- American Indian or Alaskan Native
- Asian or Pacific Islander
- Black
- White
- Hispanic or Latino
- Other: ___

Q3) What is your current occupation? (e.g. occupational therapist, physical therapist, nurse, etc.)

Q4) What population do you specialize in? (e.g. pediatrics, geriatrics, adults, other)

Q5) How old are you?

- Under 21 years old
- 21-29 years old
- 30-39 years old
- 40-49 years old
- 50+ years old

Q6) How much experience do you have with robotics in a healthcare setting?

- 1 – No experience
- 2 – Limited experience
- 3 – Neutral
- 4 – Moderate experience
- 5 – Extensive experience

Q7) Based on experience, when do you think physical robotics is most beneficial for improving impairments?

Q8) How do you view physical robotics' role in healthcare?

Q9) How likely are you to integrate robotics into your intervention program?

- 1 – Not at all
- 2 – Somewhat unlikely
- 3 – Neutral
- 4 – Somewhat likely
- 5 – Very likely

Q10) How effective do you think physical robotics are in the rehabilitation process?

- 1 – Not effective
- 2 – Slightly effective
- 3 – Moderately effective
- 4 – Very effective
- 5 – Extremely effective

Q11) Physical robotics are easily accessible.

- 1 – Strongly disagree
- 2 – Somewhat disagree
- 3 – Neutral
- 4 – Somewhat agree
- 5 – Strongly agree

Q12) The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.

- 1 – Strongly disagree
- 2 – Somewhat disagree
- 3 – Neutral
- 4 – Somewhat agree
- 5 – Strongly agree

Q13) What aspects of physical robotics do you believe greatly benefits a child?

Post-Test

Q1) After engaging with the MediTouch device, what aspects did you find the most helpful or beneficial in addressing upper extremity impairments among the pediatric population?

Q2) Were there any issues or difficulties you encountered while using MediTouch? If so, please elaborate.

Q3) Following the use of MediTouch, how do you think this technology can aid in improving range of motion?

Q4) What specific games on MediTouch did you feel would be most engaging for children and why?

Q5) What were your likes and dislikes towards the games featured on MediTouch?

Q6) How comfortable did you feel while using MediTouch during this session?

- 1 – Very comfortable
- 2 – Uncomfortable
- 3 – Neutral
- 4 – Comfortable
- 5 – Very comfortable

Q7) What limitations did you observe after interacting with MediTouch?

Q8) From your point of view, how effective was MediTouch in performing the intended tasks during your session?

Q9) After engaging with MediTouch, how effective do you think physical robotics are in the rehabilitation process?

- 1 – Not effective
- 2 – Slightly effective
- 3 – Moderately effective
- 4 – Very effective
- 5 – Extremely effective

Q10) The technological advancements of physical robotics increase the range of motion, endurance, and participation in the pediatric population.

- 1 – Strongly disagree

- 2 – Somewhat disagree
- 3 – Neutral
- 4 – Somewhat agree
- 5 – Strongly agree

Q11) How interested are you in continuing to use physical robotics for rehabilitation?

- 1 – Not interested
- 2 – Slightly interested
- 3 – Moderately interested
- 4 – Very interested
- 5 – Extremely interested

Q12) How satisfied were you with the overall experience of exploring the features of MediTouch?

- 1 – Very dissatisfied
- 2 – Dissatisfied
- 3 – Neither satisfied nor dissatisfied
- 4 – Satisfied
- 5 – Very satisfied