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Inclusive Design Intervention during COVID-19: Reflective mirror therapy rehabilitation

Zakiyah Hasan [1], Verly Veto Vermol [1], Nor Faridah Ahmad Roslan [2], Ahmad Zamir Che Daud [3]

[1] College of Creative Arts, Universiti Teknologi MARA Shah Alam, 40450 Shah Alam, Selangor Malaysia, [2] Faculty of Medicine, Universiti Teknologi MARA, 47000 Sungai Buloh, Malaysia, [3] Faculty of Health Sciences, Universiti Teknologi MARA, 42300 Puncak Alam, Malaysia

zakiyahasan@uitm.edu.my, verly@uitm.edu.my, nfarz@uitm.edu.my, zamir5853@uitm.edu.my
Tel:+6013-314 0107

Abstract
The emergence of coronavirus disease (COVID-19) has posed significant challenges in occupational therapy rehabilitation practice prior to the level of contact with patients. This paper discussed the inclusive design process and intervention procedure in developing a design of home-setting rehabilitation products, self-occupational therapy practice, and the challenges involved in the ongoing care of patients by occupational therapists, caregivers, and patients during this pandemic. The case study of Personal Reflective Mirror Therapy (P-REMIT) is premeditated as a pilot study tool, designed, and developed through patients' experience (user-centered) for Diplegia (Upper Limb Stroke) patients.

Keywords: Inclusive; Design; Intervention; COVID-19; Clinical; Therapy; Procedure

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1.0 Introduction

COVID-19 has significantly challenged the health care system and had a profound impact, particularly on the rehabilitation sector. A more inclusive and agile healthcare system is needed to sustainably integrate rehabilitation as an essential element from rehab-based solutions to home-setting practice. The demand for new and innovative, personalized medical devices, tools, or assistive aid increases each year, focusing on user-centered treatment experience and self-practice infusion. The emerging need for specifically designed products has led to rapid development and well-established benefits for patients with specific rehabilitation treatments. Inclusive design models are explored in the development of medical devices to oversee the design's effectiveness and practicality under a series of continuous evaluations and assessments to improvise for betterment or opt for a medical and clinical norm and potentially fit for home-setting application. The concept of Personalized Health Care or Personalized Medicine was well documented (Lisa M. Meckley, Peter J. Neumann, et al., 2010). It was first considered a novel strategy to tailor medical treatment to each patient's characteristics. Even effective rehabilitation treatment interventions for patients with diplegia and their caregivers require specific implementation efforts, especially in utility design innovation for the procedure. A preliminary study showed that the highly effective clinical-set and rehab-based occupational therapy program was not implemented optimally due to restricted movement control during the COVID-19 pandemic and various barriers. In order to make this program more effective, inclusive design intervention needs to be developed to facilitate the ease of rehab services to be delivered under

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a self-practice solution. A broad range of disciplines within the academic literature incorporate inclusive design, design evaluation, and design intervention discussions, providing different perspectives of design process and development within the medical context.

Medical environments involve a complex interaction between regulations, a highly diverse user base, a multitude of established, essential procedures, and a vast body of underlying science (J.L. Martin, B.J. Norris, E. Murphy, 2008). Designing for medical context is challenging and often requires co-create process and collaboration between medical, design and engineering domains. Adding to this challenge, engineering design teams are typically not composed of medical domain experts and, therefore, often lack detailed knowledge of potential users or use environments (C. Vincent, A. Blandford, 2011). Inclusive design is a significant model to be considered to give a deep understanding of intervention design and propose solutions based on specific users, accommodating diverse contexts, environments, and individuals' activities, especially related to healthcare services. Research on design intervention draws attention to explicitly introducing new findings and poses more open-ended research instruments to expose behavior, norms, and standards than as a resolution of the problem (or risen issues). Several scholars researched how designers, expert users, and patients make sense of their experience for design betterment. They are also exploring ways in which constructions of newly developed design might influence their needs to improvise design criteria, ergonomics, and enhanced features and personalized values to a product and service integration. However, design intervention often challenges the conventional outcome of design evaluation and development, aesthetic or visual comfort, and performances.

1.1 Inclusive Design Intervention in Rehabilitation

Understanding and gaining deep empathy through user research is essential in delivering options and optimizing solutions, especially when designing for healthcare and disability populations. Inclusive design models' integration in the design process can significantly impact individuals (patients), businesses, and society. It encourages patients to perform treatment or rehabilitation procedures independently. It ensures that disabled people adapt well in any situation to self-practice therapy, particularly for those with reduced mobility and specific needs. Patient-specific preference and treatments and inclusive design solutions have recently been one of the most emerging research topics. Human-centered design is the central aspect of ergonomics; therefore, it needs to be considered when designing and developing specific medical products critically observed during the design intervention phase (Vermol et al., 2017). Restraint of such innovation, utility and products provided in OT clinics, hospitals, healthcare, and treatment centers will lead to patients' limitations in proper rehabilitation assistance. There is an emerging need to investigate design standards, methodologies, and technologies for robust, efficient, and effective product intervention guidelines for medical applications. This research explores the contextual framework of inclusive design intervention in designing and evaluating the post-medical and rehabilitation treatment procedure during the COVID-19 pandemic.

Figure 1: Contextual model of Inclusive Design (IDRC, OCAD University)

Figure 2: Inclusive Design Model Adoption for Pandemic Context

In medical and health care, product design and development significantly optimized treatment and diagnosis, considering human factors, ergonomics, and practicality required to meet both technical and clinical standards. Design evaluation has often been a practice in the practicality assessment, and experience-based co-designing for medical products has been a significant debate among researchers. Donetto et al. (2015) reported difficulties of experience-based co-design process between designers, hospital staff, and patients, mainly caused by power relationships between citizens and public services, supported by Goodrich (2018) concerning the collaborative design process stated that experience-based co-design improves the design experience. The relationship of contextual norms of inclusive design to bridge the accessibility in rehabilitation innovation has led this research to adopt an intervention framework. The common understanding of the design intervention model will allow more significant treatment planning, application areas, accuracy issues, and collaborative design within multi-disciplinary scope.

Design intervention has been seen as a materially innovative method that is explicitly oriented towards exploring the contemporary new understandings as a next level towards the feasible solution to fit the inclusive design context. However, greater attention to the design intervention and protocol analysis is extended as a vital mechanism to evaluate the design efficacy throughout the treatment procedure. Moreover, the advantage of the design intervention mechanism will give a significant channel for future collaborative design and mass-customization needed to develop the optimal design and inclusive design systems of medical-related products.

1.2 Design Intervention in Reflective Mirror Therapy

Assistive product design and recovery modules are vital in comprehensive occupational therapy during patients' rehabilitation period. Those specialized products function as external devices or aid designed, fabricated, or adapted to assist a patient in performing a particular task in their therapy and recovery session. In this study, intervention in design for a reflective mirror therapy procedure has been conducted to assess the inclusive model needed for product performance and accessibility of the healthcare service. Reflective Mirror Therapy is a protocol where a mirror is used for effective visual feedback to improve hand range of motion (movement) and function (coordination) to improve motor function, motor impairment, visuospatial neglect and help design effective therapeutic interventions. Mirror therapy is based on a visual simulation where a mirror is placed in the person's midsagittal plane, thus reflecting the non-paretic side as if it were the affected side (Ramachandran, 1995). One of the advantages of mirror therapy is the relatively easy administration and the possibility of self-administered hoe therapy, even for people with severe motor deficits (Thieme H et al. 2012). In a rehab center, the availability of those aids to facilitate the treatment is limited and often does not meet the patients' specific preferences, especially for personalized medical design cater to perform specific treatment modules. The lack of a human-centered approach in evaluating product design has also been challenging due to user engagement in emotion with less empathy throughout the clinical protocol. Therefore, this study will further understand the issues faced by the designers, users, and medical experts in the design process and intervention exploration of specialized occupational therapy procedures for a clinical environment through an inclusive design model.

2.0 Reflective Mirror Therapy and Treatment

2.1 Mirror Therapy in Rehabilitation

Strokes are one of the leading causes of disability globally, particularly in high and middle-income countries (Murray, 2013). According to the Journal of Physical Therapy Science, about 85% of stroke survivors will suffer from hemiplegia, and at least 69% will experience a loss of function in the upper limbs. According to Hoffman (2019), mirror box therapy has become widely accepted, restoring motor function following a stroke. However, very few local hospitals and rehab centers opt for this treatment. The pragmatic innovation of mirror therapy

lies in simplicity, and the only physical components of the treatment are the tool (reflective mirror aid), the patient (user), and a reflection. This therapy have the fundamentals of neuroplasticity and neuron mirroring simulation. The Journals of Physical Therapy Science stated, "Visual illusions make the patients feel as if their two hands are moving simultaneously and symmetrically. The visual illusions are activated in the cerebral hemisphere, and this activation functions as the basis of a neurological mechanism for inducing brain plasticity". In rehabilitation for stroke cases, the brain can adapt after trauma experience, meaning the patient can reorganize by inducing neural regeneration. Besides the spatial attention deficits, neglect is a negative factor for functional recovery (Farnè 2004; Katz 1999) and was associated with a reduced health-related quality of life (Franceschini 2010).

2.2 Clinical Procedure and Post-Medical Treatment

Mirror therapy is defined as an intervention that uses a mirror to create a reflection of the non-paretic upper or lower limb, thus giving the person visual feedback of normal movement of the paretic limb (Thieme H et al. 2012). In most rehab centers of occupational therapy. Reflective mirror therapy exercises are designed to simulate neuron mirroring to activate neurons in the affected area of the brain. This process also eventually increases the accuracy, agility, as well as velocity of impaired limbs. An assistive measure will assign the patient to begin a structured mirror therapy regimen or procedure during the post-medical treatment. A mirror therapy protocol will first describe by a medical expert and then guide the patient in a series of mirror therapy exercises under designated modules. These exercises have been shown to help individuals with motor deficiencies regain dexterity and strength. These exercises are designed to eventually be self-guided in the stroke survivors' home and facilitate continued progress. According to Giraldo et al., 2018. different variations in the experimental protocol are possible by using the setup of mirror therapy. Moreover, in the study conducted by Thieme (2012), the intervention is extended with a combination of mirror therapy and other therapies in the experimental condition, in which a minimum of 50% from the experimental intervention time was applied as for mirror therapy.

2.3 The Product Design Process and Intervention Design Consideration

In the medical product design process (PDP), intervention is needed to explore better areas of user-experience and human-centered, not to test a prefigured solution to a defined problem, but to enable new forms of experience, dialogue, and awareness about the problem to emerge (Hales and Boffi, 2010). An intervention is seen as a combination of program elements or strategies designed to produce behavior changes or improve health status among individuals or an entire population. Generic application of interventions may be implemented in different settings, including communities, worksites, health care organizations, or in the home (Vermol et al., 2017).. Interventions implemented in multiple settings and using various strategies may be the most effective because of the potential to reach a larger number of people in various ways. In contrast, intervention in design refers to a form of inquiry that is particularly relevant for investigating phenomena that are not very coherent, barely possible, almost unthinkable, and totally underspecified because they are still in the process of being conceptually and physically articulated (Hales and Boffi, 2010). The medical design process has also been looked at in terms of the underlying methodology. Studies have outlined the device development process in the US (Ginsburg, 2005) and Europe (Medina, 2013). Still, these are representations of the process and only describe the steps involved in medical device design. This does not necessarily extend to a method of how to overcome design challenges best. Other researchers have focused on the design process from a strategic, methods-centric, and decision-making perspective.

Moreover, the importance of understanding the standard practice is towards design reasoning, where this process involves cognitive activity that dictates how users or patients respond to situations in every aspect of their lives. Design activity relies on the reasoning processes of designers. Therefore, understanding the role of reasoning and experiences in design is critical to understanding how design occurs in a medical context. The implication of this research introduces the fundamental nature of user and experience evaluation in the design process and its critical knowledge that will result from the protocol experiments conducted to influence the direction of product design development toward user-designers cognitive in collaborative-thinking inclusive design dimensions.

2.4 Adaptation of Inclusive Design

Disability through impairment can refer to those at a disadvantage through a lack of resources, support, and assistance. That users can be 'disabled' through poor design highlights the idea that users are often stifled by a restrictive, rather than de-restrictive, environment that surrounds them (Fisk, 1993). These integrate inclusive factors on how those elements will determine the intervention needed for specific or diverse patient preferences in rehabilitation practice. The three dimensions of inclusive design are 1- recognized diversity and uniqueness, 2- inclusive process and tools, and 3- Broader beneficial impact. In a pilot study made in this research, improvisation in diverse solutions is not sustainable economically and technically. Optimal inclusive design is studied and adopted through universal one-size-fit-one intervention for the prototypes (tools/aids). The diversity of patients and users always includes individuals' experiences and behavior correlated with the design intended. In this consideration, the dimension does not denigrate the skills of professional designers but calls for those skills to become more accessible and for the design process to become more inclusive of diverse designers and consumers (IDRC, 2021). Thus, for any solution or design proposed to be used in rehab practice, the impact needs to be considered beyond the design's intended beneficiary. The inclusive design infuses the designer's responsibility to be aware of the context for broader impact in terms of social innovation, society empowerment, sustainable well-being, and equal economic innovation for communities.

2.5 Invention Tools and Prototyping

Medical innovation increases knowledge and transforms existing processes and business models to serve better-changing needs and expectations, particularly in healthcare services. It implies new alternatives to prevent, diagnose, and monitor health problems and new devices to manage and treat patients' disabilities. In post-medical treatment such as occupational therapy, the invention of tools means

creating equipment, device, product, or aid kit to facilitate the diagnosis, monitoring, and treatment procedure of particular medical conditions. Moreover, new technologies help in making remote healthcare possible in where new models of diagnosis are applied and treatments are made personalized. In healthcare, the need to define innovation concerning health technologies assumes that recognizing and appropriately rewarding innovation will foster present and future innovativeness in the system (Aronson et al., 2012). The ultimate aim of any medication is to improve the well-being of patients through diagnosis, treatment and/or medication (Ciurana, 2014). A concept or idea usually arises from a need that requires collected information and analysis from medical experts, users, and therapists based on market-driven and specific customer-driven needs. There are many design methodologies as valuable tools for developing new products or improving them. These methodologies potentially assist the designer in the inventive process, either as a resource for creativity and requirements or to develop practical solutions to recurrent problems. Nevertheless, in some medical fields, in which engineering intervention helps develop and innovate, this set of possibilities is known (Gupta, S. and Vajic, M., 2000).

2.6 Procedure and Challenges of Designing for Medical Products

According to Gelijns (2002), the development of incremental innovations in clinical procedures usually occurs in a much more decentralized fashion, involving numerous physicians refining and modifying an existing procedure in everyday clinical practice. In contrast to medical device innovation, which requires the bridging of "collaborative cultures" (that of designers, engineers, and clinical researchers), the distinction between "developers" and "evaluators/users" may be very fine or even non-existent in the development of clinical procedures. The design process, product, and usage evaluation often been inducted by the technical requirement and lack of human-centered considerations. To date, the potential safety, efficacy, and effectiveness of many procedures have not been evaluated systematically during their development. (Kievit, W et al. 2017).

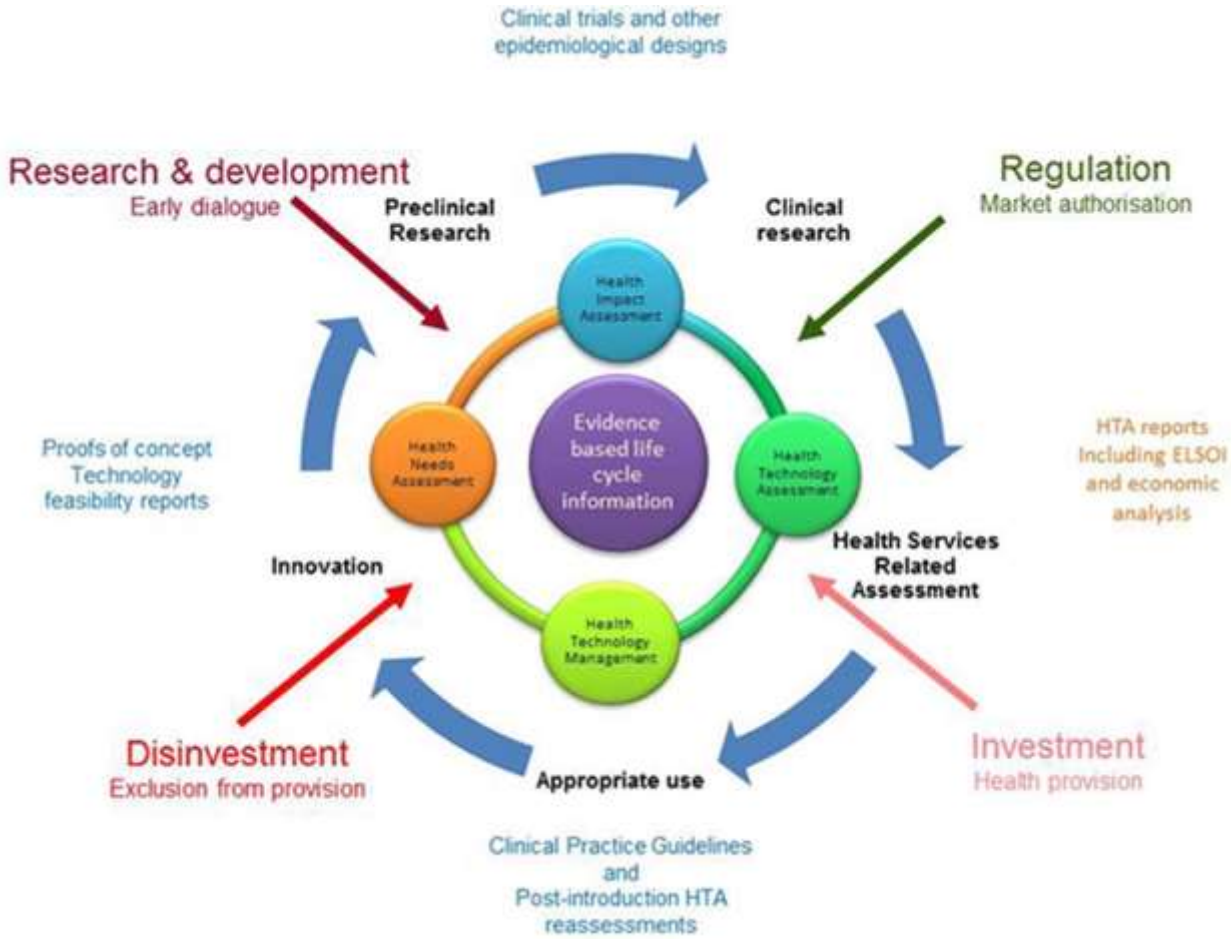

Figure 3: The life cycle of health technologies concept. ELSOI (Ethical, Legal, Social and Organizational Issues)

3.0 Inclusive Design Study Methods

This study was conducted in a rehabilitation center in a local hospital and rehab center. A need for assistive aid products in treating upper-limb stroke patients for the recovery phase has led to a newly developed design focus on the specific therapy module established to assess the treatment's effectiveness. During research time within the design development and prototype testing, great design intervention discoveries are substantially experienced from a unique perspective. These insights subsequently caused a flurry of concern from medical experts, users, patients, and caregivers. The feedback and response from the clinical and product testing demonstrated some deficiencies in human factors, environment, behavior, norms, or routine to support the treatment procedure and ongoing assessment. An examination and observation data showed that the effectiveness of the treatment, related activity, and product usage would also depend on measured and non-measured variables such as levels of comfort, trust, motivation, calibrating stage, procedural staging, and treatment setting.

This study will fill the growing gap between the conventional design evaluation and design intervention for post-medical treatment and rehabilitation practices in both clinical and non-clinical settings within the inclusive design model. It aims to assess the importance of integrating design intervention in protocol analysis before domesticating a new design evaluation mechanism of personalized product design development for specific post-medical treatment and rehab (therapy) purposes. This study is necessary to observe the most practical evaluation mechanism for designing intervention procedures in the local postoperative care and rehabilitation industry before considering a comprehensive evaluation model for a more complex medical-related practice. Therefore, this study will further understand the issues faced by the designers, users, and medical experts in the design process of specialized occupational therapy procedures for a clinical environment. Therefore, for this study, the following research objectives are addressed:

Three essential constructive design processes in this study:

- To review the product design process development within inclusive design consideration for post-medical treatment and rehabilitation in clinical and non-clinical settings.
- To reveal and describe the design intervention mechanism within the experiences of design tolerance, human factors, and collaborative thinking for optimization in treatment results within measured and non-measured variables.
- To construct a generic design intervention model as an inclusive design mechanism to assess the practical design process in post-medical treatment and rehabilitation.

The importance of this study corresponds with the obligation to provide better access to quality treatment and therapy services through a holistic solution of inclusive design and in the design process or development of medical devices to be accessible by the broader users and communities effectively. The innovation of medical-related design is greatly influenced by the patients, the care providers, the physicians, the payers, the policymakers, and the producers who significantly influence real-world healthcare decision-making towards market approval.

3.1 Methods, Design and Developing

Sharples et al. (2012) approached product development by considering human factors, control and transportation, in which design research is developed for medical devices to be utilized and implemented for the highly efficient use required from the users. The schematic design process is carried out following methods or methodologies to assure practical product results by addressing all requirements and needs of the user (patients and caregivers) or customer/client (medical experts/therapist). In design development, inclusive design has been outlined as a standard parameter to consider the user-procedure-environment context. It is an understanding of design synergizing between the device design and the resultant behavioral impact; a new design is always evaluated with design specification (Gupta, S. and Vajic, M.,2000). Within the efficacy of healthcare services during the COVID-19 pandemic, this research was conducted to assess the product design process development within inclusive design consideration for post-medical treatment and rehabilitation in clinical and non-clinical settings. A pilot and case study has been associated with exploring and discovering design intervention mechanisms within the experiences of human factors, inclusive dimension, design concepts and collaborative thinking for treatment results within measured and non-measured variables. A series of prototype developments has been generated as a mediator or assistive device to facilitate the research procedure and how inclusive design correlates to design intervention for the current mirror therapy practice to be ready or accessible for home self-practice. A further constructive generic design intervention model will be generated as an inclusive design mechanism to review the practical design process in post-medical treatment and rehabilitation.

This research aims to suit a qualitative method approach, to examine i) the product usage responses (among user experts and patients), ii) the design evaluation practice and understanding (among designers and expert users), and iii) to pursue deep insights from three significant groups of i) patients, ii) expert users – doctors, medical assistance, nurses, therapist, or caregivers, and iii) designers about the design aspects, human factors, and product feasibility. The parameter set is based on an inclusive design model within the COVID-19 context and challenges. Exploration of these objectives requires an approach that describes associations between variables and users' experiences and engagement of other participants during the design evaluation and assessment. The overall research design is strategized through i) observational to explore on user's experiences and interaction of product design (prototypes), usage, and accessing the services for post-treatment, with further investigation using ii) verbal protocol analysis VPA to ask on designer's input on design evaluation and possible design intervention on selected product/prototype. This approach reveals how results affecting the evaluation of a product design and services are insufficient to justify the need for proper design improvement and, more importantly, involving the designer's constructed notion of design intervention within inclusive design dimensions. This research is conducted within these four empirical phases of explanatory research design strategy (see methodology. Fig 4: Explanatory Research Design Activity)

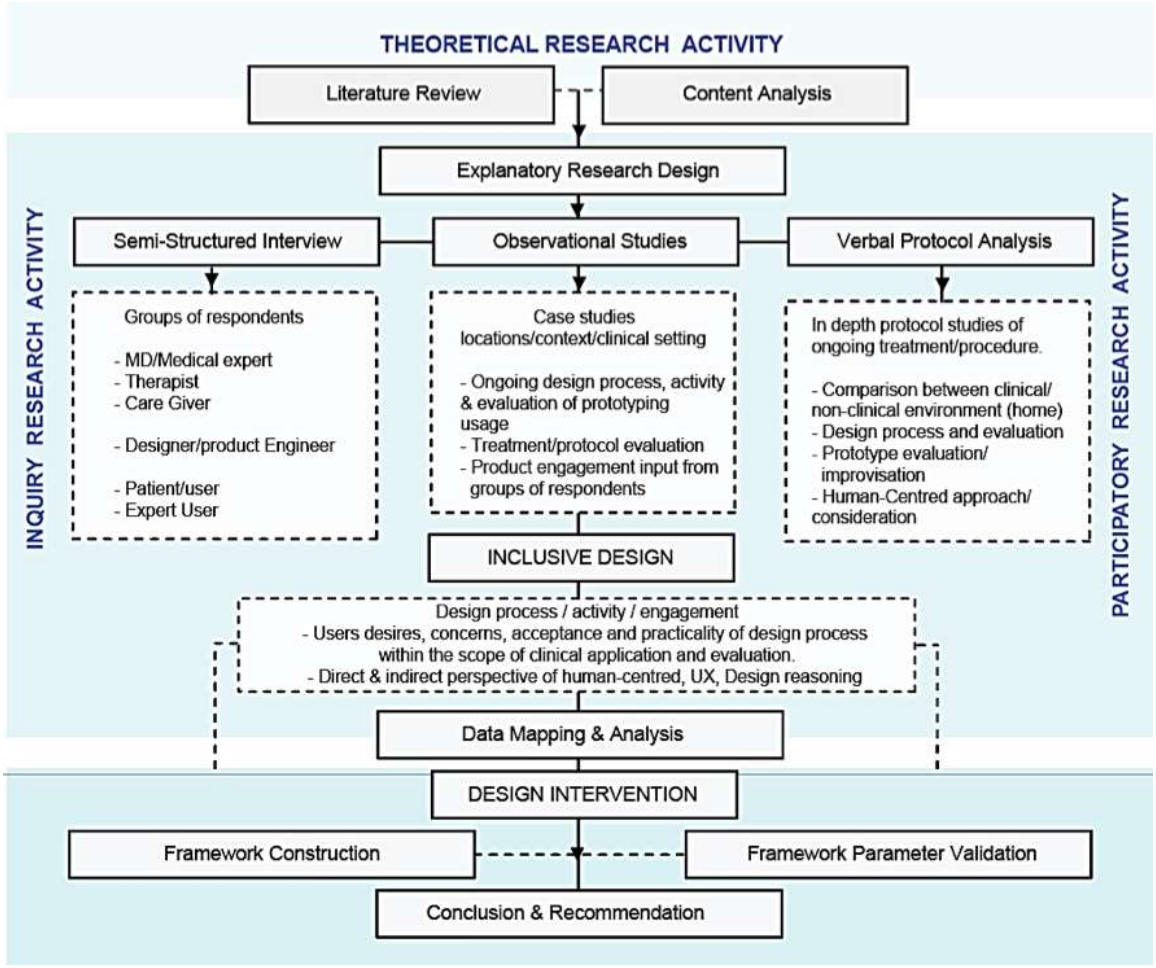

Figure 5: Explanatory Research Design Activity

This study was introduced and co-created by the Department of Rehabilitation Medicine, Faculty of Medicine UiTM. Several subjects were enrolled and attending the rehab lab to be part of the program. Participants were brief on the evaluation and consent from the study. Observational studies and verbal protocol analysis were analyzed and synthesized by a trained research assistant based on standard definitions designed for the interventional framework. Participants were given the initial trial with a prototype level in a clinical set environment. Participants were guided by the therapist and research assistant to use the prototype and practice the reflective mirror therapy module according to specific parameters and calibration procedures. Once the subjects had completed the program, they were interviewed using a verbal protocol analysis (semi-structured) format to determine their reflective experience of the treatment, product performance, interaction, and ergonomics. In addition, a post-test was administered to re-assess the inclusive design measure and feedback from participants' experiences throughout the therapy procedures. The number of participants will increase as this testing progress further within ongoing development.

3.2 Significant of Intervention Design Study for Rehabilitation

Standard designing methods of developing a product for occupational therapy in rehabilitation procedures may be complex for many designers, engineers, and medical experts in common practice. This case study was designed to examine the development of a novel prototype for reflective mirror therapy procedure, describing a hypothetical design intervention for the treatment during the COVID-19 pandemic. Users, medical experts, and designers were relatively involved in examining the necessity of critical inclusive design consideration of clinical and home-setting product usage for rehab treatment. Subjects then reviewed the design-practicality-adaption of an innovative assistive tool performing as a medium trial to facilitate the treatment procedure. The understanding of key concepts from the evaluation was again tested along with the interpretation of the product-activity-performance. The involved subjects also completed the verbal protocol study to examine their perceptions and satisfaction with the rehabilitation exercise.

3.3 Reflective Mirror Therapy Aid as an Innovative Tool

The Reflective Mirror Therapy Aid is designed as a support product to treat a patient's disability, particularly in the hands (Diplegia) for complex regional pain syndrome, phantom limb pain, stroke, and focal dystonia). It is used for both clinical and in-home tools during the rehabilitation process. This product also supports common issues like arthritis in the thumb and carpal tunnel syndrome. The product works as a tool that hides one limb from view while providing a reflective image (mirroring) of the healthy limb for the patient to see. A

mirror is used for effective visual feedback to improve hand range of motion (movement) and function (coordination). The design comes with three (3) integrated parts. 1- compact foldable box with attachable mirror, 2- accessories container, and 3- the 'X' center supporter (refer to design illustration/drawing attached). The overall concept of collapsible and portable design outcome suits the nature of the ongoing treatment procedure to allow patients to continuously perform the rehabilitation exercise at home (mobility purpose). This product comes with lightweight materials, and this product uses safe and durable, sustainable, and hygienic materials such as synthetic PU leather and PET plastic, mainly used in clinical equipment. The product can be assembled with high stability 90 degrees set up to optimize usage and viewing comfort. The accessory container is also attached to the product to incorporate all parts required in the therapy exercise in one compact solution.

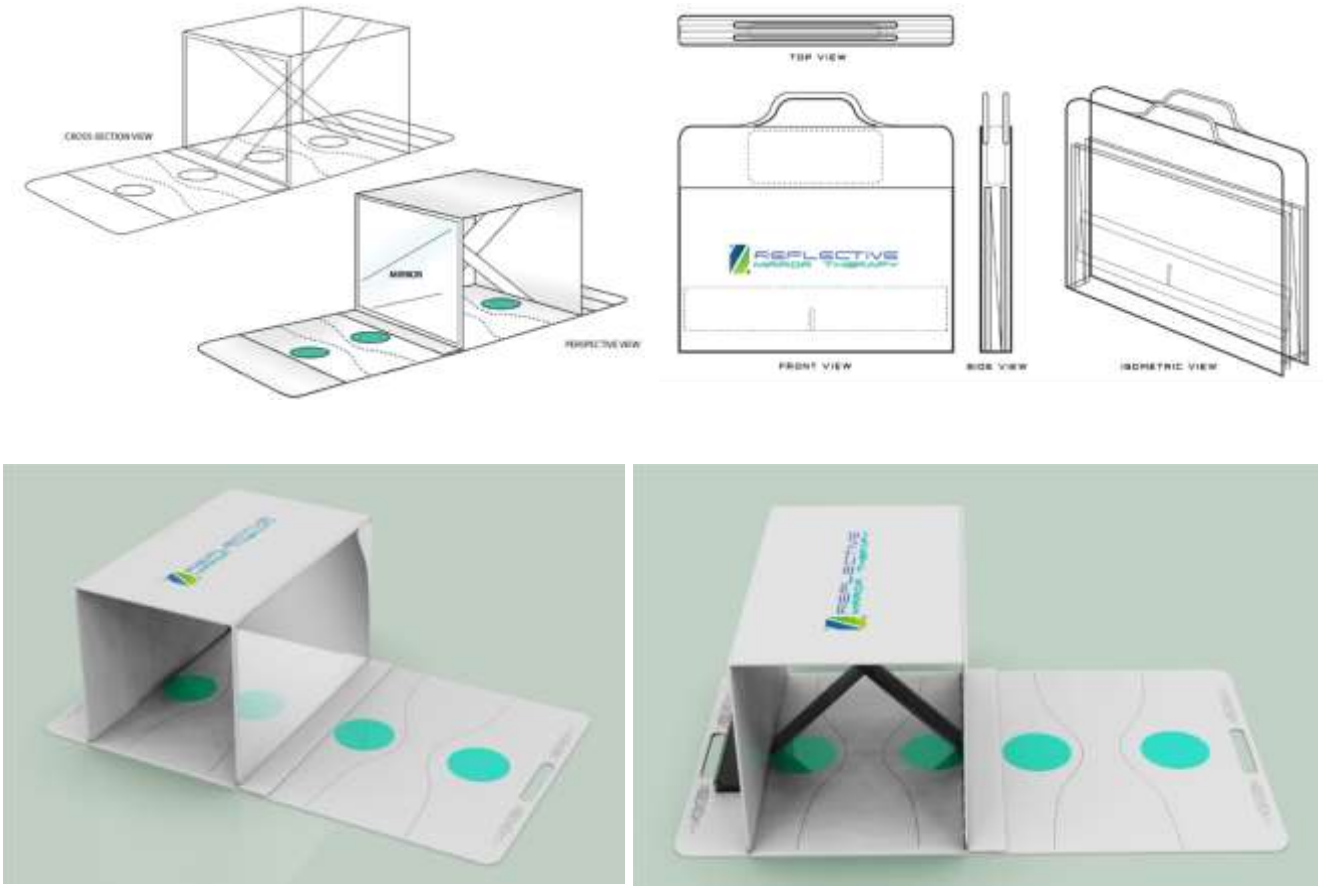

Figure 5: P-REMIT prototype/ tool (level 2) development, designed and tested for the reflective mirror therapy procedure

3.4 Product and Procedure Evaluation

Before evaluation, the comprehensive modules were tested and reviewed by medical experts and occupational therapist specialists for accuracy of modules and flow and prototype usability to suit the treatment procedure. Several iterations were performed before the release of the final prototype used in the study. The patient practiced and performed the treatment using a level 2 prototype to exercise and simulate the motor-imagery activity under rehab specialist monitoring and guidance. A clinical trial has been set for this pilot to evaluate the acceptability and usability of the prototype program, bearing in mind that testing of future versions would require knowledge of a comprehensive trial. Despite this, there is strong evidence confirming the ability of simulated studies to predict and pre-determine patient behavior and interaction during rehabilitation exercise accurately. The design version of the level 1 prototype incorporated only a center mirror with the specialist explaining the fundamental concepts of a clinical trial directly to the user (patient and caregiver). In obtaining a comprehensive evaluation of inclusive design for intervention during the COVID-19 pandemic restriction for this treatment, a level 2 prototype (second version) has been built and tested. The improvised version of the prototype contained more practical design features, details, components, and integrated accessories provided as a complete aid/kit to be used for self-practice at home. Both versions performed the same function and purpose. In both versions, the user was required to interact with the product, exercise, and calibrate by practicing six stages of different modules to obtain feedback about the trial, and review their response to the tool and procedure. Finally, an extended review module summarized all the information and feedback presented and tested user understanding of the effectiveness from two different contexts: clinical environment and home-setting environment.

Figure 6: Research procedure - Participatory Design & Product Testing

4.0 Findings

Due to its adaptability to be used and mobile for self-practice at home, the outcome reviewed significant innovative direction for the rehabilitation services during COVID-19 constraint. The result suggests that appropriate design and evaluation methodologies are significant in providing a more flexible alternative for design tools of a given data set, feedback, and requirements outlined by the patients, which allow for more inclusive design measures. Simulation of prototype testing helps in the final product decision as they are more comprehensive for designers who often are not familiar with the clinical protocol environment. The experiment also results in tremendous intervention needs, particularly in the interaction between user, designer, and expert's perception going across inclusive design parameters mediated through the context of human-centered and design performances. It would be possible to complement all elements pertaining to the methods, tools, and simulations with a prototype made by considering user-centered and lean technology. Based on the pilot test, prototypes need to be fit in form and function, but they need to be well-designed with the mechanical requirement that is close to market-driven.

Moreover, the importance of understanding the standard design and evaluation practice in a clinical context is towards design interpretation. This process involves cognitive activity that dictates how users, patients, medical experts, and designers respond to situations in every aspect of design and development processes. Design activity also relies on the broader reasoning processes within inclusive design dimensions. Therefore, understanding the role of reasoning and experiences in design is critical to understanding how design can intervene in a medical context. Further improvement should come with an inclusive design understanding of different points of view from the standard design or medical practice.

Findings suggested from this study reflects four essential impact critically dominant within the inclusive design activity; i) the effectiveness of the procedure, ii) clinical setting and facilities, iii) products, tools and utility used and iv) psychological impact. The summary is outlined in the table (1.0) below.

	TREATMENT/ THERAPY PROCEDURE	SETTING AND FACILITIES	PRODUCT/TOOLS/ UTILITIES	PSYCHOLOGICAL IMPACT/ INSIGHTS
REACTION	**Effective therapy** for patients is critical in mirror therapy rehabilitation.	**Manual** instruction on product usage, function, and sequence of treatment is required.	A **straightforward** product concept is more practical for a **specific-task solution**.	Patients tend to demonstrate **emotional change** when the performance does not achieve their expectations.
LEARNING	A patient/caregiver needs to be briefed and good in assisting the activity at home with an **actual rehabilitation product**.	The **surrounding** in the treatment room will have an impact on the **patient's emotions and engagement**	Product solutions, features, and functionality need to cater to **specific treatments.**	Patients need to be **extra focused** when doing their treatment, with **calibrating phase.**
BEHAVIOUR	All the therapy needs to be **guided by the experts** in OT so the significance of **product engagement** is established.	The room arrangement contributes to the **effective stimulation effect.**	The **demand for ergonomic** products is high for both **home-based and rehabilitation centers.**	A patient shows great feedback upon completing their task with **continuous support. Motivation** will drive to pro-long participation.

Table 1.0: Dominant impact from Inclusive Design Activity of Reflective Mirror Therapy Product Testing.

5.0 Discussion

Given that this was a pilot study and that the number of subjects limited researchers due to restricted movement control during the COVID-19 pandemic, there was insufficient power to conduct statistical analysis and extensive prototype testing activity beyond the simple frequency distributions. These results and responses from the study, albeit preliminary, suggest that inclusive design aspects hold promise as an unconventional model for improved and intervened design development process in clinical standards. Among the users, the majority appreciated the purpose, protocol, and alternatives, respectively, in product-procedure engagement during the therapy under both clinical and home-setting usage. Result and synthesized discoveries from this pilot study suggest that the inclusive design consent used in this study were well explored, considered, and appeared to facilitate both the designing and intervention process in a rehabilitation context. Patients, relatively, appreciated the flexibility and alternative of performing self-practice reflective mirror therapy at their respective homes under guidance from their caregivers. In summary, inclusive design appears to offer a novel, unconventional and effective way of providing the essential requirement for design intervention regarding the dimensions involved in the rehabilitation practice and participation in clinical trials. Further refinement of these programs incorporating input from the stakeholders in this study appears to be an appropriate 'revolutionary step' in designing medical devices and this potentially promising approach to optimizing the intervention steps for design and agile healthcare services.

6.0 Conclusion & Recommendations

This study shows how collaboration in design activity, prototyping, and evaluation for occupational therapy treatment will be vital in future research development. Strengthening the integration and co-creation forces will lead to design intervention of newly improved products and services to make healthcare accessible, especially in those highly customized products for human restitution and rehabilitation. The focus is based on three main parameters i) design and evaluation process, ii) inclusive dimension, and iii) design intervention framework. For each parameter, some prototypes were revised and more importantly, a medical device application during the COVID-19 case study was illustrated. The feedback and review support good direction for further improvisation in clinical and non-clinical settings where the important measure of the contextual inclusive design model was highlighted. Data revealed that there was a minimal exploration of

prototypes and manufacturing. Therefore, the future trend suggests research on medical devices for the actual application. In the imminent future, technical requirements, materials, processes, and regulations will focus more on design accuracy and service sophistication. The extended possibility will foster an inclusive strategy toward marketable design and a safe, secure, and reliable prototype for home-based therapy. Innovation and new product development in the medical device industry have been mainly technology-driven in the last decades but always solve clinical needs with a state-to-art approach. Design and prototypes need to be converted into real marketable products in which advancements have often been rapid and significant. Nonetheless, today's product development occurs in a complex healthcare environment, with multiple stakeholders involved. It has reached high standards; consequently, the innovative treatment generally supports an acceptable return to individuals' daily routine or activities and improves the quality of life.

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