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Understanding the Implementation of Telerehabilitation at Pre-Implementation Stage: A Systematic Literature Review

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Abstract

Despite the increased interest of academic scholar in telerehabilitation implementation, there is a scarcity of studies that provide an up to date comprehensive research on it. This study provides a systematic literature review (SLR) on telerehabilitation implementation research. This review explores the processes involved in telerehabilitation implementation, research themes and the factors that influence the implementation of telerehabilitation at pre-implementation stage. In doing this, all relevant articles in the electronic databases of Scopus, ScienceDirect, PubMed, SAGE and Web of Science that published from 2007 to 2017 were reviewed. The results show that four themes have been paid attention by the researchers' including adoption, benefits, readiness and decision making. The factors in the adoption and readiness were found more dominant than others with seven and six factors respectively. Most of the factors from adoption were in the quality aspects (e.g., system quality, information quality and service quality) while change elements (e.g., attributes of the change, attributes of the change targets) in the readiness. Thus, this study suggests that more research is needed for understanding this complex process of telerehabilitation at pre-implementation in a more holistic manner.

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1. Introduction

Telerehabilitation refers to the use information technologies (IT) to provide distant support, assessment and information to people who have physical and/or cognitive impairments [1]. Implementing telerehabilitation is an effective solution for rehabilitation services delivery in improving the patient lifestyle [2]. However, it is reported less implementation of this application in developing country compared to the developed country. One of the reasons may cause by the high-cost factor [3-5]. There are several success stories of the implementation of telerehabilitation in the developed countries for delivering rehabilitation services. In Canada, for instance, the goal of telerehabilitation is to increase geography accessibility and quality of care for older adult [6]. While in Finland, the significant of using telerehabilitation seem to improve economic barriers through reducing traveling's cost and time [2]. These show that rehabilitation practitioners are turning to telerehabilitation as a way of improving access, enhancing the quality of care and reducing the costs. At the same time, this scenario begs a question on how the practitioners in the developed countries implement the telerehabilitation?

Few studies have also discussed that successful implementation of telerehabilitation depends heavily on the expertise (e.g., project managers) in managing its implementation projects [7-8]. This includes in managing pre-implementation activities, activities during the implementation and post-implementation in the process of implementation telerehabilitation [8]. For telerehabilitation centers, handling post-implementation stage is the most stresses than pre-implementation [9]. Ignoring pre-implementation stage, however leads to various problems during the project's implementation and consequently on the outcome. This is because the outcomes which depend on a series of activities are both interconnected from one to another [9]. Therefore, this review focusses on the understanding on telerehabilitation at pre-implementation stage.

Due to the implementation of telerehabilitation is an emerging field of study with limited evidence, the information systems (IS) community and practitioners' need to understand this phenomenon in-depth. Furthermore, there has been no effort to systematically review and synthesis such studies in the literature. In view of this, this study uses a systematic literature review (SLR) approach to explore the telerehabilitation studies at the pre-implementation stage. It systematically collects, analyses and synthesizes all the current studies on telerehabilitation implementation and also provides the state of research in this domain. To achieve this, we propose few research questions as follows:

RQ1: What are the research themes that are addresses in telerehabilitation at pre-implementation stage?

RQ2: What are the factors that influence the implementation of telerehabilitation at pre-implementation stage?

The reminder of this study is organized as follow: Section 2 reports the related studies, Section 3 provides an overview of the study methodology, Section 4 discusses the results and Section 5 concludes the study with remarks.

2. Related studies

Telerehabilitation implementation research has only been studied within the past 20 years. As it is still within the early stage, there is no agreement on the definition of telerehabilitation. Generally, telerehabilitation is defined as the practice of effective communication and information technologies solution to deliver clinical rehabilitation services [4]. The types of telerehabilitation that can be delivered are broad and include IS such as home telehealth, telemedicine and telerobotics [10-11]. Among clinical disciplines that beneficial from the implementation of telerehabilitation are occupational and physical therapy, speech language pathology and cardiac and vocational rehabilitation. The aim of telerehabilitation is to transfer and use the new technologies [2] in order to help those patient with barriers of accessing rehabilitation centers [12]. Telerehabilitation patients include those with stroke, brain or spinal cord injuries, and amputation.

At the initial implementation of telerehabilitation projects (i.e., from 1900s to 1940s), the rehabilitation's clinicians generally use technologies of telephone, radio/telegraph and closed-circuit television to connect with the patients [10]. Then, the improvement occurs in 1960 with the combination of television, satellite and visual pre-recorded video to deliver video conference with patients [10]. The telerehabilitation implementation project then becomes more sophisticated in 2000s with the discovered of the Internet. It is expected that through the improvement of the Internet with high-speed wireless will increase the usability and effectiveness of telerehabilitation implementation towards stroke patients [2].

2.1. Phases of telerehabilitation implementation research

As telerehabilitation has the capacity to collect data, store, process data into information and disseminate that information to several stakeholders (e.g., physicians, therapists, nurses and patients), the technology itself can be considered IS in its own right. The most general categorization for any IS/IT implementation research is normally focused within the three phases of implementation process which are pre-implementation, during-implementation and post-implementation [9] [13]. For telerehabilitation, it is found that pre-implementation studies (i.e., with 28 articles) are more dominant compared with the other two phases (see Table 1). However, only few studies in this area tackle issues from the developing countries [14] [15]. The low number of publications from the developing country may be because of less awareness towards the benefits of telerehabilitation implication in real life. Hence, this motivates this study to focus at pre-implementation phase by identifying more on the themes and factors influencing telerehabilitation activities.

Table 1. The number of articles based to the phases.

Phase	Number of articles	Reference
Pre-implementation	28	2,6,7,8,10,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36
During-implementation	2	3,37
Post-Implementation	13	4,38,39,40,41,42,43,44,45,46,47,48,49

3. Methods

To answer the above questions, this study uses Al-Kharusi et al. [50] guidelines on systematic review process which consists of four-phases: documents identification (Phase 1), documents preparation (Phase 2), coding (Phase 3) and write-up (Phase 4). In the Phase 1, the potential relevant documents and articles are searched based on selected keywords such as “telerehabilitation”, “tele-rehabilitation”, “telerehabilitation implementation” and “tele-rehabilitation implementation” using the electronic databases such as Scopus, ScienceDirect, PubMed, SAGE journals and Web of Science. Moreover, the articles are filtered by inclusion and exclusion criteria. Inclusion criteria consist of the articles that present telerehabilitation implementation during past ten years. The articles after inclusion criteria been applied are 173 articles. Meanwhile, the 80 articles determined after applying inclusion criteria. Here, exclusion criteria focus on removal of duplicate articles and to analyze the primary study extraction. The articles after exclusion criteria been applied are 43 articles. Table 2 shows the inclusion and exclusion criteria used in this SLR process.

Table 2. The inclusion and exclusion criteria used for this study.

Inclusion Criteria	Exclusion Criteria
Articles from January 2007 to present (April 2017)	Articles that applied telerehabilitation in others field
Articles which related to the telerehabilitation implementation	Duplicated articles
Articles that contain the keyword in Title and Abstract	
Articles which written in English	
Full text articles	

Next, in Phase 2, NVivo software is used to export those articles selected in Phase 1 [51]while the reference databases are created by using Mendeley. This phase also involves the preparation step to propose the related categories as themes or nodes in NVivo. In Phase 3, the important stage is 1st and 2nd level coding. The 1st level coding refers to code the important text and drag to the relevant theme (node). The aim of 1st level coding is to determine all the content in the articles related to the assigned nodes [51]. The 2nd level coding refers to analyse coded text and categories into child nodes. The last phase which is write up is the stage to analyse coded text in child nodes and reports the findings. This phase involves the outcome from NVivo 11 and the use of reference databases. The NVivo 11 helps to present the findings effectively due to its ability in helping the researchers to keep track of the data analysis [51].

4. Result and Discussion

This section provides the data extraction process and its synthesis. It also covers on the research questions results. text etc.

4.1. Data extraction and synthesis

There are 44 journal papers, 7 conference papers and 2 review papers were extracted from the period of time 2007 to 2017. The distribution of the telerehabilitation implementation studies is shown in Fig.1. The domain of this research actually increases gradually since 2007, except falls at 2010. It also receives most attention in 2009 and 2014 with 10 publications, after maintaining the number of publications in 3 years consecutively (i.e., 2011 to 2013). At the year 2015, the publications have decreased and again started the increasing at 2016.

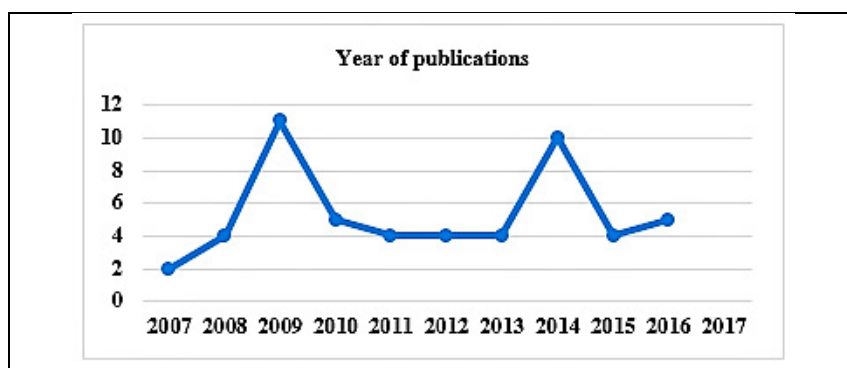


Fig. 1. The temporal view of primary studies

4.2. Research questions results

The first research question is concern on the themes from the telerehabilitation research at the pre-implementation stage. It is found that there are 4 themes emerged from the analysis (see Table 3). The themes are issues on adoption, benefits, readiness and decision-making. From these four themes, readiness has received the highest number of references which is 12 publications, followed by the adoption theme with 10 publications. The other two themes, benefits and decision making have received 4 and 2 publications respectively.

Table 3. The number of papers of each theme in pre-implementation studies on telerehabilitation.

Phases / Theme	Theme	Number of papers	Reference
Pre-Implementation	Adoption	10	6,7,10,16,17,18,19,20,21,51
	Benefits	4	15,22,23,24
	Readiness	12	2,8,25,26,27,28,29,30,31,32,33,34
	Decision Making	2	14,35

1) *Adoption*: The reason for adopting the new technology is to overcome the barriers and implement the potential benefits to the customers. For instance, Lee [28], found 12 factors that act as enablers to adoption including cost, social and technical support, reliability, compatibility, independence, confidence, emotion, accessibility, affordability, usability and value.

2) *Benefits*: With the telerehabilitation implementation, the patients do not need to come to the rehabilitation centre as compared with the traditional method. The patient just needs a computer at home and start video-conferencing or do interactive virtual reality's activity [51] [5]. However, the telerehabilitation implementation can lead to overcoming

many barriers such that money, time and distance [5] [28].

3) *Readiness*: Readiness is the important theme since it refers to the acceptance of the stakeholders towards the implementation of telerehabilitation. The acceptance of the stakeholders is divided into two which are the acceptance of the stakeholder to receive and the acceptance of the stakeholders to apply the telerehabilitation to the patients [15] [37]. The success of telerehabilitation is depends on the readiness of the stakeholders such as physician, therapist, nurse and patient.

4) *Decision-Making*: In term of telerehabilitation implementation, decision-making occurs when the organization such as rehabilitation centre uses telerehabilitation as one of their way to deliver rehabilitation towards patients. This theme is important because it leads the success of the project and the ability to give benefits such as cost-effectiveness [8].

The second research questions are considered the factors which influence the implementation of telerehabilitation at the pre-implementation stage (see Table 4). Here, the adoption and readiness theme were seen dominant rather than others with seven and six factors respectively. The details factors under each theme are as follows:

Table 4. Factors influencing the implementation of telerehabilitation at the pre-implementation stage

Theme	Factor	Sub-factor
Adoption	System Quality	Flexibility
	Information Quality	-
	Service Quality	-
	System Development	User Training, System Training
	User Satisfaction	-
	System Use	-
	Organization	Strategy, Culture, Communication, Top Management Support
Benefits	Satisfaction	Interaction through Technology, Use of equipment, Convenience, Health Benefits
	Usability	Usefulness, Ease of Use and Learnability, Interface Quality, Interaction Quality, Reliability
Readiness	Stakeholder's Attitude / Behaviour	-
	Stakeholder's Social Environment	-
	Attributes of the Change	Vision Clarity, Change Appropriate, Change Efficacy
	Leadership Support	Top Management Support, Presence of a Project Champion
	Organizational Context	Organizational Conflicts, Organizational Flexibility
	Attributes of the Change Targets	Collective Self-Efficacy, User Training
Decision-Making	Awareness	-
	Funding	-
	Human Resources	-

1) *Adoption*: There are seven significant factors influencing organization to adopt telerehabilitation. This includes the factors of system quality, information quality, service quality, system development, system use, user satisfaction and organization [19]. The first factor, *system quality* describes the ability of the system's functions and features to be more useful, faster and easier compared to existing manual system [6] [16] [19]. The second factor, *information quality* defines that the delivered information must be accurate and can be understood by all stakeholders especially the patients [17] [19]. Next, *service quality* factor specifies the assessed system by follow-up service, empathy, assurance and responsiveness [19] [47]. The fourth factor, *system development* classifies the characteristics into user training and system training [7] [10] [19] [22]. Here, user training includes a plan for updating technology skills, technical and security training to stakeholders. Whilst a system planning sub-factor refers the good of system implementation plans to avoid various problems. The fifth factor, *user satisfaction* shows the job performance may be improved if the

stakeholders satisfied with the good system performance [18] [19] [20]. The sixth factor, *system use* refers the effective and useful system that meet the expectation from limit IT skill of stakeholders [19]. The last factor, *organization* consists of 4 sub-factors. The first aspect, *strategy*, refer to what are the organization's strategy which aims to make the stakeholders (physician, nurse and therapy) ready to adopt the new system [19]. Next, the *culture* aspect states that good environment with high stakeholders' involvement leads to the success of the system, while the third aspect, *communication*, focuses on good communication interaction such as meetings and discussions improve the system use¹⁹. The last aspect, *top management support*, refers to the importance of the existence of champion (super user) that can influence and encourage other stakeholders to use the system [10] [19] [52].

2) *Benefits*: There are two important factors in the theme benefits. The first factor is *satisfaction* [15], which refer for the successful of telerehabilitation, it can be determined by the high level of satisfaction. The satisfaction can be in a form of interaction through technology, use of equipment, convenience and health benefits from the use of telerehabilitation. For interaction through technology, it refers to feedback after performing telerehabilitation via telerehabilitation's categories (e.g., image-based, sensor-based and virtual reality). The use of equipment is referring to the accessibility of tools usage can lead to the adoption of the telerehabilitation. For convenience, it describes the ability of the system to reduce time and cost and the last sub-factor refer to a capability to give positive health benefits to patients [15] [21]. The second factor of benefits theme is *usability* [15], which refers to measure the quality of the telerehabilitation can be conducted through usefulness, ease of use & learnability, interface quality, interaction quality and reliability aspects. Here, usability specifies the comparison of stakeholders' perception against the telerehabilitation delivery [15]. Next, the ease of use & learnability refers to the ability of the telerehabilitation to be understood clearly [15]. The next two of usability aspects are interface quality which describes the quality of telerehabilitation system's interface (graphic) that affect its delivery, and interface quality which refers to the interaction measurement between stakeholders through video conferencing. The last aspect of usability is reliability, which states the option prepared if the patients do mistake or error while using the telerehabilitation [23] [24].

3) *Readiness*: This theme consists of two division, stakeholders readiness [32] and organizational readiness [8]. In the stakeholder readiness, the involved factors are *stakeholder attitude and stakeholder's social environment* [32], while *attributes of the change, leadership support, organizational context and attributes of the change targets* [8] are in the organizational readiness. Within the stakeholder readiness, the effectiveness changes of the system implementation can be determined from the *stakeholder's attitude* while the *stakeholder's social environment* plays an important role in individual's attention towards the phenomenon of telerehabilitation implementation [2] [28] [29] [30] [33]. Next, within the organizational readiness, *attributes of the change* consist vision clarify, change appropriate and change efficacy characteristics [8] [34]. Generally, these three aspects give significant influence of organizational readiness for change, where the good quality leads to the success of telerehabilitation implementation [34]. This is because the vision clarity inspires and motivates the sense to make the change while the change appropriate is the phase of the stakeholder give full support instead of believing that the change must be done [26] [27]. The change efficacy, on the other hands leads to the consideration of the stakeholder to the possibility of the telerehabilitation implementation success. The next factor, *leadership support* contains aspect of top management support and present of a project champion towards the telerehabilitation [8]. Here, the top management support sub-factor must exist in the rehabilitation centres to make the changes process happens [8]. In addition, the presence of a project champion may increase the interest to collect goals and influence others towards change [8]. The next factor is *organizational context* focus on the situation that influences the organization to make changes [8]. To make this factor is significant in the readiness, organizational conflicts and organizational flexibility are required. Here, organizational conflicts refer any conflict of interest from stakeholders that lead the readiness to change. In addition, organizational flexibility aspect is the importance of the organization to make the change affects the readiness of the stakeholder in order to adopt changes [25] [31]. The last factor for organization readiness is *attribute of the change target* [8]. This factor contributes the person required to be applied changes based on their readiness, abilities and skills. The first aspect in this factor is collective self-efficacy aspects which refers to the stakeholder's confidence towards their ability that lead to the success of telerehabilitation [8] [34]. The second aspect is user training, which refer the method used to get stakeholder ready in implementing the changes [8].

4) *Decision-Making*: This theme consists of three factors - awareness, funding and human resources [14]. The first factor, *awareness*, describes the burden of diseases lead to the existence of awareness [14]. Next factor is *funding*

where to proceed the implementation of telerehabilitation, it requires allocation of enough fund [14]. The last factor involves with *human resource*, where sufficient human resource (e.g., physician, therapies and nurses) is needed to make the telerehabilitation system able to give the advantages [14] [35].

5. Conclusions

This paper aims to create the foundation for the telerehabilitation implementation researchers by exploring the literature on the major theme discussed and the factors that influence the implementation at the pre-implementation stage. In doing this, the study employed SLR as a main approach to answer the research questions by following the Al-Kharusi et al. guideline [50]. The study then has identified 53 out of 173 articles from 10 years' period (2007–2017) after applying a set of inclusion and exclusion criteria. Generally, the domain of this area actually increased gradually since 2007, except fallen at 2010. Telerehabilitation implementation research also received most interest in 2009 and 2014 with 10 publications each year. During the same period, the adoption, benefits, readiness and decision-making were emerged as the themes that received most attention from researchers. From these four themes, readiness and adoption have received the highest number of publications. In terms of factors that influence the telerehabilitation implementation at the pre-implementation stage, again the adoption and readiness themes were seen dominant. The benefit and decision-making themes are still lack of research. Most of the factors from adoption were in the quality aspects (e.g., system quality, information quality and service quality) while in the readiness, the factors were most in change aspects (e.g., attributes of the change, attributes of the change targets). However, since this study only used five online databases (Scopus, ScienceDirect, PubMed, SAGE journals and Web of Science), it is suggested for future work to extend the study more on various online databases with various dedicated journal searches. Thereby, a stable body of knowledge in the telerehabilitation implementation at the pre-implementation stage area can be established.

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