PHYSIORX APP: THE DEVELOPMENT OF A SMARTPHONE APPLICATION FOR PRESCRIBING HOME EXERCISE PROGRAMS BY PHYSICAL THERAPISTS

Manuel Alejandro R. Gonzalez IV, PTRP, DPT
University of Perpetual Help System Laguna, **PHILIPPINES**

Noel R. San Antonio PTRP, MSCPD, DPT
University of Perpetual Help System Laguna, **PHILIPPINES**

ABSTRACT

The study developed a smartphone application and sought to find out its acceptance by physical therapists and its overall functionality as evaluated by IT experts. The level of acceptance was evaluated using a TAM questionnaire which asked about the app's perceived usefulness and perceived ease of use answered by the physical therapists. The overall quality of the app was assessed using the ISO 9126 questionnaire which evaluates an app based on essential characteristics which are; functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. To discuss the current practice methods of prescribing home exercise programs a descriptive design was utilized to find out if PTs are currently aware and using apps in their clinical practice and how they currently formulate and prescribe HEPs. The population of the study included twenty-eight (28) Physical Therapists and five (5) IT experts in app development. Both questionnaires were distributed to the respondents using Google forms and was sent through their Email addresses. A 5-point likert was used for evaluation and scoring to measure the level of acceptability and overall functionality of the app. Frequency, percentage distribution, and weighted mean were used as statistical treatment of data. Results about current practice methods reveal that PTs are aware of apps in their practice but they currently do not use them, the main reason being that no app is useful for them, the most common method of prescribing HEPs reported is using a desktop or laptop computer. The perceived usefulness and perceived ease of use of the app as evaluated by PTs was rated acceptable. Its overall functionality as evaluated by the IT experts was rated acceptable. PhysioRx was found to be acceptable and functional. Utilization of the app is highly recommended for use by PTs to assist them in formulating and prescribing home exercise programs.

Keywords*:* PhysioRx**,** smartphone, application, level of acceptability, overall functionality

INTRODUCTION

Today's people are unable to go about their daily lives without their phones to complete their tasks, whether it is attending a class, giving a lecture, ordering food, shopping, and so on. To complete these tasks, people need a smartphone application, also known as an "app," for example, if they want to shop online, they can use Lazada and Shopee, or if they want to order food, they can use Food Panda and Grab. Apps are already being used in the healthcare industry to assist with patient management, from documentation through assessment. An app can be used to create electronic medical records, which can be used to store patient information and follow their progress. Home exercise programs have been an integral part of physical therapy in the rehabilitation of patients. Home exercise programs have increased in importance during this time of the COVID-19 pandemic, many professions have needed to adapt their services so that they continue to provide them even when people are at home. Typically, a physical therapist prescribes a home exercise program verbally or using a pen

and paper, instructing the patient on how to do the exercises at home and letting the patient demonstrate to confirm understanding. With the rise of telerehabilitation as a means of availing of physical therapy treatment, there is a need to adapt how physical therapist offers their services. One way a physical therapist can adapt to the current landscape of physical therapy practice is to utilize currently available technology. Smartphones and tablets are easily accessible today due to their affordability to the public. There are many smartphone applications today that we use to avail services from the comfort of our homes, you can shop, order food, and have things delivered just by using apps on our phones. In the context of healthcare, apps are already being utilized to help in the management of patients, from documentation to assessment. An app can be used for making electronic medical records for storing patient information and tracking the patient's progress. A goniometer app, which measures the range of motion of the different joints of the patient, can be used as an assessment tool by a physical therapist.

Research about the use of smartphone applications in the last five years has primarily focused on the impacts of an app on patient outcomes, the development of an assessment tool for use in patient evaluation, and its effectiveness compared to traditional assessment tools. Lee et al. (2018), noted the exponential growth of smartphone penetration has started the time of mobile health, commonly referred to as "mHealth". mHealth is the term used for health care practices supported by mobile devices, this includes personal digital assistants, patient monitoring devices, and smartphones. During this time, mHealth has continued in popularity and it is thought that smartphone users lead this activity. Ellis et al. (2019), stated that the most convenient option to give rehabilitation interventions remotely and collect outcomes in real-time is through mobile health (mHealth), which contributes to disease management by shifting care from the hospital to the home. It improves patients' comprehension of their illness and willingness to engage in self-management, resulting in high-quality care that both patients and healthcare providers appreciate. Nussbaum et al. (2018), mentioned that the introduction of mobile devices to the global market has the potential to have a huge impact on how rehabilitative treatment is delivered. The number of mobile devices per capita is predicted to reach 1.5 by 2021. Mobile phones are the most widely used of these mobile devices. More than 80% of Americans own a cell phone, and more than 40% own a smartphone, with the latter number anticipated to rise to more than 80% in the next ten years. The use of mobile phones has increased in emerging countries as well. In 2017, developing countries had a penetration rate of 98.7%, while least developed countries had a penetration rate of 70.4 percent. Smartphone applications (apps) have been a major factor in people's decision to purchase smartphones. Lastly, Ardern et al. (2020), indicated that since smartphones are an essential part of our daily lives, it offers an appealing platform from which to deliver evidence-based treatment for building confidence to return to normal levels of activity that patients may use anywhere and at any time.

Few studies have explored the impact of smartphone applications in the formulation of a home exercise program for rehabilitation medicine patients, most of the studies searched explore the impact on the patients, e.g., addressing specific impairments and observing patient adherence. App development for use in prescribing home exercise programs in physical therapy patients is currently an under-researched subject. With the penetration rate of smartphones in third world countries as high as 98.7% in 2017, this provides an untapped area for research on the use of apps in formulating and prescribing home exercise programs. This study aims to develop a smartphone application for physical therapists to be used in formulating and prescribing personalized home exercise programs to utilize already existing technology to assist in their clinical practice. The study will also find out the level of the

acceptability of the smartphone application as evaluated by physical therapists and find out the overall quality of the developed smartphone application as evaluated by IT experts.

METHODS

The study used a descriptive-developmental type of research. Portney and Watkins defined that descriptive research is designed to document the factors that describe characteristics, behaviors, and conditions of individuals and groups, sources of data for this type of research can be secondary analysis, surveys, and questionnaires. This study is descriptive in nature in that it will use a questionnaire to evaluate the usability and acceptability of the smartphone application that will be developed. Developmental research as defined by Rita, Richey, and Klein, is the systematic study of design development and evaluation process to establish an empirical basis for the creation of instructional and non-instructional products and tools and new or enhanced models that govern development. This study is developmental in nature in that it will design, develop, and evaluate a smartphone application for the improvement of prescribing home exercise programs.

The Software Development Life Cycle (SDLC) was used to construct the smartphone application. SDLC is a framework that describes the phases involved in developing software or applications. Its goal is for developers to be able to deliver high-quality software that meets the needs of their customers.1. Gathering and analyzing requirements During this phase, all necessary information about the product to be built according to the customer's expectations is collected. A Software Requirement Specification (SRS) document is prepared once the requirements are properly understood. The software developers should properly understand this document, and the client should examine it for future reference.2. Design. The requirement from the SRS document is used as an input in this phase, and the software architecture needed to implement system development is derived.3. Coding or implementation When the software developer receives the design document, this step begins. After that, the software design is turned into source code for the app. This phase includes the implementation of all application components.4. Testing. Testing can commence once the coding is finished. The developed application is rigorously examined for flaws, and if any are discovered, the developer corrects them at this stage. Retesting is carried out until the application meets the customer's expectations. To confirm the customer's specifications, developers will consult the SRS document.5. Deployment. The product is deployed in the environment once it has completed its testing.6. Maintenance. If an issue develops after deployment that has to be corrected or enhancements made, the developer will address it at this phase.

The pre-implementation phase included the development of the smartphone application, this entailed the acquisition of the services of an IT professional with expertise in software engineering specifically app development, this phase also included determining the current methods of home exercise prescription used by physical therapists. During the app development phase, the author of the study provided the name, general layout, color scheme, and most importantly the app database, which includes the exercise prescriptions that is used for the application. The IT expert then wrote the source code to start developing the app for actual use. Once finished, the app underwent testing of key features before being distributed for use. The next step was then to acquire approval from the graduate school and research adviser to conduct the study. Upon approval, the selection of respondents was conducted using the inclusion criteria mentioned previously. The implementation phase included obtaining permission from the clinic manager or chief physical therapist for the chosen

physical therapists to participate in the study, a consent form was given before participation. Once all the participants were chosen, the researcher sent them the application to be installed on their smartphones and was oriented on how to use the app. After 6 weeks, or after a physical therapist had prescribed at least five home exercise programs, the TAM questionnaire was sent to the participants through an online platform to evaluate the application. Simultaneously, the ISO/IEC 9126 questionnaire was sent to the IT experts to obtain their evaluation. The results gathered were given to a statistician for statistical treatment. The researcher then interpreted the acceptability and overall quality of the app.The evaluation of the smartphone application was conducted by IT professionals through an online platform using the ISO/IEC 9126 Software engineering- Product quality. The ISO/IEC 9126 is specifically used to evaluate software product quality, it evaluates the quality of a software based on eight characteristics, which are: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The questionnaire has a total of thirty-one (31) items that assess' the quality of the application based on the mentioned characteristics.

A separate questionnaire answered by physical therapists through an online platform was used to obtain the evaluation from the users of the smartphone application. This study uses the Technology Acceptance Model (TAM) as the theoretical basis and therefore will use the TAM questionnaire to evaluate the smartphone application. The TAM questionnaire was developed and used specifically for measuring the constructs of the TAM, which are perceived usefulness and perceived ease of use which contributes to the users' attitudes towards the application and thereby influence their intention to use the product it is a 12 item instrument, the first 6 questions ask about the perceived usefulness of the app and the last 6 questions asks about the perceived ease of use of the app. Frequency and percentage distribution were used to describe the current practices and methods of prescribing home exercise programs.Weighted mean was used to describe the a) level of acceptability of developed smartphone application as evaluated by physical therapists and b) level of quality of developed smartphone application as evaluated by IT experts.

RESULTS AND DISCUSSIONS

Discussion on the current practice methods, level of acceptance among physical therapists, and level of overall function of the app is presented in the succeeding tables and textual presentations:

Table 1 Current Practices and Methods of Prescribing Home Exercise Program

Indicators	Frequency	Percentage
1. Are you aware of any smartphone applications that can be used in your practice?		
Yes	27	96.43
No	1	3.57
2. Do you currently use any of the following types of smartphone applications in your practice?		
Medical reference & database apps	0	0
Professional networking apps	0	0
Patient medical health tracking apps	0	0
Doctor appointment & clinical assistance apps	0	0
Telehealth mobile apps	0	0
Exercise prescription apps	0	0

No	28	100
3. If you don't currently use apps in your practice, please choose or state a reason why		
No app is useful for me	10	35.71
Apps are expensive	8	28.57
Apps require subscription fees	7	25
Lack of time to use it	3	10.71
4.How do you currently formulate and prescribe home exercise programs?		
Pen and paper	8	28.57
Verbal instructions with demonstration	7	25
Using computer device	13	46.43
N=28		

Results show that 27 out of the 28 respondents, 96.43%, were aware of the existence of smartphone applications that can be used in their current practice. 0 of the 28 respondents, 100%, indicated that they do not use apps in their practice. when asked to state the reason why they don't use apps, out of the 24 that don't use apps, 10 (35.71%) said that no apps are useful for them, 8 (28.57%) said that apps are expensive, 7 (25%) said that apps require subscription fees, and 3 (10.71%) said that they lack the time to use apps. When asked how they currently formulate and prescribe HEPs, 8 (28.57%) said that they use pen and paper, 7 (25%) used verbal instructions with a demonstration, and 13 (46.43%) used a computer device to manually formulate and print HEPs.

The majority of the respondents are aware of the existence of apps that can be used in their practice but when asked if they use apps in their practice all of them answered that they do not use apps in their practice, when asked for the reason why they don't use apps, the most common reason is they feel that there are no useful apps for them. The second most common reason is that they feel that apps are expensive, followed by apps requiring subscription fees and lastly they lack the time to use them. Using the data gathered one can design a smartphone application that addresses these problems and promote the use of the app. Comparing these results to a similar survey in Nigeria of 48 PTs by Bolarinde et al. (2021) where only half of the respondents were aware of apps they can use in their practice, although they were not aware of the apps when asked if they would recommend apps for PT practice, 70% of the respondents recommend the development of PT-related applications. While this study enumerates the different reasons of PTs for using apps, the study of Bolarinde et al. concluded the reason for low usage rates of apps is because of lack of awareness. Contrary to this study, Chakravarthy et al. (2021) found that lack of organizational support is a major factor in the adoption of new technologies, the results of this study indicate that lack of any useful app and fees were major factors for not using apps.

No studies in the reviewed literature were found to investigate how PTs formulate and prescribe home exercise programs, although studies by Boudreau et al. (2020) and Lendner et al. (2019) tested the validity and reliability of using a smartphone's gyroscope to measure different joints in the body compared to a traditional goniometer indicating that apps are a reliable and acceptable alternative. The results of this study found that the majority of the PTs asked used a computer device to manually formulate and prescribe their home exercise programs, and the second most common method is using pen and paper followed closely by verbal instructions with demonstrations. The results provide a representation of how PTs in several hospitals in the Cavite area formulate and prescribe their home exercise programs. The results indicate that implementing and promoting the use of an app for formulating and prescribing HEPs may provide PTs with an alternative for them to use.

Table 2 Level of Acceptability of Developed Smartphone Application in terms of Perceived Usefulness as Evaluated by Physical Therapists

Indicators	Weighted Mean	Standard Deviation	Verbal Interpretation
1. Using PhysioRx in my job enables me to accomplish tasks more quickly than other products in its class.	4.79	.424	Acceptable
2. Using PhysioRx improves my job performance.	4.54	.506	Acceptable
3. Using PhysioRx in my job increases my productivity.	4.68	.480	Acceptable
4. Using PhysioRx enhances my effectiveness on the job.	4.46	.506	Acceptable
5. Using PhysioRx makes it easier to do my job.	4.57	.500	Acceptable
6. I have found PhysioRx useful in my job.	5.00	.000	Acceptable
Average Weighted Mean	**4.67**	**.246**	**Acceptable**

With a weighted mean of 5.00, PhysioRx's usefulness to PTs was ranked 1 among the indicators for perceived usefulness of the app. Followed by its ability to enable PTs to accomplish tasks more quickly with a weighted mean of 4.79. Ranking third with a weighted mean of 4.68 is the apps ability to increase reported productivity among PTs. Ranking fourth with a weighted mean of 4.57 is PhysioRx's ability to make PTs job easier for them. Ranking fifth, with a weighted of 4.54 is the apps ability to improve job performance. Lastly, with a weighted mean of 4.46 is the apps ability of enhance the effectiveness of the PTs job. With an average weighted mean of 4.67, PhysioRx's perceived usefulness is "Acceptable".

Huang et al. (2021) used the TAM model to assess the acceptance of Google Classroom among nursing students. The study assessed the program's perceived usefulness, perceived ease of use, and intention to use after implementing the program from the start of the semester until the end. Results showed high evaluation scores by the participants indicating that the program is highly acceptable based on the factors mentioned. PhysioRx app also scored highly on perceived usefulness supporting the study of Huang that a high score for this indicator contributes to a probability that PhysioRx may be adopted by physical therapists.

Table 3 Level of Acceptability of Developed Smartphone Application in terms of Perceived Ease of Use as Evaluated by Physical Therapists

Indicators	Weighted Mean	Standard Deviation	Verbal Interpretation
1. Learning to operate PhysioRx was easy for me.	4.93	.267	Acceptable
2. I found it easy to get PhysioRx to do what I want it to do.	4.43	.506	Acceptable
3. My interaction with PhysioRx has been clear and understandable.	4.82	.396	Acceptable
4. I found PhysioRx to be flexible to interact with.	4.75	.447	Acceptable

5. It was easy for me to become skillful at using PhysioRx	4.54	.506	Acceptable
6. I found PhysioRx easy to use	4.89	.320	Acceptable
Average Weighted Mean	**4.73**	**.240**	**Acceptable**

With a weighted mean of 4.93, PhysioRx's characteristic of being easy to learn ranked 1 for perceived ease of use of the app. With a weighted mean of 4.89, the app's characteristic of being easy to use ranked 2. With a weighted mean of 4.82, the app's interaction with PTs for being clear and understandable ranked 3. With a weighted mean of 4.75, the app's ability to be flexible ranke 4. With a weighted mean of 4.54, the app's ability for PTs to easily become skillful using the app ranked 5. Lastly, with a weighted mean of 4.43, the app's ability for PTs to get the app what PTs want it to do easily ranked 6. With an average weighted mean of 4.73 indicating the perceived ease of use of the PhysioRx app as "Acceptable".
Zhang et al. (2017) investigated the factors affecting the intention to adopt a new technology which was perceived ease of use and perceived usefulness. The study found that perceived ease of use is directly related to perceived usefulness which both significantly impact the intention of users to adopt the technology, in this regard, the findings of PhysioRx app's perceived ease of use as "Acceptable" contribute positively to the probability of PhysioRx being adopted by physical therapists.

Table 4 Summary Table of Level of Acceptability of Developed Smartphone Application as Evaluated by Physical Therapists

Indicators	Weighted Mean	Standard Deviation	Verbal Interpretation
1. Perceived usefulness	4.67	.246	Acceptable
2. Perceived ease of use	4.73	.240	Acceptable
Average Weighted Mean	**4.70**	**.241**	**Acceptable**

With an average weighted mean of 4.70 indicating that users gave the PhysioRx app an overall evaluation of "Acceptable". Results of the evaluation of the PhysioRx app by physical therapists indicate that they find the app both useful and easy to use. According to TAM, these are the two primary factors influencing users' intention to use new technology. For example, if a person finds an app difficult to use he or she will most likely not adopt it in their practice. The results of the TAM questionnaire indicate that the PhysioRx app has a high acceptance rating and has a high possibility of being adopted by physical therapists in their practice. Several studies reviewed in the literature review explored the acceptance of apps in PT practice, Clavijo-Buendia et al. (2020) and Pepa et al. (2017) used apps to analyze the gait of Parkinson's patients. studies by Boudreau et al. (2020) and Lendner et al. (2019) used apps to measure joint range of motion. Systematic reviews by Keogh et al. (2019), Pfiefer et al. (2020), Gal et al. (2018), Ferriera et al. (2020), and Zhou et al. (2018) investigated the use of different apps in both assessment and treatment of patients. All these studies reported the reliability, validity, and benefits of using apps in physical therapy practice. The results of this study contribute to the existing literature that apps are acceptable as an alternative to assessment, treatment, and in this case, as a tool for formulating and prescribing HEPs.

Table 5 Table of the Quality of Developed Smartphone Application as Evaluated by IT Experts

Areas	Weighted Mean	Standard Deviatio	Verbal Interpretation

		n	
1.Functional Suitability	4.40	.595	Acceptable
2. Performance Efficiency	4.53	.506	Acceptable
3. Compatibility	4.50	.612	Acceptable
4.Usability	4.37	.505	Acceptable
5.Reliability	4.10	.518	Slightly Acceptable
6.Security	4.60	.400	Acceptable
7.Maintainability	4.48	.334	Acceptable
8.Portability	4.67	.335	Acceptable
Average Weighted Mean	**4.46**	**.458**	Acceptable

All characteristics of the PhysioRx app are acceptable except its slightly acceptable reliability. With an average weighted mean of 4.46, the overall quality of the PhysioRx app as evaluated by the IT experts using the ISO/IEC 9126 questionnaire is categorized as "Acceptable".

PhysioRx was evaluated by 5 IT experts who have experience in app development. The majority of the characteristics on which the app was assessed yielded highly positive results indicating that the PhysioRx app is reliable and a fully functional app for use in formulating and prescribing HEPs. The only characteristic that scored slightly lower is reliability, considering that the app in its current state is in its first iteration this is to be expected. App development is a continuous cycle, after the deployment of an app, as part of the normal app development cycle, the app is continually improved based on user feedback and routine maintenance. A study by Galipot et al. (2021) also used the ISO/IEC 9126 questionnaire to evaluate a newly developed telerehabilitation platform, the software developed by the authors was also evaluated by experts in the field and was found to be highly acceptable. Wang et al. (2019) described quality as creating a comfortable and useful product that meets the user's satisfaction. In this regard, PhysioRx meets these requirements based on users' and experts' evaluations. The development of high-quality software is the major goal of PhysioRx's developers, the results of this study not only affirm that the app is reliable, acceptable, and overall functional, but it also provides information to identify errors and points for improvement for future updates of the app.

RATIONALE

Physical therapists serve an important role in the rehabilitation of patients, the primary method of administering treatment for PTs is through exercise. Exercise not only helps the patient recover from impairments, but it also helps in preventing possible injuries that may otherwise arise from not engaging in exercise. Continuing exercise at home through a home exercise program is an essential part of rehabilitation, PTs usually formulate and prescribe home exercises manually and give them to a patient to read. This method is time consuming for both the PT and the patient, if this part of the rehabilitation can be automated it will free up time for both parties to do more important tasks. It is with these thoughts that the development of "PhysioRx" app is conceptualized, by designing an app specifically for formulating and prescribing exercise programs and utilizing already existing technology, some of the limitations of the current practice methods may be addressed.

Future Directions

In the light of the findings and conclusions, the following are offered as recommendations for possible actions:

1. Smartphone applications are underutilized in physical therapy practice therefore future studies should promote the use of existing smartphone applications in physical therapy.
2. More physical therapists can collaborate with app developers to design and develop other types of apps that can be useful in physical therapy practice.
3. Physical therapists evaluated PhysioRx as "acceptable" indicating an intention to use therefore it is recommended to continue maintaining and using the app for their practice.
4. IT experts evaluated PhysrioRx as "acceptable" in all quality characteristics except for its reliability, continuous support of the app may address this by doing updates for the app

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