INTEGRATING COOPERATIVE USERS TO DEVELOP FRAMEWORK FOR AN EFFECTIVE MOBILE PHYSIOTHERAPY

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ABSTRACT

M-Health applications (apps) have recently attracted much attention from both manufacturing and research communities. Currently, the rapid evolution of the smartphone, which has been aided by advanced communications technology, presents challenges in term of reliability and accurate apps. An awareness of these challenges could help industries and designers to develop better tools to support either patients or users in order to get effective apps. The aim of the study is to identify the critical features, contents and essential users` group for a salient mobile physiotherapy framework. Accordingly, this study reviews 80 papers with more than 100 apps regarding m-health to gain a deeper understanding of the critical content requirements for future improvements to m-health apps features. Four prominent characteristics of the most important features emerged: 1) Reminder, 2) Monitoring program, 3) Training program, 4) Community network features. These features were then incorporated into the design of a mobile physiotherapy framework. Followed by qualitative methods such as, interviews, observation and examination of archival documents the above four features are adopted in order to validate the preliminary framework. Indeed, the aim of this research is that mobile health technology adoption will increase in the near future through improvements to patient engagement. The researcher believes that by understanding m-Health apps critical content requirements and its classification, a new solution may reveal itself, with the potential to overcome the present challenges in mobile physiotherapy.

In the name of ALLAH the Most Beneficial and the most Merciful.

Specially dedicated to my beloved mother and father.

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ABSTRAK

Aplikasi M-Kesihatan baru-baru ini telah menarik perhatian pihak pengilang dan penyelidik. Pada masa kini, evolusi telefon pintar telah berkembang pesat seiring dengan kemajuan komunikasi yang membentuk cabaran dari segi ketahanan dan pemilihan aplikasi yang tepat. Kesedaran mengenai cabaran ini dapat membantu pihak industri dan pereka bagi membangunkan alat yang lebih berkesan dalam membantu pesakit atau pengguna bagi mendapatkan aplikasi yang efektif. Kajian ini bertujuan untuk mengenal pasti ciri-ciri kritikal, kandungan dan komponen penting bagi rangka kerja fisioterapi mudah alih. Sehubungan dengan itu, artikel ini mengkaji 80 kertas kerja dengan lebih daripada 100 aplikasi berkaitan aplikasi M-Kesihatan bagi mendapatkan pemahaman yang lebih mendalam mengenai keperluan komponen penting bagi tujuan penambahbaikan dalam ciri-ciri aplikasi M-Kesihatan pada masa hadapan. Terdapat tiga ciri-ciri utama yang penting: 1) Peringatan; 2) Program pemantauan; 3) Program latihan; 4) Ciri-ciri jaringan komuniti. Kesemua ciri-ciri ini digabungkan ke dalam reka bentuk rangka kerja fisioterapi mudah alih. Kaedah kualitatif seperti temubual dan semakan dokumen ke atas kesemua ciri-ciri tersebut digunakan bertujuan untuk mengesahkan rangka kerja awal. Kajian ini menyasarkan akan terdapat peningkatan dalam penggunaan teknologi kesihatan mudah alih pada masa akan datang dengan adanya penglibatan pesakit. Penyelidik percaya bahawa dengan memahami komponen penting yang terdapat dalam aplikasi M-Kesihatan, cabaran semasa dalam fisioterapi mudah alih dapat ditangani dengan mudah dan berkesan.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

RESEARCH OVERVIEW

1.1   Introduction

Every year, epidemic diseases kill millions of people around the world (Zhang, 2012). Every 60 seconds, at least one woman dies from complications related to pregnancy or childbirth. There are several new resources available to help these patients.

Innovative applications in healthcare and medical technologies have opened doors with the invention of high data connectivity on mobile devices. The current generations of smart phones such as 3G and 4G connectivity have had a big effect on all aspects of life. Smart phones have become handheld computers rather than merely phones (Agarwal et al., 2013). As result, in developing countries there are more than 5.3 billion phones, which have dominated the communication market, meaning people may no longer use computers any more. Indeed this device has become a lifeline for users who need to subscribe to health services provided online. Utilizing mobile phones in the health domain has become the tendency of the community, a practice known as Mobile health or m-health which provides a tremendously significant service (Sandhu, 2011). Furthermore, in 2012, the Healthcare Mobility Strategy survey found that hospitals made significant use of the communication devices. Smart phones and pagers were the essential supported devices. However,

tablets and Wi-Fi phones were regularly used, while laptops were also included in the mix (PointClear, 2012).

Using smart phones for health purposes can provide numerous advantages such as a continuous uninterrupted data stream, powerful computing power, portability, large memories, wide screens and the capability to support multimedia application software, when compared to other wireless communication technology (Agarwal et al., 2013). Lower costs and an improvement in the quality of healthcare can be gained through mobile apps as well as assistance in preventing chronic diseases such as human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS), heart attack, diabetes, cancer and others.

The purpose of mobile health apps is to distribute health care very fast at anytime, anywhere, without obstruction. Thus, health care providers (HCP) can upload test results, medical information and records to hand-held device such as Smart phones tablets, push-to-talk devices, cell phones or Smart phones. As a consequence, patients or users can easily retrieve information about their health diagnoses, test results and medicine information, which later can be used to monitor their situation in a comfortable way (Lopes et al., 2011). People can also easily exchange information with each other and with HCP, and can even self-monitor and access their records and freely communicate with physicians. Patients grab these opportunities to monitor particular conditions of their health that help them to fill the gaps in their health care and make sure that their wellbeing is reached (Agarwal et al., 2013).

Along with the advances in wireless medical applications, computer-assisted rehabilitation and therapy should be highlighted (Guerri et al., 2009), such as exists in the physiotherapy domain. Many researchers have utilized different concepts in their research about mobile applications, but the interpretations are different between one domain and another. Thus, the scope of this study is restricted to the physiotherapy domain, although it is expected that the framework will be able to be leveraged across other kinds of mobile work in the healthcare sector.

Moreover, a focus on continuous monitoring of children with suspected cardiac arrhythmias, at home or outside the clinic, is the most important procedure in the mobile physiotherapy domain, with a view to estimating the size and seriousness of the problem. It is generally believed that Arrhythmia is a dangerous disease which it is a common cause of death. Children suffer from it a lot. For instance, the situation of hypertrophic cardiomyopathy is well known because of the high risk of arrhythmias and unexpected death in children.

Thereby, suspected cardiac arrhythmia can be easily monitored by using m-health apps from a physiotherapist. Real-time acquisition and transmission of electrocardiography signals from patients can be easily supplied using this type of technology. The ability to create an alarm schema that is able to determine potential arrhythmias has been offered by the system as well. This reports to the available doctor and caregivers of the children that an incident is taking place which needs urgent attention, so that they can manage it as quickly as they can (Kyriacou et al., 2009). Indeed, this mobile system has made a significant expansion in emergency health care, by facilitating real-time ambulatory monitoring.

Although, it is generally believed that m-health apps have outstanding benefits, some apps still need enhancement with regard to contents and features so that they properly meet health worker, physiotherapist and patient needs. Further, it has been found that a total of only 75 apps across the medical landscape in different diseases have met 510k clearance (in order to consider the app as a medical app) (Eng and Lee, 2013) due to some missing requirements which many m-Health apps have not yet reached. In contrast, the m-health app is a phenomenon that is expected to rapidly progress in many areas in the years to come. Therefore, there is great scope for developing the potential of mobile applications to improve health care services. This paper aims to discuss the following questions in order to contribute to m-Health apps enhancement.

1.2   Problem Background

Nowadays, mobile technology is approaching saturation in the developed countries while developing countries have increased their share of mobile subscriptions from 53% in 2005 to 73% at the end of 2010 (Kool et al., 2014). In developing countries, providing healthcare services to communities still faces several challenges for many reasons. One of the most important factors is a shortage of medical resources in this area, when health providers could in fact solve this problem simply by using mobile technology as developed countries do. The healthcare delivery setting in rural areas, for example, is reported to have limited access to highly specialized consultancies (Vatsalan et al., 2010).

Obviously, some issues, such as computational ability, dimension of the devices, power competence and expenditure have been restricting the accessibility of devices and services in a few special cases. However, the development of new technologies specifically in communications has recently enhanced the healthcare domain to make it cheaper and more effective (Kyriacou et al., 2009). By discussing the issue, they concluded that information technologies can improve the quality of a wide range of health care services: using mobiles devices and intelligent software to enhance provider communications; minimize long waiting time for patients; and meet patient, physiotherapist and health worker needs (Software, 2013). As a result, providers have been able to adjust their timings and schedule their contact preferences for various times. Consequently, this strategy saves time by improving communication efficiency with patient that meets their requirements (Software, 2013).

Indeed, it is clear that the mobile phone is an essential part of healthcare living. Its usage offers elegant applications close at hand, using photos, measuring devices and sensors to automate logging of personal health states (Klasnja and Pratt, 2012). According to this trend, mobile physiotherapy adoption will change the traditional delivery of healthcare by providing an opportunity for patients, caregivers

and physiotherapists to continuously monitor patients' treatment and health conditions outside of the clinic or patients' homes.

While, *"the term of Physical therapy or physiotherapy (sometimes abbreviated to PT) is a health care profession primarily concerned with the remediation of impairments and disabilities and the promotion of mobility, functional ability, quality of life and movement potential through examination, evaluation, diagnosis and physical intervention. It is carried out by physical therapists (known as physiotherapists in most countries) and physical therapist assistants (known as physical rehabilitation therapists or physiotherapy assistants in some countries). In addition to clinical practice, other activities encompassed in the physical therapy profession include research, education, consultation, and administration"* (Wikipedia, 2012).

In addition, the technology (Ex: Mobile Physiotherapy) provides tools to users such as caregivers to provide the best care to their loved ones. It can assist physicians with appointments, providing monitoring and linking to additional services such as rehabilitation, home nursing and the patient`s electronic health record portal. Healing takes more than information, but involves complex problem solving and care coordination that requires medical experience. Therefore m-health apps require the involvement of integrated users. Thus, one object of this study is to integrate cooperative users such as physiotherapist, caregivers and patients in one framework with a view to meet users' needs and ensure efficiency of patient care.

Physiotherapist involvement is a vital part of making mobile health successful in improving patient`s life. Remote coaching and symptom monitoring for example, can keep the physiotherapist informed of their patient`s condition and facilitate coaching interaction (Klasnja and Pratt, 2012) among physiotherapists, patients and caregivers. Some key benefits for physiotherapists include improved access to real time patient information and patient health education information during treatment appointments. This is very useful for patients who have physical disabilities or mobility problems as they can fully interact via the portable device.

Likewise, children with cerebral palsy problems need a much higher level of attention than someone who has a knee injury. Even the prescription should not be standardized. People with same analysis or symptoms require individual assessment based on severity of illness, concomitant medications, extent of caregiver support and the patient's wishes. Even with the best physicians, if the patient does not pursue the treatment or consult a medical doctor then it is valueless. Using mobile phones provides a new opportunity for patients to interact using m-health apps which break down communication barriers.

As the number of built-in devices and applications expand on mobile devices, the provision of appropriate content such as user interfaces becomes increasingly important (Subramanya and Yi, 2006). For instance, acceleration sensors will let patients or physicians interact more closely, with better control and a realistic feel which enhances their enjoyment of m-health apps usage. In the near future, mobile apps should produce considerable amounts of content to at least address the two distinct goals of content production and adoption. The thinking behind the design of mobile physiotherapy should include integration features with the involvement of key users groups.

Recently, we have seen that m-health apps have been increasingly recommended by the health market. Nevertheless, these apps have yet to reach the quality required for them to be effective tools. In this article several papers regarding m-health app will be reviewed and many interviews will be conducted with a view to improving its features.

1.3   Problem Statement

In order to aid the healthcare domain to provide the best service with a view to reaching optimum usage of m-health apps by health workers and physiotherapists, this research will develop a framework for effective mobile physiotherapy, focussing

on mobile physiotherapy in Malaysia. The framework represents mobile health industries in developing countries. Indeed, this research has exploited the growing numbers of mobile users in developing countries to examine the integration of mobile usage with physiotherapy. Undoubtedly, this framework is going to meet needs of physiotherapist, caregivers and patients in order to reach effective and efficient mobile physiotherapy.

1.4   Research Question

The main research question addresses how to beneficially leverage an effective mobile physiotherapy by integrating cooperative users together to exploit the commercial value of a mobile application. Thus, this study attempts to answer the following research questions:

(i) *"What are the essential user groups of mobile physiotherapy?"*

(ii) *"What are the critical mobile features and contents requirements of mobile physiotherapy?"*

(iii) *"What is the most practical framework for an effective mobile physiotherapy?"*

1.5   Research objective

The main purpose of this research is to identify critical requirements that may affect the success of mobile physiotherapy and suggest appropriate strategies to leverage the value of this mobile health approach.

(i) *To identify the essential user groups of mobile physiotherapy.*

(ii) *To find the critical mobile feature and contents` requirement of mobile physiotherapy.*

(iii) To develop practical framework of mobile physiotherapy framework by integrating physiotherapist end-users' requirements.

1.6   Project Scope

Nowadays, using technology in healthcare is essential area that determines whether countries are either developed or developing. Mobile physiotherapy is a tool which can be put it as successful way in order to provide best services to patient in the healthcare domain.

For this research, Malaysia has been selected as an example of a developing country. It will focus specifically on the Clinic of Great Life in the UTM Technovation Park in Johor Bahru. Further, this study has focused on mobile physiotherapy, which plays an essential role in healthcare. The researcher uses a qualitative method with a view to collecting and analyzing the data, as well as utilizing cross case analysis to analyze the data collected from interviewees. For instance, physiotherapists, who are the most important elements in mobile physiotherapy, are included. Patients and caregivers are also a significant consideration in the process of creating a practical framework for an effective mobile physiotherapy. Physiotherapy is huge domain which offers many different types of treatments for different situations. The researcher therefore only focuses on the aspects such as general patients and children with cerebral palsy (CP), as CP has strong community within physiotherapy in Johor Bahru.

1.7 Significance of the Research

This research is essential in order to offer insights into how to optimize mobile physiotherapy performance from two perspectives: the academic/research perspective and the practical.

(i) Academic/Research:

This study will help designers to improve their model of services in terms of quality, design quality and planning. It also gives guidance for practical procedures to guide the process of planning in order to enhance service quality of mobile physiotherapy services so that they attract and engage with users.

The research results in a content-based framework of mobile physiotherapy and outlines the critical features and content requirements. It presents a preliminary study that concerns itself with a framework of mobile physiotherapy service success that can shape an essential beginning for framework building and further investigation.

This study also creates an awareness of mobile physiotherapy and the physiotherapy domain, while providing details about particular features and content that can give better understanding of the benefits of each one.

(ii) Practical:

This research can deliver significant practical benefits to patients, caregivers and physiotherapists, and can also resolve conflicts among prospective users' requirements. As well as this, it hopes to encourage the healthcare community to seek ways to efficiently utilize technology for better managing peoples' wellbeing. It can help physiotherapy

enormously in delivering better care to patients while cutting expenses, a target which everybody should struggle towards.

It further describes how mobile physiotherapy has opened up the opportunity to deliver health care anytime, anywhere; because it allows physiotherapists, caregivers and patients to monitor health cases outside the clinic as well as at home, and facilitates access to healthcare and health-related information, which permit patients to self-manage regarding time and cost.

Moreover, it also presents identification of mobile physiotherapy services objectives and critical features and their contents, which must be understood effectively in order to implement successful mobile physiotherapy. At the same time, this identification provides an understanding of why clinics or community should consider mobile physiotherapy. Therefore, children with CP and their families can benefit from several aspects. Parents may use a catalogue of simulated practices that have been provided with a view facilitating exercises for their child with CP at home. They have also been able to record videos of the child and send it to their physiotherapist for consultation even without visiting the clinic.

1.8   Chapter Summary

This chapter presents an overview of the significance of mobile health apps in developed countries. At the same time, it has explains how this small device, the mobile phone, can play essential role in changing our lives when used for mobile physiotherapy. This chapter also provides a background to the problem which prompted the study as well as clarifying the argument proposed in the research. The research objectives are then outlined, according to the scope of the research, and the

significance of the study is clarified. Indeed, by conducting this research effectively, the objectives are likely to be achieved.

In Chapter 2, the researcher will make a review of the relevant literature, in order to identify the essential content and feature requirements of mobile physiotherapy.

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