

The Adoption of Mobile Health Applications by Patients in Developing Countries: A Systematic Review

Nasser Aljohani¹, Daniel Chandran²

Faculty of Engineering and Information Technology
University of Technology Sydney Australia, Sydney, Australia

Abstract—Mobile health (m-health) apps adoption in developing countries is a new research area in the healthcare industry. M-health is comparatively recent in information systems, with little attention being paid to it developing countries in the previous years. Applications of the m-health strategies in developing nations are considered one of the best platforms for guaranteeing the citizenry's safety and healthcare security. A systematic review was conducted of m-health apps adoption by patients in developing countries to evaluate the current results. It reviews 22 papers that were published on the topic of m-health adoption in developing countries in academic journals and conferences over the last decade. It identifies the research in terms of research methodologies, theories and models adopted, significant factors identified, limitations and recommendations. Findings show there is a limited contribution to m-health apps adoption in developing countries. Most studies employed TAM and focused on the technological and individual levels; very low intention has been made to health-related factors, levels, and theories. The review presents a broad overview of previous academic studies with a view to future research.

Keywords—M-health; mobile health; apps; adoption; review; developing countries

I. INTRODUCTION

Mobile technology has grown in use in the healthcare delivery and health results in developed countries in the last few years. Electronic health (e-health) refers to computer-based services, while mobile health (m-health) applies to mobile systems with specialized features to improve health care delivery [5]. The concept "m-health" was first used by Prof. Isteparian, who refers to mobile devices and networking systems used for healthcare delivery [28]. Fig. 1 presents the role of both e-health and m-health.

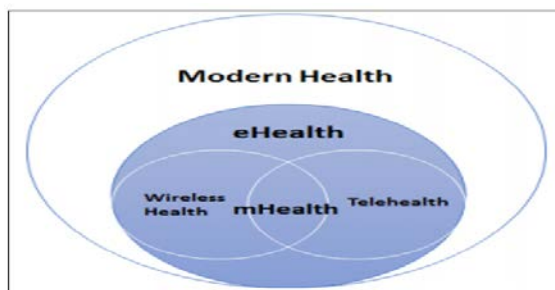


Fig. 1. Role of E-health and M-health (Adopted from [26]).

In Fig. 2, Dehzad et al. classify m-health into three classes of technologies: devices, sensors, and applications [10]. Besides, they categorized the target group of m-health into healthy people, hospital patients, and chronically ill individuals. M-health solutions can carry four areas: wellness and prevention, diagnosis, treatment and [10]. There are currently more than 165,000 health apps available on smartphone online stores [9]. According to Larson [29], m-health apps categorized by searchers into four different types:

- Information app: Provide general health information to the public.
- Diagnostic app: To enter patients' information and provide a diagnosis to physicians.
- Control app: Assist medical devices with remote monitoring and control.
- Adapter app: Transform smartphones to become mobile medical devices.

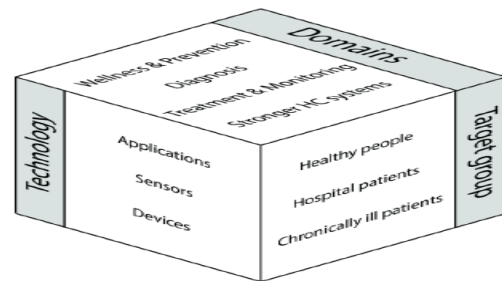


Fig. 2. Classification Model for M-health Solutions (Adopted from [10]).

Having m-health technology will promote healthcare awareness and access to knowledge that will enhance the lives of the citizenry and provide the developed countries with the opportunity to create a sustainable workforce with economic resilience [16]. The majority of mobile phone users, especially smartphones and computing technology in developing nations, have adopted mobile devices to access information, particularly about the right healthcare facilities that offer quality services to guarantee security and healthcare safety. The initiative of downloading mobile apps for understanding the proper treatment procedures and the most appropriate types of medication has enabled the majority of the citizens in the developing nations to access Medicare conveniently and reduce cost [1]. The adoption of m-health gives the governments of

the developing nations the advantage to guarantee patients safety and health information records by considering data protection and visualization strategies. Some developing countries, such as Malaysia, Thailand, China, and India, have been introducing technological advances in healthcare systems to improve the treatment process [24].

Despite the prospective benefits of m-health apps, adopting and accepting such a technology is not as widespread as expected in developing countries [30]. Factors found to be influencing m-health have been explored in several studies. However, an insufficient contribution has been paid to the factors affecting the adoption of m-health by patients; besides, the factors influencing e-health adoption rates in developed countries have been comprehensively reviewed against m-health. In the sense of developing countries, we conducted a systematic literature review to properly comprehend and verify the adoption of m-health apps. This is an especially significant discovery in the advancement of a modern research area. It provides a possibility to step back and review several samples, methods, and theories collected from different studies in m-health. Thus, this research seeks to play a key role in enhancing the research in this rapidly growing field of m-health. Beyond that to examine the existing state of m-health among people of devolving countries.

II. LITERATURE SEARCH APPROACH

Several keyword sets were evaluated to have a sufficiently reliable and authentic secondary source. For instance, the sets of keywords considered for the study include "adoption of m-health", "adoption of mobile health", and "adoption of Google mhealth" and this focused on the use and application of Google Scholar as one of the most reliable search engines for academic journals with both comprehensive and conclusive information about the initiative of developing the m-health in the developing nations. The technique that was idealized to establish the search setting considered extensive and varied studies published between 2010 and 2020. The core underlying principle for choosing the wide range of timeline is to present information with a broad historical background about the nature of the developing countries' approach to adopting m-health.

The major reasoning for choosing the wide range of timelines is dependent on two fundamental reasons. First, due to the nature and the quality of healthcare outcomes before and after the developing nations begun the initiative of adopting the m-health. It is imperative to note that restricting the healthcare systems in developing countries by adopting the m-health strategy has improved and stands a better chance to improve the citizens' overall quality of lifestyle in the developing nations in the foreseeable future [25]. Second, by 2013, the use and application of mobile technology to access and receive healthcare services had become most popular since both the government and the citizenry in the developing nations considered the strategy one of the best platforms of accessing quality healthcare conveniently and at a reduced cost [14]. The use of mobile apps can be a fast and reliable way to provide healthcare to large numbers of people who cannot make a physical visit to a healthcare facility.

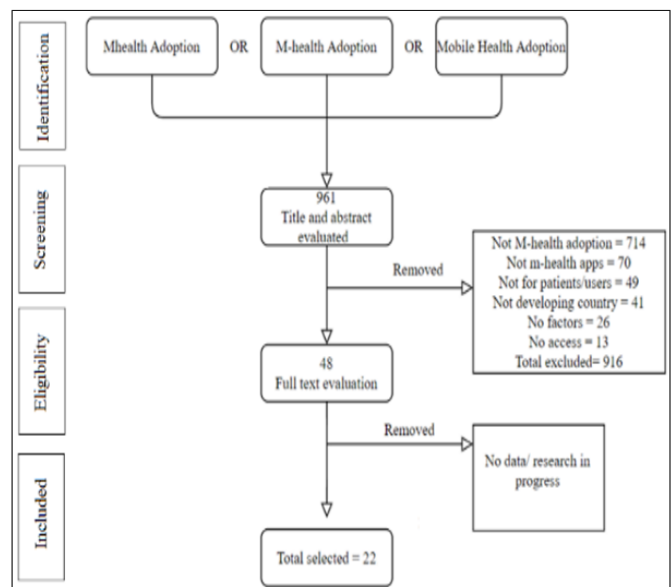


Fig. 3. Flowchart of the Search Strategy.

A total of 22 secondary sources were selected for the study, particularly academic journals, to investigate the approach taken by the developing nations for reasons of adopting the m-health strategies. These studies proved relevant and authentic about affirming the perspective that the developing countries should adopt the m-health approach to improve the overall quality of lifestyle and health condition of their citizens. Using the PRISMA flow diagram [32], Fig. 3 shows the research selection strategy.

III. LITERATURE ANALYSIS

This section explains several of the existing primary literature concerning m-health from a scholarly perspective. The analysis included the date of publication, theories and methods used the identified significant factors, and the limitations and findings of the m-health applications research.

A. General Analysis

1) *Publication date analysis*: Publication dates were analyzed to determine the latest most significant developments in research publications. As shown in Fig. 4, the number of articles increased from 2012 until 2015. Then, the number increased to reach 3 to 4 papers during the years 2016 to 2018. No complete studies have been conducted in developing countries during the last two years. This could be because m-health concept is new or has not been applied thoroughly in developing countries.

2) *Countries and number of participants analysis*: The analysis of studies conducted in developing countries showed that ten studies were conducted in China, five studies in Bangladesh, two in Jordan, one in Arab countries, one in Taiwan, one in Malaysia, and one in United Arab Countries. Table I and Fig. 5 show broad information about each study.

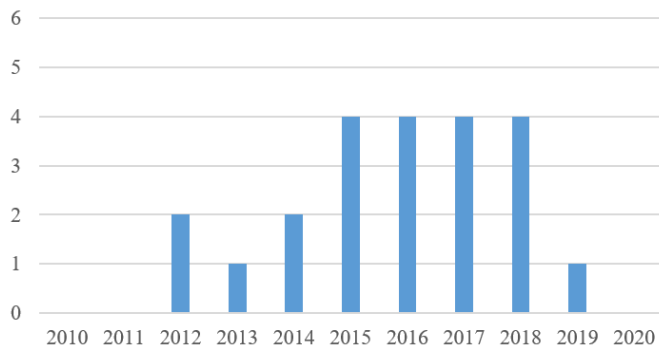


Fig. 4. Number of Studies Per Years (2010-2020).

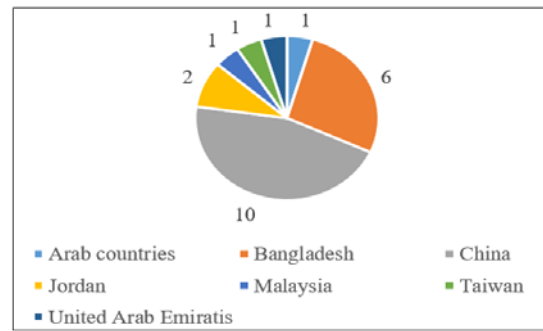


Fig. 5. Number of Studies Per Countries.

TABLE I. DETAILS OF THE STUDIES

Country	Targeted group	Participants	Reference
Arab countries	Elderly Arab m-health users	134	[7]
Bangladesh	Young citizen of public and private universities	144	[20]
Bangladesh	Elderly users	375	[14]
Bangladesh	All	227	[21]
Bangladesh	Patients	37	[27]
Bangladesh	Elderly users above 60	274	[22]
Bangladesh	All	296	[3]
China	All	429	[17]
China	Elderly users	212	[33]
China	M-health users Over 40	424	[11]
China	All	481	[35]
China	M-health users	428	[18]
China	All	650	[17]
China	Hypertensive patients	157	[13]
China	M-health service users	650	[36]
China	All	388	[12]
China	Elderly users above 60	395	[31]
Jordan	All	366	[15]
Jordan	All	365	[2]
Malaysia	All	480	[24]
Taiwan	Young users	170	[23]
United Arab Emirates	M-health users	144	[6]

B. Theories and Models Used

Different theories and model have been used in the 22 studies. These include the Technology and Acceptance Model, Theory of Reasoned Action (TRA), Unified Theory of Acceptance and Use (UTAUT), Protection Motivation Theory (PMT), Theory of Planned Behavior (TPB). It has been noted that the TAM model is the most applied model among the 22 selected papers. Some researchers used the same model, extended, or even combined it with other models. Two studies proposed hypotheses without specifying any theory or model. In addition, two studies have suggested new models. However, one study, which applied quantitative methodology, did not involve any theory. Table II shows the theories used in each study and their references.

C. Research Methodologies

The most popular research approach used in the m-health area is the quantitative research technique, while qualitative research is used only by Khatun et al. [27] out of the 22 studies. This could be due to the impossibility to interview patients directly. Health conditions of patients could be the possible reason.

D. Significant Factors

This section identifies only factors that have been proven to be affecting the behavioral intention in different countries. It has been noted the most significant factor identified in most studies is the preserved ease of use. The following Table III shows the significant factors, the number of studies, and their references.

TABLE II. THEORIES AND MODELS USED

Theory/ Model	Number of studies	Reference
TAM	10	[6] [7] [13] [17] [20] [21] [33] [15] [23] [36]
UTAUT	5	[2] [3] [14] [22] [33]
TRA	2	[33] [35]
PMT	2	[18] [33]
TPB	2	[33] [11]
New model	2	[17] [31]
No Model	2	[24] [27]
VAB	1	[11]

TABLE III. IDENTIFIED SIGNIFICANT FACTORS

Factor	Reference	N	Factor	Reference	N
Technical					
Perceived ease of use	[2] [6] [7] [12] [13] [15] [20] [21] [23] [33]	10	Perceived usefulness	[2] [6] [12] [15] [20] [21] [23] [33]	8
Performance expectancy	[3] [14] [22] [33]	4	Facilitating conditions	[3] [14] [35]	3
Effort expectancy	[3] [14] [22]	3	Resistance to change	[13] [22]	2
Technology anxiety	[22]	1	Technological incapability	[27]	1
Lack of access	[27]	1	Technological incapability	[27]	1
Individual					
Attitude	[7] [23] [24] [33] [35]	6	Trust	[6] [12] [15] [19] [27] [31]	6
Age	[18] [19] [23]	3	Self-Efficacy	[13] [18] [33]	3
Response Efficacy	[18] [33]	2	Awareness	[2] [27]	2
Gender differences	[27] [35]	2	Innovativeness	[2]	1
Smartphone technology usage experience	[13]	1	Illiteracy	[27]	1
perceived reliability	[3]	1	Language	[27]	1
Perceived Behavioral Control	[33]	1	Poverty	[27]	1
Waiting time	[14]	1	Perceived personalization	[19]	1
Social/Cultural/Environmental					
Social influence	[2] [3] [13] [14] [15] [22]	6	Subjective norm	[21] [33] [35]	3
Culture	[7]	1			
Security/Privacy					
Privacy	[12] [15] [19]	3	Security	[6] [15]	2
Performance risks	[12]	1			
Health					
Perceived Severity	[18] [33]	2	Perceived Vulnerability	[18] [33]	2
Relationship with the doctor	[13]	1	Support from hospital	[31]	1
Chronic disease	[12]	1	Declining physiological conditions	[31]	1

IV. DISCUSSION OF RESULTS AND LIMITATIONS

The number of studies in m-health adoption in developing countries is still low compared to the total number of devolving nations. There is an increased interest and attention by researchers in China, 10 studies, and Bangladesh, 6 studies, about the adoption of m-health apps by patients in the last ten years. However, the number of studies comparing to the number of developing countries is still low. Previous literature analysis revealed that little to no attempt to exploit qualitative or mixed methods had been made by present researchers. Only one research out of the 22 papers has used the qualitative approach. The qualitative method in healthcare can answer difficult questions or questions that may not be answered by quantitative research considering the context in which it has been examined [4]. Since mixed study methodology affords a clearer perspective and further interpretations of the conclusions and can provide richer account of healthcare than any approach can provide alone [34], both qualitative and mixed methodologies are crucially needed in m-health studies.

Regarding theories and models applied to m-health adoption studies, the TAM model has been mostly used, followed by UTAUT over other theories. The selected papers mostly focused on the technological and individual levels with the minimal intention to health-related factors. M-health is a combination of technology and health areas. Only three studies have mentioned some health-related factors in their studies, the role of chronic disease [12], declining physiological conditions [31], and relationship with doctors [13]. Some studies have used the theories with no consideration of the context that had been examined. Meng et al. [31] state a limitation of their study that it may not be applicable to other countries due to cultural differences. Chandran and Aljohani state that Saudi Arabian culture, for example, is a mixture of both traditions and Islamic believes and call for more consideration [8]. This is also applicable to other Arab and Islamic nations. From the analysis of the selected 22 studies, only one study considered cultural affect. Hence, there is a need to put more efforts to examine health-related factors by considering cultural aspects.

Age has been considered as a targeted group in some studies. For example, elderly m-health users have been included as the main targeted group in five studies [7-14-22-33-31] and young m-health users in two studies [20-23]. It would be more useful for future contributions to consider age to be a moderator to target more participants instead of specifying the sample size. Only two studies have examined the role of gender as a significant factor. Hence, there is a need to put some efforts into age and gender as moderators of factors affecting the adoption of m-health apps in developing countries.

In summary, there is a call for more studies about m-health adoption in developing countries. Exploring the adoption of m-health by applying qualitative or mixed methods will yield more excellent perspectives and offer more reliable evidence to m-health apps studies. There is more space for future research to analyze the impact of m-health on health and cultural factors.

V. CONCLUSION

A systematic review of literature to evaluate at m-health app adoption in developing countries between 2010 and 2020 was conducted for this study. Among 48 studies, 22 studies were included in the review, thereby proving to be suitable. Most studies had used quantitative methodology, but this particular one chose the qualitative method, and no one attempted to employ a mixed method. As most studies used the TAM model and focused on the technological and individual levels, the very low intention has been made to other health-related factors, levels, and theories. Moreover, there is a lack to consider the culture being examined. The review presents a broad overview of previous academic studies with a view to future research. This study would be useful as guide to other researchers in the future. Lastly, another research field for e-health is to look into whether e-health research can also be extended to m-health.

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