



## A framework for m-health service development and success evaluation

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### ABSTRACT

The emergence of mobile technology has influenced many service industries including health care. Mobile health (m-Health) applications have been used widely, and many services have been developed that have changed delivery systems and have improved effectiveness of health care services. Stakeholders of m-Health services have various resources and rights that leads to a complexity in service delivery. In addition, abundance of different m-Health services makes it difficult to choose an appropriate service for these stakeholders that include customers, patients, users or even providers. Moreover, a comprehensive framework is not yet provided in the literature that would help manage and evaluate m-health services, considering various stakeholder's benefits.

In this paper, a comprehensive literature review has been done on famous frameworks and models in the field of Information Technology and electronic health with the aim of finding different aspects of developing and managing m-health services. Using the results of literature review and conducting a stakeholder analysis, we have proposed an m-health evaluation framework which evaluates the success of a given m-health service through a three-stage life cycle: (1) Service Requirement Analysis, (2) Service Development, and (3) Service Delivery. Key factors of m-health evaluation in each step are introduced in the proposed framework considering m-health key stakeholder's benefits. The proposed framework is validated via expert interviews, and key factors in each evaluation step is validated using PLS model. Results show that path coefficients are higher than their threshold which supports the validity of proposed framework.

### 1. Introduction

The growth rate of Information Technology is so fast that we can observe new developments and applications every day in various fields like government, commerce, education and healthcare. Recently, IT developments in healthcare have demonstrated increasing proliferation potential [1]. Mobile health (M-Health) is a sub-segment of e-Health that is growing fast in recent years and more than 1500 mobile health applications have been developed by 2013 [2]. M-health is defined as “using the Internet and other technologies for releasing health information and services” [3]. Based on the definition provided by the Foundation for the National Institutes of Health (FNIH), m-Health refers to the delivery of healthcare services via mobile communication devices [4]. M-health has lots of advantages for health centers and patients, as it helps with reducing treatment mistakes, increasing time saving, improving efficiency and quality of care, facilitating m-health data gathering, and easing access to patient information [5].

Abundance of new coming and extant health services, coupled with limited resources, makes it a cumbersome task to rank and pick successful services. So, proposing a tool or model for determining the value of, and assessing and choosing m-Health services seems to be necessary.

A few studies have proposed conceptual service evaluation models or frameworks from a customer's viewpoint [2]. Yet, none of them presents a comprehensive framework which can be used for evaluating m-Health services while considering the viewpoints of all stakeholders in all steps required for developing the services.

Thus, this study attempts to propose a comprehensive framework for evaluating m-Health services which observes the following characteristics as per Khang & Moe [6]:

- Considering m-Health service evaluation from analysis stage to implementation stage.
- Guaranteeing service development and improvement through a service lifecycle.
- Considering different m-health stakeholder's points of view in evaluation process.
- Identifying suitable criteria for m-Health services evaluation in different steps of service lifecycle from viewpoint of different stakeholders.

The rest of this paper is outlined as follows. First, the extant literature is surveyed with two main tasks: (1) a stakeholder analysis of

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the m-Health field, and (2) an overview of m-Health related frameworks. This paper builds on the conducted literature review in order to shape service evaluation criteria upon which the proposed framework is developed. Then, the research methodology employed in this paper is outlined and described. Then, the proposed framework is introduced and validated using a Partial Least Squares. Finally, research findings are discussed and future research avenues are presented.

## 2. Literature review

As mentioned earlier, this section of the paper covers two tasks: 1) Identification and analyzing m-health service stakeholders, 2) Surveying evaluation framework in the three related fields including Information Technology, Health Information Systems and m-Health Applications. According to the results of studying these frameworks, suitable evaluation dimensions and measures can be defined for mobile health concept.

### 2.1. Stakeholder analysis

Stakeholder participation in the health sector is seminal due to its effects on health service quality as well as public health [7]. Therefore, considering different stakeholders, their needs and their interests is important in various stages of delivering a health service. This participation can mitigate risks of delivering an unwanted health service. In addition, it may lead to higher stakeholder satisfaction, and it can increase the likelihood of service success [8]. Stakeholder refers to an individual or group that can affect or be affected by actions of an entity such as an organization, a project or even a service. Stakeholders can be defined in four types [9]: 1) those who potentially benefit from an organization’s activities, 2) those who are affected inversely by the activities, 3) Supporters and opponents, and 4) those who are vulnerable to the aforementioned activities. Our categorization of m-Health stakeholders is illustrated in Table 1.

### 2.2. Evaluation framework and models

Recently many studies are done in the field of IT service management and various framework and models have been introduced. Evaluation frameworks and models are surveyed in this study considering three major fields: 1) IT evaluation frameworks such as ITIL and COBIT, 2) Evaluation frameworks in HIT and m-health fields and 3) Evaluation frameworks of Information system. Surveying different evaluation frameworks of these major fields helps us find out evaluation dimensions and factors of an m-Health service. The results of the survey are summarized in Table 2.

ITIL, as a set of best practices experienced by large companies in the field of IT service management, represents service development process via a life cycle [13]. Delone and Mclean [14] provided a framework for information system evaluation which Urbach and Müller [15] improved

initial framework by adding “service quality” and “net profit” as new factors. Yusof et al. [16] compared various evaluation frameworks of information systems and health information systems in a comprehensive study [16]. Buccoliero et al. [17] proposed a new approach for evaluation of e-health projects. Akter et al. [18] have surveyed quality of m-health services from three points of view: system, interaction and information. Leon et al. [19] have introduced a qualitative framework for evaluation of m-health service in large scale. Moreover, there are various frameworks which have been proposed by health experts and professional to evaluate e-health services and m-health services [20–23]. Although the aforementioned references outline several frameworks and models that are proposed for evaluating IT and e-health services in general, there are two main reasons that make m-Health different enough to have a specific evaluation framework: first, small size, no mouse and keyboard and widespread access of mobile tools and second, special operation system and variable connections [24]. Hence, our study proposes an evaluation framework that is specific to evaluation m-Health services.

As illustrated in Table 2, most of the frameworks and models reviewed in this study have considered different perspectives in evaluating services. Success of m-Health services not only depends on organizational measures, but also social, cultural and legal measures affect it. Therefore, considering various stakeholders is critical in order to guarantee success of m-health services. Among various models and frameworks surveyed in Table 2, there are some well-known frameworks while others have evaluated services considering a few measures with their interrelations. ITIL and COBIT follow a systematic and comprehensive approach in managing and evaluating IT services and Delone-Mclean Model considers various aspects affect success of an e-health service; so these three frameworks/models are valuable resources that are taken into special consideration in this study.

## 3. Research methodology

In order to review previous researches systematically, PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) has been used in this paper [33]. Flowchart of identifying, selecting and applying related researches is shown in Fig. 1.

Search terms have been considered top-down. First, broad search terms such as “service evaluation”, “evaluation of information system” and “evaluation of electronic services” have been surveyed. Then, more precise and relevant search terms such as “evaluation of healthcare information system”, “evaluation of electronic healthcare services” and “evaluation of mobile health services” have been used to survey literature which were published since 1980–2016. Due to the limited research terms and researches, no keyword has been deleted. Four databases including Science direct, Scopus, IEEE and PubMed were searched which lead to 76 researches. Moreover, four more researches were identified as a result of a search we conducted on open access dissertations and theses. There were no repetitive cases in these two

**Table 1**  
Different stakeholder of m-Health Services.

Stakeholder Group	Members	References		
		Omachonu and Einspruch [10]	Schmeer [11]	Hyder, et al. [12]
Society	Patients, their relatives and all people in society who are affected by the service.	●	○	
Government and Legislature	Health Ministry and any governmental/legislative body that can affect or be affected by the service.	●	○	●
Health Experts	Doctors, nurses and the heads of health centers/associations.	●	○	●
Health Consulting Firms	Public/private firms that serves customers with m-Health Services.	●	○	●
Suppliers/Service Providers	Providers of service content/software/hardware/infrastructure.	●	○	●

● means the stakeholder group has been explicitly mentioned in the related.  
○ means the stakeholder group has been implicitly mentioned in the related reference.

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