MOBILE HEALTHCARE SERVICES ADOPTION

Research in Progress

Genet Shanko, Addis Ababa University, Addis Ababa, Ethiopia, gdekebo2020@gmail.com
Solomon Negash, Kennesaw State University, Kennesaw, GA, USA, snegash@kennesaw.edu

Abstract

There is a growing consensus that electronic healthcare services is emerging as the modality for addressing healthcare delivery problems; as a result government agencies all around the world are touting some form of healthcare provision for their citizens. However, the adoption of mobile healthcare services is challenging. This research in progress evaluates adoption perceptions of mobile healthcare services among healthcare professionals. The explosion of mobile apps in supporting healthcare services has made it extremely important to understand the determinants of adapting mobile healthcare services. This study contributes to theory by providing empirical support for two new constructs, mobile network quality and facilitating conditions, in addition to compatibility and self-efficacy which were already confirmed in prior studies for assessing participants’ intention to use mobile healthcare services. For practitioners this study identifies what service providers and designers need to focus when developing mobile healthcare services.

Keywords: Mobile, Healthcare, TAM model, Adoption, Mobile network quality, Facilitating conditions, Compatibility, Self-Efficacy.

NOTE: The final papers should contain the authors' names, university and contact information, placed between the main title and the abstract.
1. Introduction

Healthcare access is a human right (Wu, Li, and Fu, 2011), the ubiquitous mobile device avails the potential to make it accessible for all. However, the adoption of mobile healthcare services is challenging. Government agencies in many countries have been touting some form of healthcare provision (Eysenbach, 2001). This paper evaluates adoption perceptions of a mobile healthcare system among healthcare professionals.

There is a growing consensus that eHealth, electronic healthcare services, is emerging as the modality for addressing healthcare delivery problems (Braa, Monteiro, and Sahay, 2004). Considering the global penetration of mobile devices, in some regions mobile devices are the only means of network access, understanding mobile healthcare services adoption is critical. This research in progress is designed to address the research question: What are the determinant factors that affect adoption of mobile healthcare services among health-extension workers?

Mobile healthcare system discussed in this paper refers to a computerized system that uses mobile phone interface for data input. Back-end processing and management reporting is still done on a server in a central location, but the data collection and input takes place using mobile phones, often at a remote location. Healthcare professionals that participated in this study are employees of a public healthcare organization that are tasked in collecting, communicating, and providing healthcare information to rural residents.

We use two mobile healthcare system examples to describe the domain. First, antenatal mobile healthcare system project in Ethiopia, this project has fifty-four posts where health-extension workers (often referred to as healthcare professionals) collect data from expecting mothers and assist them with prenatal care. The health professionals work in remote areas, converse with expecting mothers and input the information to a central system using their mobile phone. Further confirmation of data entry is done with reply SMS message to the server. The second example of a mobile healthcare system is the new-born and maternal health in rural Ethiopia with 13-million participants. Health professionals serve as intermediaries where they input health information about the mother and child, receive appropriate information from the central system back to the mother and child.

The health extension workers play a critical role in the success of the maternal and new-born as well as the antenatal service. Understanding the determinant factors of the health-extension worker is critical in reaching the millions of rural residents that are otherwise not connected to health information. This has impact in both practice and theory. Adoption characteristics of these types of mobile healthcare systems are different from the traditional system adoption of employees within the confines of an organization. While mobile technology has a broader reach, there are millions in rural areas that do not have access to mobile devices—the ability to reach the millions of rural residents maybe through health-extension workers. Understanding adoption characteristics of health-extension workers will inform policy makers and designers how best to develop these systems.

This research-in-progress attempts to understand the adoption characteristics of health-extension workers when using mobile healthcare systems.

2. Literature Review

The Technology Acceptance Model (TAM) has received broader empirical support for mobile healthcare services adoption (Wu, Wang, and Lin, 2007; Yi, Jackson, Park, and Probst, 2006; Yu, 2012; Wu, Li, and Fu, 2011; Cilliers and Flowerday, 2013).
We adapted the mobile healthcare acceptance model from Wu, Wang, and Lin (2007) and incorporated two empirically confirmed constructs for mobile systems including mobile network quality (Negash, 2011; Pikkarainen, Karjaluoto, and Pahnila, 2004; Negash, Meso, and Wirdeu, 2011) and facilitating conditions (Cilliers and Flowerday, 2013). Mobile network quality is a new construct we are testing within the TAM context. The theoretical model we tested is depicted in Figure 1.

Figure 1. Mobile Healthcare Services Model.

Perceived usefulness is the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). Healthcare professionals use mobile healthcare services to enhance their work, therefore we hypothesize:

- H1: Perceived usefulness has a positive effect on healthcare professional’s behavioral intention to use mobile healthcare services.

Perceived ease of use is a perception about operating a technology with less effort (Davis, 1989). Mobile healthcare services need to be easy to learn and use. Technological innovations that are easy to use will be less threatening to the individuals (Moon and Kim, 2001). This implies that perceived ease of use is expected to have a positive influence on professionals’ perception and their interaction with mobile healthcare services. Perception about operating a technology has a positive effect on the degree to which a person believes that using a particular system would enhance his or her job performance. Therefore, we hypothesize:

- H2a: Perceived ease of use has a positive effect on consumer acceptance of mobile healthcare services.
- H2b: Perceived ease of use has a positive effect on perceived usefulness.

Compatibility refers to the degree to which the innovation is perceived to be consistent with potential users existing values, prior experience, and needs (Rogers, 2003). Horan, Tulu, Hilton, and Burton (2004) integrated work practice compatibility and TAM to examine health professional acceptance of an online disability evaluation system and confirmed that compatibility affects the perceived usefulness of healthcare professionals. We also posit that healthcare professionals prefer easy access and use to mobile healthcare services. Compatibility has a strong direct impact on the variation in behavioural intention. Therefore, we hypothesize:

- H3a: Compatibility has a positive effect on perceived usefulness of mobile healthcare services.
H3b: Compatibility has a positive effect on perceived ease of use of mobile healthcare services.

H3c: Compatibility has a positive effect on behavioral intension to use mobile healthcare services.

Self-Efficacy is defined as the judgment of people’s capability to organize and execute course of action required to attain designated type of performance (Bandura, 1977). It is concerned not with the skills one has but with judgment of what individuals can do with skills they possess. We posit that users’ judgement about what they can do with their mobile healthcare skills will affect their usefulness and ease of use perception of mobile healthcare services. Therefore, we hypothesize:

H4a: User’s self-efficacy has a positive effect on perceived usefulness of mobile healthcare services.

H4b: User’s self-efficacy has a positive effect on perceived ease of use of mobile healthcare services.

Quality Internet connection and access is one of the key factors for mobile healthcare services use (Negash, 2011; Pikkarainen, Karjaluoto, and Pahnila, 2004; Negash, Meso, and Wiredu, 2011). Hoffman and Novak (1996) found significant correlation between download speed and user satisfaction. Therefore, we hypothesize:

H5a: Mobile network quality has a direct effect on perceived usefulness of mobile healthcare services.

H5b: Mobile network quality has a direct effect on perceived ease of use of mobile healthcare services.

Facilitating conditions describe the potential conditions that constrain or facilitate behavioural intention, similar to the concept of perceived behavioural control in the Theory of Planned Behaviour (Ajzen, 1991; Yang and Farn, 2009). Therefore, we hypothesize:

H6a: Facilitating conditions has a positive effect on perceived usefulness of mobile healthcare services.

H6b: Facilitating conditions has a positive effect on perceived ease of use on mobile healthcare services.

3. Methodology

We used survey methodology for this study. All questions were adopted from instruments validated in prior research; the only change made to the survey questionnaire is context change to reflect the mobile healthcare services we are studying. When distributing the survey we provided background information on the definition and use of mobile healthcare services, captured demographic data, and asked the related item questions for each construct. Data are collected using a five points Likert scale with strongly agree, agree, undecided, disagree, and strongly disagree scale.

4. Data Collection and Results

We collected data from 85 healthcare professionals that are enrolled in an extension evening university program. Seventy-five out of the eighty-five respondents indicated they are employed full-time at a healthcare facility where mobile healthcare systems are being implemented. Demographic information of the survey respondents is depicted in Table 1.
The causal effects theorized in our model are assessed using Partial Least Squares (PLS), a structural modelling tool using SmartPLS that has been supported in prior research (Chin, 1998; Gefen, Rigdon and Straub, 2011; Wixom and Watson, 2001; Hair, Ringle and Sarstedt, 2011).

PLS is similar to regression with respect to components based structural equation modelling technique. However, it differs from regression analysis in two fundamental ways. First, it simultaneously models the structural model (i.e., theoretical relationships among latent variables) and measurement model (i.e., relationships between a latent variable and its indicators). Second, the PLS algorithm allows each indicator to vary based on how much it contributes to the composite score of the latent variable rather than assume equal weights for all indicators. This means, indicators with weaker relationships are given lower weights (Chin, Marcolin and Newsted, 1996; Lohmöller, 1989; Wold, 1989). Analysis of the measurement and structural model are provided in the next two sections.

4.1 Analysis of the Measurement Model

The internal consistency reliability, convergent validity, and discriminant validity of the measurement model were assessed by the quantitative strength of each of the paths in the measurement model (Chin, 1998; Wixom and Watson, 2001). Internal consistency reliability is given by the Cranbach alpha values as presented in Table 2. All reliability measures were above the recommended level of 0.7 (Nunnally, 1967), this confirmed the validity of the survey instrument.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach Alpha</th>
<th>Average Variance Extracted (AVE)</th>
<th>Composite Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td>0.796511</td>
<td>0.8056764</td>
<td>0.880633</td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td>0.849385</td>
<td>0.757901</td>
<td>0.897681</td>
</tr>
<tr>
<td>Compatibility</td>
<td>0.912751</td>
<td>0.745592</td>
<td>0.927576</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>0.880316</td>
<td>0.852447</td>
<td>0.958494</td>
</tr>
<tr>
<td>Mobile Network Quality</td>
<td>0.850877</td>
<td>0.799452</td>
<td>0.940959</td>
</tr>
<tr>
<td>Facilitating Conditions</td>
<td>0.912144</td>
<td>0.814376</td>
<td>0.936456</td>
</tr>
</tbody>
</table>

Table 2. Cronbach Alpha, Average Variance Extracted (AVE), and Reliability.

Convergent validity is considered adequate when constructs have an average variance extracted (AVE) of at least 0.5 (Fornell and Bookstein, 1982). The AVE of each construct as presented in Table 2 is greater than the recommended 0.5 threshold. Convergent Validity is also confirmed when items load highly (greater than 0.5) to their respective reflective constructs (Fornell and Bookstein, 1982). All items have loaded highly, over 0.7 as shown in Table 2, once again confirming convergent validity.

To satisfy discriminant validity, the square root of AVE for each construct should be greater than the variance shared between the construct and other constructs in the model (Fornell and Bookstein, 1982; Gefen, Rigdon and Straub, 2011; Wixom and Watson, 2001). The square root of AVE (√AVE) results as shown in Tables 3 satisfies the recommended threshold confirming discriminant validity except the case of PU/FC where discriminant validity is not confirmed. This is a research in progress and we will evaluate this further in the full study.

Table 1. Demographics characteristics.
## 4.2 Analysis of the Structural Model

The structural model reveals the extent to which independent constructs explain the variance in a dependent construct’s $R^2$ values. Based on the results depicted in Figure 2 the model explains 67.4% ($R^2=0.674$) of the variance in participants’ intention to use mobile healthcare services. All path coefficients indicate support for the hypothesized relationships with 95% confidence level ($p=0.05$).

![Figure 2. Structural model for mobile healthcare services](image)

### Table 3. Square Root of AVE ($\sqrt{AVE}$) and Correlations. Legend: Use=Intention to Use, PU=Perceived Usefulness, PEOU=Perceived Ease of Use, CPAT=Compatibility, SE=Self-Efficacy, MNQ=Mobile Network Quality, FC=Facilitating Conditions, and $\sqrt{AVE}$=Square Root of Average Variance Extracted.

<table>
<thead>
<tr>
<th></th>
<th>$\sqrt{AVE}$</th>
<th>Use</th>
<th>PU</th>
<th>PEOU</th>
<th>CPAT</th>
<th>SE</th>
<th>MNQ</th>
<th>FC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>0.873</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU</td>
<td>0.783</td>
<td>0.665</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEOU</td>
<td>0.865</td>
<td>0.512</td>
<td>0.691</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPAT</td>
<td>0.834</td>
<td>0.754</td>
<td>0.461</td>
<td>0.542</td>
<td>1.000</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>SE</td>
<td>0.923</td>
<td>0.865</td>
<td>0.656</td>
<td>0.745</td>
<td>0.345</td>
<td>1.000</td>
<td></td>
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</tr>
<tr>
<td>MNQ</td>
<td>0.893</td>
<td>0.614</td>
<td>0.591</td>
<td>0.612</td>
<td>0.518</td>
<td>0.842</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td>0.724</td>
<td>0.435</td>
<td>0.891</td>
<td>0.713</td>
<td>0.424</td>
<td>0.655</td>
<td>0.412</td>
<td>1.000</td>
</tr>
</tbody>
</table>

5. Discussion and Conclusions

With all hypotheses supported this research in progress extends the Wu, Wang, and Lin (2007) mobile healthcare adoption model by empirically confirming two additional constructs: mobile network quality and facilitating conditions. Our findings are consistent with prior studies where mobile network quality (Negash, 2011; Pikkarainen, Karjaluoito, and Pahnila, 2004; Negash, Meso, and Wiredu, 2011) and facilitating conditions (Cilliers and Flowerday, 2013) were confirmed as essential constructs in mobile services. And compatibility and self-efficacy were already shown to extend the TAM model (Wu, Wang, and Lin, 2007).
Compatibility has a direct impact on the dependent variable (intention to use) as well as the mediating variables (perceived usefulness and perceived ease of use); furthermore the structural model confirms compatibility has the strongest magnitude in the path coefficients. This implies compatibility is the most significant antecedent of mobile healthcare services adoption and must be taken into account when promoting and implementing mobile healthcare services. These findings are consistent with prior studies; for example, Holden and Karsh (2010) had confirmed the significance of staff facilities for implementing and using an online system in clinical practices. Other studies (Hu, Chau, Sheng and Tam, 1999; Istepanian and Pattichis, 2006; Hung, Ku and Chien, 2012) have also shown that intra-organizational computing facilities had influence on perceived ease of use and internal and external computing services also had effect on perceived usefulness for technology acceptance.

There is increased interest in understanding the benefits that can be obtained from an information technology investment in healthcare such as improvement of healthcare quality, patient’s satisfaction, decreasing clinical error, and up-to-date and pertinent healthcare information. The explosion of mobile apps in supporting healthcare services has made it extremely important to understand the determinants of adapting mobile healthcare services. This study contributes to theory by providing empirical support that mobile network quality and facilitating conditions extend the TAM model in assessing participants’ intention to use mobile healthcare services in addition to compatibility and self-efficacy. For practitioners this study identifies what service providers and designers need to focus when developing mobile healthcare services.

Larger data set are being collected to extend the results of this research in progress.

References


