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Research Article

Issues and Challenges of Implementing Mobile e-Healthcare Systems in South Africa

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ABSTRACT

Mobile e-Healthcare implementation in South Africa has the potential to improve the delivery and access to healthcare services. However implementation of Mobile e-Healthcare continues to face various challenges such as inadequate policy, lack of management support, poor infrastructure and concerns around security of information, especially in the rural and remote areas. This study aims at identifying the issues and challenges of implementing Mobile e-Healthcare in South Africa and then develop a framework which healthcare facilities can use as a guide for successful implementation of a Mobile e-Healthcare system. An exploratory study was conducted at the beginning of the study, followed by a literature study. A questionnaire was then developed from findings of literature and exploratory study and used to conduct a survey among 200 healthcare professionals and managers in Limpopo Province. Permission and ethical clearance was obtained from Tshwane University Technology and Limpopo Healthcare Department. Structural Equation Modeling using AMOS was used to test the hypotheses. Lack of management support was identified as the biggest challenge whereas, the Acceptance and Use readiness and its sub-components have the strongest ability to predict preparedness to implement Mobile e-Healthcare. This study has developed and validated a Framework for assessing a healthcare facility readiness to implement a Mobile e-Healthcare system which is the gap identified from literature. Policy and decision makers will be able to use the developed model as an important reference when a healthcare facility is implementing a Mobile e-Healthcare system

Keywords: Mobile, e-Healthcare, Readiness, Assessment, mHealth, and Issues and challenges

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INTRODUCTION

Information and Communication Technology (ICT) has proven indispensable in the delivery of healthcare and access to healthcare services. ICT has facilitated the delivery of healthcare services to places and people that were previously not possible, enabling solutions to numerous healthcare delivery challenges. However despite advancements in medical technologies and a general increase in income levels, delivery and access to healthcare services continues to be a challenge in both developed and developing countries, (GSMA –PWC- Report, 2012), especially in rural and remote communities which are not benefiting much from the ICT revolution in healthcare.

Many rural areas are resource challenged in a number of ways, from lack of: basic ICT infrastructure, electricity and

poor network connections. The healthcare facilities in the rural areas are also equally disadvantaged in so many ways, lacking qualified medical personnel, hospital equipment and infrastructure. This makes it difficult for healthcare facilities in the rural areas to handle the numerous healthcare needs of the community. In South Africa for example majority of the citizens are poor and unemployed with almost 60% of poor households living in rural areas with limited access to decent healthcare (Hofman & Tollman, 2010). As Gaede and Versteeg (2011) put it, majority of those living in rural areas face numerous barriers in accessing affordable healthcare such as poor infrastructure in many rural healthcare facilities; limited healthcare services; the costs involved such as simple consultation turning into a day's work; distance to and from healthcare facilities; as well as inadequate modes of transport.

E-healthcare systems are being used worldwide to address this rising healthcare issues and challenges. However geographical locations, wires and cables are threatening e-healthcare benefits. Mobile technologies which are not constrained by wires and cables in particular have shown remarkable effectiveness in various areas of healthcare delivery, services and procedures. However, implementation of e-health initiatives is very problematic, with many failing to demonstrate predicted benefits (Murray et al., 2011). Several researchers have documented the challenges facing successful implementation of e-healthcare systems in general and Mobile e-Healthcare in particular especially in rural areas. Ross, Stevenson, Lau and Murray (2016), identified *Adaptability* – the ability of the technology to fit local context, *Interoperability*, *Complexity*, *start-up costs*, *Inadequate Legislation and policies*, *Compatibility*, *Resistance of Physician to e-health implementation*, *Availability of resources Knowledge, Attitude and Beliefs*, *Lack of a strategic planning*, *Engagement and Management Support* – as some challenges of implementing e-health initiatives. Other challenges include: inadequate policy, lack of technical expertise and poor infrastructure (Kay et al. 2011; King et al. 2012); concerns around security, and privacy of highly sensitive patient data (Wickramasinghe & Goldberg, 2009; Whittaker, 2012), scalable architecture, which would enable programmes to run on every device in the market (Ehrler et al. 2013). Laxman, Krishnan and Dhillon (2015) enumerated the following barriers to the adoption of Mobile e-Healthcare from various researchers: lack of physician support; lack of existing technology; concerns about regulation and efficacy of applications; security; difficulty understanding the technology; not user-friendly; Mobile e-Healthcare being seen as detachment from human touch, lack of support, connectivity barrier because some places are still without internet and broadband.

Modi and Mohanty (2015) describe confidentiality of data, security and safe guarding of personal data; market volatility, rapid evolve of devices, consumer's habits which change rapidly and issues of integration with the existing systems as some of the challenges of implementing a Mobile e-Healthcare system. Mcaskill (2015) identified lack of: specific regulatory framework; standard comprehensive reimbursement policies; security in terms of patients of information, misplacement of the devices or even downloading and spreading virus with own device and IT Support as some of the challenges to overcome for successful implementation Mobile e-Healthcare.

Aranda-Jan et al. (2014) identified lack of an organizational capacity, standards, guidelines, policies and regulations; inadequate planning and poor project design; limited funding of long-term projects (Cost); lack of in-depth research; external factors such as: culture, illiteracy, treatment duration, unclear roles and responsibilities in government and ministries, and limited local technical support and capacity as failure factors of Mobile e-healthcare implementation.

Similarly, Albabtain, Almulhim, Yunus and Househ (2014) enumerated the challenges of implementing Mobile e-Healthcare in developing countries as: the unreliability and cost of the internet; cultural diversity; security and privacy concerns because of limited security features of the cellular

phones, smartphones and PDA; the cost of mobile health devices, lack of required education and the needed knowledge to use the Mobile e-Healthcare system, and non-availability of relevant training; lack of policy and the absence of mobile phone usage guidelines and standards; poor infrastructure and lack of skilled healthcare workers.

In 2015 Applied Clinical Trials and SCORR Marketing carried a survey on Mobile e-Healthcare in Clinical Trials, the result showed that the leading challenge in implementing Mobile e-Healthcare is the knowledge to execute the skills, followed by cost and buy-in by the organisation management (Applied Clinical Trial Editorial Staff, 2015).

The result of the most recent survey also carried out by SCORR Marketing (2017), in partnership with Applied Clinical Trials indicated that security and cost are the most key challenges of Mobile e-Healthcare technology, whereas the biggest challenges facing the pursuit of Mobile e-Healthcare goals are: Organizational buy-in, internal knowledge and Funding.

Gurupur and Wan (2017) identified implementation challenges and barriers of Mobile e-Healthcare as: resistance to change in general, existence of unreliable technologies, non-uniformity of technological availability, inadequate usability features, *System Integration and interoperability*, *Data security and Privacy* and lack of end-user education among others.

Meyers et al. (2017) state that poor process planning and design, management and leadership transitions, and a lack of consistent vision of how to operationalise the data are some of the challenges encountered in their implementation of Mobile e-Healthcare. They concluded that for Mobile e-Healthcare or any e-health intervention in low-resourced global settings to be successful, appropriate and actionable data collection, organisational buy-in and effective process management are necessary.

Other challenges for e-healthcare in general include: the costs involved in initial outlay and sustainable financing, (Ojo et al. 2008; Leon et al. 2012; Ehrler et al. 2013), different expectations from stakeholders (King et al. 2012; Jimoh, 2012), fear and anxiety of new technology (Luo, 2008), resistance to change (Lorenzi & Riley, 2003; Qureshi et al. 2012) staff interference (Dowling, 1980) and lack of top management support (Ilorah, 2009).

The challenges discussed above may impede successful implementation of Mobile e-Healthcare, leading to failure, disruptions in the workplace, loss of time and financial resources. Accordingly the World Bank stated that for an organisation to put mobile devices to effective use in healthcare delivery and access, the stakeholders must be mobile health ready in terms of infrastructure, accessibility to clients, affordability, and the effect of the legal and regulatory framework on mobile technology use (Naidoo & Klopper, 2005).

Over the years efforts of some South Africa health Department to implement Hospital Information systems and e-health initiatives were met with numerous challenges and problems.

This study therefore aims at identifying the issues and challenges affecting successful implementation of Mobile e-Healthcare system in South Africa, and then suggest ways

which healthcare facilities can use as a guide for successful implementation of a Mobile e-Healthcare system

METHODOLOGY

An Exploratory study was carried out for need assessment of the Department of Health in Limpopo to identify barriers and facilitators of implementing a Mobile e-Healthcare system. The key informant indicated that they had not really implemented a Mobile e-Healthcare; they are looking towards mobile health but there is no policy yet to guide the implementation. Their focus is gathering information on what need to be done to be ready to implement a Mobile e-Healthcare system. The key informant interviewed for the exploratory study spoke in terms of their experience from the Hospital information systems, telemedicine and the now towards mobile health. From the analysis of exploratory study several factors were gathered from the key informants as the key challenges they are facing for the implementation of Mobile e-Healthcare. These include: lack of technological infrastructure in the rural and remote areas; lack or inadequate policy that will guide the implementation process, reimbursement, use of personal devices; negative attitude from the Top management, resistance from the doctors who protests that they are being given more work arguing that patient needs human touch; the argument that the patients are too poor and might not have the mobile devices for the Mobile e-Healthcare system to work. The exploratory study was followed by an extensive literature study. Numerous factors were gathered as the challenges and issues of implementing e-healthcare in general and mobile e-Healthcare in particular as discussed in section 1 above.

A quantitative study using survey method was conducted. The factors gathered from literature, and the exploratory study were categorised and grouped into the following constructs. Need Change; Engagement; Technological; Resource; Policy; Community and Acceptance and Use Readiness. Acceptance and use readiness has six sub-factors: Performance Expectancy; Effort Expectancy; Organisational Influence; Facilitating Conditions; Compatibility; and Attitude. These constructs are also readiness factors from literature. Applying the identified factors, issues and challenges of implementing an e-Healthcare system from literature and the challenges gathered from the exploratory study, a questionnaire was constructed and used to collect data. They were hand delivered and later collected back. The study participants were 200 healthcare professionals (Doctors and nurses) and healthcare facility managers in the participating healthcare facilities. The necessary ethical clearance was obtained from research Ethics Committee of Tshwane University of Technology. The Limpopo Department of Health South Africa gave the clearance and permission to conduct the research.

In designing the survey questionnaire for this research study, the guidelines as provided by Babbie (2005) and Kumar (2011) were followed. Each construct was represented on the survey by multiple statement items. Some of the statements or questions were adapted from items generated from previous readiness studies (Khoja et al. 2007; Ojo et al. 2008; Jennett et al. 2003; Snyder-Halpern, 2001; Edwards et al. 2000), and

technology acceptance and use studies (Davis, 1989; Moore & Benbasat, 1991; Venkatesh et al. 2003).

The questionnaire was structured as a multiple choice closed statement items where participants were asked to select their level of agreement with each statement. The questionnaire also has elements of open-ended questions to cater for participants opinions. Five PhD students, 5 medical doctors and two healthcare managers pre-tested the questionnaire statements to check for ambiguous statements, negative, double barrelled questions, errors, instruction clarity and duplicate items. The questionnaire was then restructured based on the feedback from the pre-test. The instrument has a five-point Likert-scale, which ranges from strongly agree (5) to strongly disagree (1).

Data analysis: IBM SPSS version 23.0 was used in the analysis of the quantitative data collected. IBM AMOS 23.0 was used to perform the Structural Equation Model (SEM) to investigate the inter-relationship between the 7 constructs, the associated 5 sub-constructs and Mobile e-Healthcare. Data from the open-ended questions were analysed manually by finding the themes and used to support the findings of the quantitative data.

The questionnaire instrument was evaluated for reliability using Cronbach alpha. The result showed individual constructs reliability of .726 to .966.

The Convergent and Discriminant validity were also checked using factor loadings, Composite Reliability (CR) and Average Variance Extracted (AVE). Farrell and Rudd (2009) describe discriminant validity as the extent to which a latent variable discriminates from the other latent variables. That is the extent to which a construct is truly distinct from other constructs (Hair et al. 2006). Convergent validity on the other hand is the extent to which items of a specific construct converge or share a high proportion of variance in common (Hair et al. 2006).

Before performing the SEM analysis the constructs were subjected to principal component analysis (PCA). The result shows organisational readiness and Facilitating conditions (FC) loading in one component. The FC was dropped from further analysis to avoid multicollinearity.

SEM consists of two paths, the measurement model and the structural model. The measurement model was confirmed in Confirmatory Factor Analysis (CFA). Structural Model (SM) is a set of one or more dependence relationships linking the hypothesised model constructs (Hair et al. 2006).

RESULTS

A total number of 200 questionnaires were distributed, 160 were returned resulting in a response rate of 80%. 125 (78.12%) were found to be useful for analysis. Out of the 125, [71 (56.8%)] were females and 54 (43.2%) were males. The modal age group of the respondents was 35-44 [39 (31.2%)], followed by 25-34 [34(27.2%)]. The rest are 18-24[1(0.8)], 45-55 [30(24%)] and 55 and above [21(16.2)].

The result from the analysis of SEM is presented in the Table 1.

Need for Mobile e-Healthcare System: The need for Mobile e-Healthcare systems was tested using Need Change Readiness construct defined as implementers' realisation of problems in accessing and delivering healthcare services, exacerbated by a combination of real or genuine needs (Ojo et al. 2008). It appears not an issue or challenge by the participants. Majority of the participant indicated that there is a need for change in status quo and for a system such as Mobile e-Healthcare but result of the SEM analysis shows that it does not influence the implementation of Mobile e-Healthcare.

Engagement readiness: This construct tests the communication messages between the implementers and users, the need for the implementers to provide the necessary training and the willingness of the healthcare professionals to engage candidly about the proposed system and participate in the required training. This is regarded as a very important factor that if not attended to may impact negatively to the implementation of Mobile e-Healthcare. This also agrees with other studies such as (Whittaker, 2011) that found that absent of engagement leads to implementing a system that will face rejection and resistance.

Technological Readiness: This construct tests the extent to which healthcare institutions have efficient IT infrastructure and technical resources in place to support successful implementation of Mobile e-Healthcare. The result shows that Technological Infrastructure is a big challenge. This supports

the result from the open-ended part of the questionnaire. In the question;

What challenges do you foresee in the implementation of Mobile e-Healthcare?

Below are some of the responses:

Unavailability of technological infrastructure, Lack of IT equipment, corruption in procurement -maintenance (poor) for sustainability.

Technology- we need easy access and availability of Wi-Fi in the hospitals for easy access to the web.

The facility is not ready because of the following: no computer, laptops, no secured infrastructure and no security fencing for safekeeping or for safeguarding of the available assets.

We have no computers and internet in our facility -we don't even have an IT trained personnel

Lack of IT equipment, Need for ICT & telecommunications and Network challenges in remote areas

Resource Readiness: tests the extent to which a healthcare organisation is aware of organisational resources required for the initial Mobile e-Healthcare innovation, customisation and implementation process as well as on-going maintenance (Li et al. 2012). This result shows that this is not an issue or a challenge for implementation. From the open-ended question the participant indicated that being aware is not the issue but the willingness of the Top management to provide the required resources.

Table 1:
Results of the analysis

Construct	Result from SEM	Interpretation	Issues and challenges of implementation of Mobile e-Healthcare system in SA
Need Change Readiness	Not Supported	Not viewed as an issue in Implementation	N/A
Engagement Readiness	Supported	Issue for Implementation	Lack of Engagement with key users
Technological Readiness	Supported	Issue for Implementation	Lack of Technological Infrastructure
Resource Readiness	Not Supported	Not viewed as an Issue in Implementation	N/A
Policy Readiness	Supported	Issue for Implementation	Lack of adequate policy to guide implementation and use
Community Readiness	Not Supported	Not an Issue in Implementation	N/A
Acceptance and Use Readiness			
Performance Expectancy	Supported	Issue for Implementation	Concern about system performance
Effort Expectancy	Supported	Issue for Implementation	The concern on if the system will be user friendly
Organisational Influence	Supported	Issue for Implementation	Top Management support
Compatibility	Not Supported	Not an Issue in Implementation	N/A
Attitude	Supported	Issue for Implementation	Attitude of users

Policy Readiness: Tests the existence of policies at the government and healthcare institution levels to address issues such as licensing, liability, and reimbursement (Khoja et al. 2007). The result indicated that it is a challenge. Policy is also identified by several studies as described in section 1 above as a challenge for the implementation of Mobile e-Healthcare systems. Lack of clear policy is also one of the top barriers for implementing mobile health in all the WHO regions (Kay et al., 2011). The result also agrees with the open-ended question below.

To the question - **please suggest other factors you consider a challenge for Mobile e-Healthcare implementation, give reasons.** The participants are unanimous on the need for clear guiding policy, they had these to say about policy:

There is a need for policies and guidelines

Maybe if there are national and local policies in place

Policies: to address areas of concern such as the ethics of confidentiality and the potential for abuse (the use of devices for what is not initially intended for).

Policies to guide reimbursement should healthcare professionals use their devices

Community Readiness: This construct tests the communication channel between the healthcare facility and the community and other healthcare facilities. The result does not indicate this factor as a challenge.

Acceptance and Use Readiness: tests the intention to accept and use Mobile e-Healthcare system (Ojo et al. 2008). The collective result of the sub-constructs shows that user acceptance and use is an issue and challenge.

Performance Expectancy: tests the degree to which a person believes that using Mobile e-Healthcare will enhance his or her job performance. The result indicated this construct as an issue since most participants indicate their intention to use the system if it enhances their productivity and it is not disruptive.

Effort Expectancy: tests the degree of ease associated with the use of a system; that is, the belief, that using the system will not be difficult. This is an issue because even if a system enhances performance but is difficult to use then it will not be used. If the users of a system find it easy to use then it will lead to continuous use, hence increasing performance. However Davis (1989:333) states, although difficulty of use can discourage use of an otherwise useful system, no amount of ease of use can compensate for a system that does not perform a useful function.

Organisational Influence: addresses the degree to which an organisation's Top management supports (financially, provide security and other needed resources) and influences workers to use the technology. The result from analysis indicates this factor as a major challenge in the Mobile e-Healthcare implementation. The literature also supports this finding. The result of the open-ended question supports this result for example, where the participants were asked; *what challenges do you foresee in the implementation of Mobile e-Healthcare?* The responses were unanimous and include:

Commitment from management, for it to succeed there should be transparency of "tender process";

Our management are not willing to help us, we need commitment from our management, we have too much management turnover, one manager will support a project another will come and not care, there goes the project We should be consulted when they (the management) make decisions about our works because sometimes they think they are helping us but the systems they put does not support what we do.

Compatibility: looks at the degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of healthcare facility, potential implementers and users (Moore & Benbasat, 1991). This result shows that this is not considered as an issue to successful implementation. The participants might not regard compatibility as a factor because they might have had a very bad experience with current system that anything compatible with it is viewed with suspicion. According to Karahanna et al. (2006), the existing practices may be so inefficient and ineffective that compatibility of a new system with such practices may be viewed negatively and indeed have a negative effect on its perceived usefulness.

This view of Karahanna is supported by the following comment from open-ended question:

Telemedicine project failed dismally, capacity is reduced year by year (Financial and human skilled resources) are decreasing yearly but the number of patients are increasing yearly without the financial resources, expertise and knowledge to use e-technology, so why should accept this new system.

Attitude: tests an individual's positive or negative feelings towards the implementation and use of Mobile e-Healthcare (Fishbein & Ajzen, 1975). The result shows that this is an issue and challenge. If the intended users view the system negatively, then they might not be willing to give the systems a chance.

DISCUSSION

In this study, the issues and challenges of implementing a Mobile e-Healthcare systems were investigated through data collected were analysed using SPSS version 23 and Structural Equation Modelling (SEM). Schermelleh-Engel et al. (2003) suggest that SEM be evaluated using multiple criteria and also to evaluate model fit on the basis of various measures simultaneously as there is no single statistical significance test that identifies a correct model given the sample data. Similarly Chin (1998) asserts that many researchers are over relying on goodness of fit measures for SEM studies to the detriment of other measures. The fit measures only show how well the parameter estimates are able to match the sample co-variance, leaving out how well the latent variables or item measures are predicted. In support of this, Fabrigar et al. (2010) assert that researchers using SEM tend to over-emphasize the use of model fit indices at the cost of other important information. Many models that have good fit indices may still be considered poor based on other measures such as the R-square,

factor loadings and vice versa (Chin, 1998). The result from SEM analysis were evaluated using multiple criteria.

Literature also shows that most of the challenges and issues are basically readiness factors. The study therefore, armed with the different issues and challenges, together with the readiness assessment factors from literature, designed a questionnaire instrument and used it to collect data from healthcare professionals and managers to gather their opinions. This tool was designed to extensively identify the issues and challenges of implementing a Mobile e-Healthcare system in South Africa. The tool also doubles out as a tool for assessing healthcare facility readiness to implement a Mobile e-Healthcare system by addressing the major barriers, challenges and issues of m-Healthcare implementation. Management support appears to be very important for a successful implementation. Hence in planning of Mobile e-Healthcare system, there should be consideration of the issues raised, such as management support, how the change messages are communicated, the infrastructure requirements, issues around security and confidentiality. These will lead to successful implementation and will allow greater acceptance and use.

Mobile e-Healthcare implementation should be preceded by thorough planning, preparation and assessment of healthcare facility readiness. The Mobile e-Healthcare tools developed were validated in participating healthcare facilities of Limpopo Province of South Africa and are intended for managers and decision makers to use when planning for Mobile e-Healthcare programs in their healthcare facilities. The tool explained the factors that need to be in place or to be addressed when planning to implement a Mobile e-Healthcare system. Having tools that could be used in the assessment of Mobile e-Healthcare readiness should help in improving the quality of planning and addressing the issues and challenges of implementing Mobile e-Healthcare programs in healthcare facilities in South Africa and other developing Countries, and also help in creating awareness of the change process thereby increasing the stakeholders' trust in the system.

Competing interests

The authors declare that they have no financial or personal relationships which may have inappropriately influenced them in writing this article.

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