Readiness Assessment Framework for Implementation of Mobile e-Healthcare in Rural South Africa

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Abstract

Although healthcare is the biggest service industry in the world, it has yet to realise the full potential of the e-business revolution in the form of e-Healthcare due to many complex challenges. E-Healthcare also does not solve all the problems of rural and remote communities with geographical barriers, because most of the rural and remote areas that e-Healthcare are supposed to help have no electricity connections and other infrastructure needed by e-Healthcare systems. Mobile e-Healthcare removes the restrictions imposed by infrastructure challenged, underserved population, rural geographical locations, wires and cables and enables patients to benefit from increased mobility provided by e-Healthcare. The main objective of this study was therefore to identify e-Healthcare readiness assessment factors in the literature and use them to develop a Mobile e-Healthcare readiness assessment framework for the implementation of Mobile e-Healthcare in rural South Africa health facilities.

Keywords: Mobile e-Healthcare, Mobile e-Healthcare readiness, Readiness assessment, e-Readiness

1. Introduction

Although healthcare is the biggest service industry in the world, it has yet to realise the full potential of the e-business revolution in the form of e-Healthcare due to many complex challenges (Wickramasinghe et al., 2005). These challenges include but not limited to chronic shortages of healthcare practitioners, limited healthcare budgets, poor healthcare delivery infrastructure, and inefficient use of the limited

healthcare resources (Kay et al., 2011; Shen, 2012; GSMA –PWC- Report, 2012). Numerous benefits are promised by E-Healthcare. These include more efficient healthcare services; improving access to healthcare, especially in remote areas, for people with disabilities and for the elderly through higher quality of care and health promotions. It also promised reduction in healthcare cost, redundancy and duplication of examinations (Ojo et al., 2008).

E-Healthcare however is not a magic bullet to all people everywhere due to different geographical locations. Most of the rural and remote areas that e-Healthcare are supposed to help may not have electricity connections, may not able to afford initial cost and other infrastructure needed by e-Healthcare systems. Moreover, challenges presented by landline connectivity and constant disruption of power by cable thefts make it hard for point-to-point systems. This calls for a different e-Healthcare strategy or an alternative solution such as using mobile technological devices to deliver or access healthcare services. E-Healthcare delivered through mobile devices is referred to as Mobile health (M-health) and various other names by different authors such as; mobile healthcare (Wu et al., 2007) or mobile e-health (Panteli et al., 2007). In this study mobile health is referred to as *Mobile e-Healthcare*.

Mobile e-Healthcare (m-Healthcare) a component of e-Healthcare is a rapidly expanding area within e-Healthcare. It makes use of mobile computing and communication technologies in healthcare delivery to the public (Free et al., 2013). Mobile healthcare is the use of mobile devices such as cell phones, smartphones, laptops, tablets, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices to collect, retrieve and/or deliver healthcare services and information (Boisvert, 2012; Kay et al., 2011). In this study *Mobile e-Healthcare is defined as the use of mobile technological devices such as cell phones, laptops, smart phones, computer tablets and their features to meet the healthcare needs of citizens unbound by time and geographical locations.* Mobile e-Healthcare removes the restrictions imposed by rural geographical constraints, wires and cables and enables patients to benefit from increased mobility provided by e-Healthcare (Ojo et al., 2008; Ditsa & Ojo, 2011).

The successful implementation of Mobile e-Healthcare has the potential to improve efficiency, reduce cost, inequity, medical errors and transform the face of healthcare services delivery across the globe (Kotz et al., 2009; Kay et al., 2011; Chaudharya et al., 2014). This will also solve a number of pressing problems facing healthcare systems, including challenges of access and quality of care (Jennett et al., 2003).

The ubiquitous nature of mobile platform applications also makes them indispensable for emergency situations due to the availability of services anytime and anywhere (Friedland & Muylken, 2009). This is because peoples' healthcare problems follow them wherever they go and people also more else carry their mobile devices with them always. Mobile e-Healthcare also removes location constraints as there is no need for patient and healthcare professionals to be in the same location or to be stationary (Varshney, 2014).

Despites the above numerous benefits of e-Healthcare and Mobile e-Healthcare, the literature has however documented several challenges and barriers of implementing an e-Healthcare system in general (Jennett et al., 2005; Dowling, 1980; Ilorah, 2009; Littlejohns et al., 2003; Al-Ahmad et al., 2009; Lorenzi & Riley 2003; Qureshi et al., 2012) and Mobile e-Healthcare in particular (Kay et al., 2011; Khan et al., 2013; Whittaker, 2012; Ehrler et al., 2013).

These challenges include but not limited to the cost involved in initial outlay and maintenance, Ojo et al., (2008), different expectations from stakeholders (Jimoh, 2012), fear of change, and anxiety of new technology (Luo, 2008), resistance to change (Dowling, 1980; Lorenzi & Riley, 2003; Qureshi et al., 2012) and inadequate policy and infrastructure (Whittaker, 2012; Kay et al., 2011). Other barriers and challenges include: perceived lack of relevance of research into practitioner Macfarlane et al., 2011) and other stakeholders' needs (Al-Ahmad et al., 2009); and lack of sponsor or management support (Geethalakshmi & Shanmugam, 2008), conflicting ICT application preferences by end-users and that of the top management, which if ignored will make implementation difficult and sustainability less likely

(Jimoh et al., 2012). Luo (2008) further states that the anxiety of learning the use of new systems, the frustration with constant technological change, and hesitance to get out of an established routine may fuel the implementation challenges.

Including in the above challenges are a number of risks associated with the implementation of e-Healthcare and e-Healthcare initiatives. One of the biggest of these risks is the unintended widening of the gap in health status and knowledge between different sectors of the population, thereby increasing rather than addressing health inequity (Khoja et al., 2008; Eysenbach, 2001).

One method of avoiding this divide is for governments and healthcare institutions in developing countries to assess and prepare for change before adopting programs that require the use of ICT (Khoja et al., 2008). The literature shows that e-Healthcare preparedness or readiness is measured by assessing the status of the government, the healthcare facility, managers, healthcare professionals, and users amongst others in terms of e-Healthcare implementation, adoption and use (Wickramasinghe et al., 2005;Ojo et al., 2008; Alliance for Building Capacity, 2002; Khoja et al., 2007). In other words if the status are unknown, these challenges and risks may impede the successful implementation of Mobile e-Healthcare, if the environment where it is to be implemented is not ready.

Numerous factors determine whether or not an organisation is ready to implement and use a technological innovation to effect a change. One such factor is readiness (Armenakis et al., 1993; Susanto, 2008). Readiness is described in terms of the organisational members' beliefs, attitudes, and intentions, with regards to the proposed change and the extent to which changes are needed and the organisation's capacity to successfully make those changes (Armenakis, 1993; Susanto, 2008).

Consequently, any organisation planning to implement an e-Healthcare initiative such as Mobile e-Healthcare must be at an acceptable level of readiness. An organisation that is not at a satisfactory level of readiness will likely face more challenges during the implementation phase (Peterson et al., 2011).

This study therefore aimed to develop a framework which healthcare facilities can use to assess their readiness to implement a Mobile e-Healthcare system in rural South Africa. E-Healthcare readiness factors, barriers and challenges implanting mobile health and South African e-health priority strategy 2012-2016 were considered in the development of this framework.

2 E-Healthcare and Mobile e-Healthcare Readiness

Weiner et al., (2009:296) defines organisational readiness for change as "the extent to which targeted employees are psychologically and behaviourally prepared to make the changes in organisational policies and practices that are necessary to put the innovation into practice and to support innovation use". Information Technologies Group (2002) describes readiness as the degree to which a community or organisation is ready to participate in a networked world.

Readiness is an integral and preliminary step in a successful implementation and adoption of an innovation and is defined by factors that must be in place before the innovation is introduced (Alliance for Building Capacity, 2002). Readiness also indicates the degree to which an individual or individuals are wholly intend to accept, embrace, and adopt a particular plan to purposefully alter the status quo (Holt et al., 2007; Holt et al., 2010).

Readiness in Information and communication technology (ICT) is referred to as e-readiness. Defining e-readiness is not easy because it varies in scope, depending on the study done (Naidoo, 2005). According to Bridges.org (2005:6), most definitions from governments or NGOs of e-readiness were of a general view such as "the extent to which the country is prepared to integrate into the global information society/networked world/digital economy". Dada (2006) describes electronic readiness (e-readiness) as a measure of the degree in which a country or economy may be ready, willing or prepared to obtain benefits which arise from the use of ICT. As Ojo et al., (2008) put it e-readiness helps to identify potential problems that might interfere with the ability of a community or organization to implement ICT solution and to pre-identify.

In healthcare, for example, e-Healthcare readiness is defined as the degree to which a community is ready to participate and succeed in e-Healthcare adoption and implementation (Ojo et al., 2008; Alliance for Building Capacity, 2002; Khoja, 2007). That is, their preparedness and willingness to embrace and participate in the technological innovation and new technologies. E-Healthcare can also be defined from other perspectives for example: Alliance for building capacity (2002) described *Telehealth Readiness as* a concept that involves the early aspects of change: that is the consideration of change, the overcoming of resistance to change, the development of a social, technical and clinical environment conducive to the diffusion and infusion of telehealth innovations. In the same vein Ganapathy (2014) describes telemedicine as encompassing all methods used to examine, investigate, monitor and treat, while the patient and doctor, are physically located in different places

In this study Mobile e-Healthcare readiness is defined as *the degree of motivation, awareness, availability of required resources, technological infrastructure, policies, and the preparedness and willingness of healthcare facility, workers and community members to accept, support, and participate in a successful Mobile e-Healthcare implementation*.

E-Readiness in healthcare has been studied and assessed from various perspectives such as: electronic healthcare records (Li et al., 2008); telehealth (Jennett et al., 2003; The Alliance for Building Capacity, 2002); telemedicine (Emuoyibofarhe, 2012); or just e-Healthcare (Khoja et al., 2007; Ojo et al., 2008), but no known tool have been developed to assess healthcare facility readiness to implement Mobile e-Healthcare. Yet there are numerous evidences about the value of mobile phones and other mobile devices for the delivery of healthcare services and the promotion of personal health (Ajami & Torabian, 2013). Hence the successful implementation of Mobile e-Healthcare also requires readiness assessment framework. As Khan et al., (2013) put it, healthcare organizations still need to assess their readiness to implement Mobile e-Healthcare in a structured way albeit it not requiring separate strategies from healthcare IT.

3 Mobile Health in South Africa

In 2011 Global Observatory for e-health (GOe) reported that 83% of the 112 member states that completed m-health module survey indicated at least one m-health initiative. Out of this, countries in the African Region reported the fewest m-health initiatives, compared to those in the South-East Asian regions which reported the most (Kay et al., 2011). This lag in African regions seems different from South Africa.

There are about 101 m-health services in South Africa as at June, 2013 with about 83 of them active excluding those in planning (Cargo, 2013:23). Forty (40) out of the 83 m-health services are in provincial level, and out of these 40, Eastern Cape, Free State and Limpopo has only 2 province specific m-health services each.

According to Leon et al., (2012), South Africa has a mature ICT market, an optimistic and progressive technology environment, well developed infrastructure, high prevalence of mobile phones therefore it is well suitable for m-health implementation. However it has major weaknesses in the functioning in the public sector (Primary Health Care (PHC) system which could jeopardize the successful implementation and value of m-health programs (Leon et al., 2012).

A Mobile e-Healthcare readiness assessment will help to identify potential problems and how to mitigate them to ensure a successful implementation (Kahn, Berk & Wheeler, 2013).

4 Theoretical Foundations and Conceptual Framework

The popularity of the readiness concept has led to the development of various range of assessment tools which can be used to measure or assess a country, business or economy's e-readiness (BRIDGES.ORG, 2005). Researchers have been coming up with different tools and models in their bid to explain technology readiness of individuals, organisations or communities in implementing, adopting, accepting,

or use of technology. These assessment tools Bridges .org (2005) categorised into three, namely; E-System Readiness Models, E-Society Readiness Models and E-Economy Readiness Models.

Some of the models and tools developed for business includes: VERDICT (Verify End-user e-Readiness using a Diagnostic Tool) to be used in assessing readiness of construction organisations for e-commerce (Ruikar et al., 2006); model from critical factor analysis of macro models which can be used to assess the e-readiness of non-profit ICT SMEs for adoption of e-commerce in a developing country (Fathian Akhavan, & Hoorali, 2008); and the study of how technology readiness (TR) influences customers' perception and acceptance of mobile payment (m-Payment) (Guhr et al., 2013).

In healthcare sector several e-Readiness assessment tools and models have also been developed. They include Hierarchical e-healthcare Readiness Index System (He-HRIS) model for developing countries (Ojo et al., 2008). He-HRIS provides tools that can be used to determine the critical factors of e-healthcare readiness. These include need change, engagement, structural and acceptance and use readiness, the same factors identified by Emuoyibofarhe (2012). Lanseng and Andreassen (2007) use technology readiness index (TRI) and TAM to measure peoples' readiness and attitude towards using internet technology in performing health self-diagnosis. They came up with four constructs; Expected ease of use, Expected convenience (Usefulness), Trust and Attitude. Wickramasinghe et al., (2005) developed a framework for assessing a country's/regions' e-healthcare potential. They identified the following constructs: information communication technology architecture/infrastructure, standardised policies, protocols and procedures, user access and accessibility policies and infrastructure, and government regulation and control.

Alliance for building capacity (2002) developed a framework for telehealth readiness and identified four constructs: core readiness, structural, engagement and non-readiness which are the same as Jennett et al., (2003). Li et al., (2012) developed an E-Health Readiness Assessment Framework for Public Health

Services from Pandemic response perspective and identified five dimensions of readiness constructs; Motivational forces, engagement, technological, resources and societal readiness.

Snyder-Halpern (2001) identified and validated the followings factors; knowledge, staffing skills, technology, administrative support, management structures, processes, resources, values and goals, as indicators of organisational readiness for clinical information technology/systems innovation. Similarly, Khoja et al., (2007) developed two sets of e-health readiness assessment tools for healthcare institutions in developing countries. The tools contain four categories of readiness for both managers and providers. Core-readiness, societal readiness, and policy readiness are common to both tools and fourth one is technological readiness for managers and learning readiness for providers.

However none of these tools focused on Mobile e-Healthcare readiness or is for assessing healthcare facility readiness to implement a Mobile e-Healthcare system. Consequently, it is important to develop tools and measurement instruments which focus on issues and challenges that are specific to Mobile e-Healthcare. In developing the instruments and tools for this study, the constructs, tools and instruments identified by the e-Healthcare researchers above formed the basis because e-Healthcare systems use the same platform (e.g. ICT infrastructure, communication links, healthcare providers (professionals) and management) that Mobile e-Healthcare uses (Li et al., 2008).

5.1 Brief summary of the barriers and challenges of m-Healthcare, SA e-Healthcare strategic priorities and readiness factors

5.1.1 South African 10 e-healthcare strategic priorities (2012-2016).

South African e-Healthcare strategy document listed 10 e-Healthcare strategic priorities for 2012-2016. The priorities are: 1. Strategy and Leadership; 2. Stakeholder Engagement; 3. Standards and Interoperability; 4. Governance and Regulation; 5. Investment, Affordability and Sustainability; 6. Benefits Realisation; 7. Capacity and Workforce, 8. e-Healthcare Foundations; 9. Applications and Tools to Support Healthcare Delivery; and 10. Monitoring and Evaluation of the e-Healthcare Strategy.

Various factors were identified as contributing to challenges and barriers to implementing Mobile e-Healthcare initiatives. The Global Observatory for e-Healthcare (GOe) identified the following factors as the most important barriers to Mobile e-Healthcare implementation globally (Kay et al., 2011).

5.1.2 Top 4 barriers in descending order to Mobile e-Healthcare implementation by WHO regions

- **Africa:** Operating costs, Knowledge, Infrastructure and Policy**;**
- **America:** Competing healthcare system priorities, Legal issues, Cost effectiveness and lack of Knowledge;
- **Eastern Mediterranean:** Competing healthcare system priorities, Policy, Cost effectiveness and lack of Knowledge;
- **Europe:** Legal issues, Knowledge, Priorities and Cost effectiveness;
- **South East Asia:** Policy, Knowledge, Technical expertise and Operating costs;
- **Western Pacific:** Healthcare system priorities, Cost Effectiveness, Operating costs & policy.

Only the African region identified the lack of infrastructure as one of its top barrier. One indicator of infrastructure challenges is the level of cellular network coverage.

Other key issues affecting successful implementation of m-health includes: concerns around private healthcare record security and disclosure of protected healthcare information; lack of funding and support for Mobile e-Healthcare initiatives by managers; decision makers and the healthcare system funders' concerns that many Mobile e-Healthcare applications in use currently may not be effective, engaging, usable, or meeting the needs of users and issues around few or quality research on m-Healthcare, such as cost effectiveness on what works (Whittaker, 2012).

Research by Khan et al., (2013) identified the following barriers: challenge of which healthcare initiative to fund; lack of awareness about how to implement mobile health; lack of collaboration among healthcare organizations; and difficulty in keeping pace with innovation.

Ehrler (2013) noted the following challenges of implementing a mobile application in clinical practice: cost of devices; being able to run a program on every device in the market; visibility and computational power; sustainability of applications; linking devices with existing clinical systems; and data protection and authentication. This challenge calls for adequate security for both data and devices unlike in point to point connection and technical experts to ensure that healthcare processes are well linked.

From the above challenges, a need arises to determine factors that need to be in place for a healthcare facility to successfully implement a Mobile e-Healthcare system. This is because readiness is defined by factors that must be in place before the innovation is introduced (Alliance for Building Capacity, 2002).

5.1.3 E-Healthcare readiness factors.

The following are e-Healthcare readiness factors as generated from literature. These factors are also the major categories of assessment criteria used in different tools identified. They include: Efficient ICT architecture/infrastructure; Standardized policies, protocols and procedures; User access and accessibility policies and infrastructure; Government regulation and control (Wickramasinghe et al., 2005); and Core readiness, engagement, structural and non-readiness (Alliance for Building Capacity, 2002; Jennett et al., 2003). Other five key categories of assessment criteria as identified by (Azab, Kamel & Dafoulas, 2009) from 18 e-Readiness models include: IT infrastructure; Human resources; Policies and regulations; Environment (economic, political & cultural); and ICT usage.

Several assessment tools that assess a healthcare facility's readiness to implement e-Healthcare initiatives identified, with four categories of readiness for both managers and providers, are: *Core-readiness; societal readiness; Policy readiness; and Technological readiness* for managers and *learning readiness* for providers (Khoja et al., 2007). Li et al., (2008) from electronic Health records perspective the following readiness are identified: *Core; Technological; Engagement; and Societal readiness.* Li et al., (2012) identified the following five readiness dimensions for Public Health Services from Pandemic

response perspective: *Motivational forces; Engagement; Technological; Resources; and Societal readiness,* which when presented determine readiness.

Although the above tools measure e-Readiness, Dada (2006) asserts that e-Readiness assessment tools do not undertake an in-depth research, in that they ignore vital elements, such as culture and technology acceptance of users. Subsequent researchers such as Lanseng & Andreassen (2007), Walczuch, Lemmink & Streukens (2007), Ojo et al., (2008), Lopez-Nicola, Molina-Castillo & Bouwman (2008), Abbad (2010), and Guhr et al., (2013) integrated technology acceptance elements in their e-Readiness studies. Ojo et al., (2008) developed a Hierarchical e-Healthcare Readiness Index System (He-HRIS) tools with the following categories of readiness: *Need Change; Engagement; Structural; and Acceptance and use readiness.*

From the above categories of e-Healthcare readiness factors identified from the literature, considered together with barriers to Mobile e-Healthcare implementation and the South African e-Healthcare strategic priorities, the following readiness factors are taken to be relevant to this study: *Need Change; Engagement; Technological; Resource; Policy; Community & Acceptance and Use readiness*. *Acceptance and use* has six sub-factors: *Performance Expectancy; Effort Expectancy; Organisational influence; Facilitating Conditions; Compatibility; and Attitude*. These constructs represents the variables or factors that determines Mobile e-Healthcare readiness. The higher the score the more prepared a healthcare facility is in that construct category. These factors were then use to construct the conceptual framework.

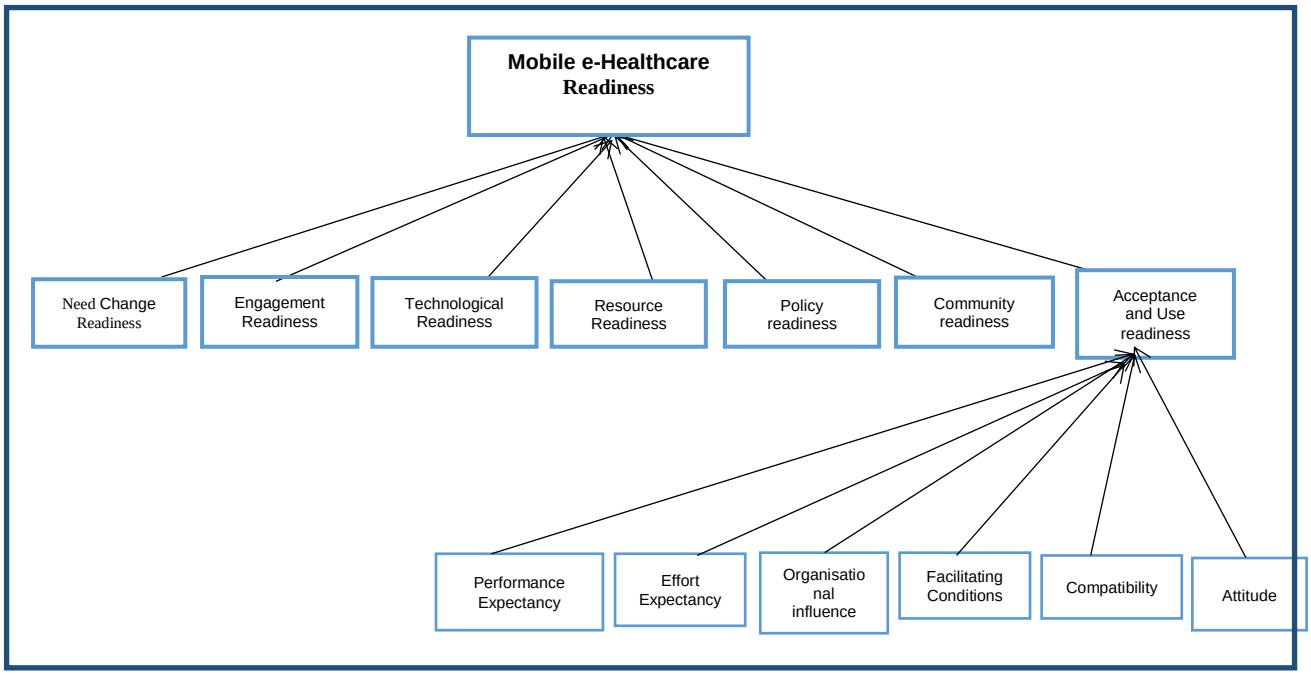

Figure: 1 Conceptual Mobile e-Healthcare Readiness Assessment Framework

6 Explanation of Constructs

6.1 Need Change Readiness

Basing on Ojo et al. (2008), Li et al. (2012), and Jennett et al. (2003) definitions, Need Change Readiness is defined as implementers' realisation of problems in accessing and delivering healthcare services, exacerbated by a combination of real or genuine needs based on conditions caused by isolation and a felt or expressed dissatisfaction with current practices (Status quo). Lehman, Greener and Simpson (2002) explain that if motivational forces or real needs (e.g., healthcare providers' dissatisfaction with status quo) are not present, the innovation process is unlikely to be initiated. It is therefore hypothesise that:

H1: *Need change readiness will positively influence a healthcare facility Mobile e-Healthcare readiness.*

6.2 Engagement Readiness:

Engagement readiness is a process in which stakeholders (in this study healthcare professionals and managers) are willing, and enthusiastically engaged in the idea of Mobile e-Healthcare, but still considering its potential advantages and disadvantages (Ojo et al. 2008). The healthcare professionals

are also engagement ready where they are open and willing to accept and participate in the required training (Jennet et al. 2003; Ojo et al. 2008; Li et al. 2008; Li et al. 2012). If the stakeholders, especially healthcare providers, over-expressed fear and concern about the negative effects of using Mobile e-Healthcare or are unwilling to learn or show overly resistance, then engagement readiness is low (Li et al.(2008). Therefore, the success of implementing a complex change in an organisation is most likely when people within that system are fully engaged in a cooperative process of creating it (Zolno, 2009).

Hence:

H2: *Engagement Readiness will positively influence a healthcare facility's Mobile e-Healthcare readiness.*

6.3 Technological Readiness

Technological readiness is the extent to which healthcare institutions have efficient IT infrastructure in place to support successful implementation of Mobile e-Healthcare (Ojo et al. 2008; Jennett et al. 2003, 2005). The consideration here is the availability and affordability of IT infrastructure, mobile devices Software and hardware, formal and informal network.

It is therefore, hypothesise that:

H3: *Technological Readiness will positively influence healthcare facility's Mobile e-Healthcare readiness.*

6.4 Resource Readiness:

Resource readiness is the extent to which a healthcare organisation has knowledge and awareness about the type and availability of organisational resources required for the initial Mobile e-Healthcare innovation, customisation and implementation process as well as on-going maintenance. Resource readiness is the healthcare organisation's technical and non-technical ability to support the clinical Mobile e-Healthcare innovation (Li et al. 2012, Snyder-Halpern, 2001). These resources include finance, human, and IT competing priorities (Snyder-Halpern, 2001). Although adequate motivations (such as

feeling of isolation, dissatisfaction with status quo) may be present, sufficient resources are required to allow and support steps for change (Li et al. 2012).

It is, therefore, hypothesised that:

H4: *Resource Readiness will positively influence healthcare facility Mobile e-Healthcare readiness.*

6.5 Policy Readiness

Policy readiness deals with the existence of policies at the government and healthcare institution levels to address issues such as licensing, liability, and reimbursement (Khoja et al. 2007). It also deals with awareness and support for ICT among politicians; and awareness and support for ICT among institutional policymakers (Li et al. 2008). Friedland and Muylken (2009) describe policy as a deliberate plan of action to guide decisions and achieve rational outcomes. Hence to ensure successful e-health projects, there must be appropriate administrative, legislative and regulatory frameworks to guide the implementation process and use of technological innovation (Healy, 2008). We, therefore, hypothesise that:

H5: *Policy Readiness will positively influence healthcare facility Mobile e-Healthcare readiness.*

6.6 Community Readiness:

Community readiness with regards to Mobile e-Healthcare readiness is the degree of awareness, acceptance of an innovative intervention and the ability of the community members to participate and benefit from the intervention as well as the communication link between healthcare facilities in the region and community members. The willingness of community members to support an initiative or the readiness of the municipal and governmental components of the community to take on the work needed to solve an emerging issue is critically important to the success of an intervention (Trautman et al. 2012). In a situation where healthcare facilities and healthcare providers have communication links to both hospitals and administrative centres and use multiple mediums to communicate with one another, patient

and community members and the communication frequency (Li et al. 2008). We therefore, hypothesise that:

H6: *Community Readiness will positively influence healthcare facility Mobile e-Healthcare readiness.*

6.7 Acceptance and Use Readiness

Acceptance and Use Readiness is the intention to accept and use Mobile e-Healthcare (Ojo et al. 2008). Dillon and Morris (1996) define user acceptance as "the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support". According to Dada (2006), having an environment that is supportive of technologies is not enough - a further requirement is the question of how likely users are to accept, adopt and use them so as to maximise potential advantages. Acceptance and Use is measured using the total influence of its sub-constructs explained as follows:

H7: *Acceptance and Use Readiness will positively influence healthcare facility Mobile e-Healthcare readiness.*

The following are constructs within Acceptance and Use Readiness that influence the Mobile e-Healthcare acceptance and use or rejection: *Performance Expectancy, Effort expectancy, Organisational Influence, Facilitating Conditions, Compatibility, and Attitude.*

They are defined and hypothesised as follows:

Performance Expectancy: The term Performance Expectancy is adapted from Venkatesh et al. (2003). Performance Expectancy is defined in this study as the degree to which a person believes that using Mobile e-Healthcare will enhance his or her job performance (Davis, 1989). This construct is described the same way as perceived usefulness (Davis, 1989; Davis et al. 1989) and relative advantages (Moore & Benbasat, 1991). Based on prior research this study hypothesised that:

H7a: *Performance Expectancy of Mobile e-Healthcare will positively influence healthcare facility's acceptance and use readiness*

Effort Expectancy: Venkatesh et al. (2003) define Effort Expectancy as 'the degree of ease associated with the use of the system'; that is, the belief, that using the system will not be difficult.

In addition to usefulness, usage is theorised to be influenced by perceived ease of use. According to Davis (1989), a system may be useful but if it is hard to use it may end up not being used. In the same vein, Godoe and Johansen (2012) assert that in a situation where certain specific characteristics of a system such as perceived usefulness and perceived ease of use are too low, it will be rejected regardless of people's general technology readiness. Based on prior research this study hypothesised that:

H7b: *Expected ease of use of Mobile e-Healthcare will positively influence healthcare facility's acceptance and use readiness.*

Organisational Influence: In this study organisational influence is defined as the degree to which an organisation support and influences workers to use the technology. People decision to perform a given behaviour is sometimes influenced by what other individuals or groups will think, whether or not these other people will agree or disagree with their decisions and how important these other individuals or groups are to the decision maker (Abadi et al. 2012). When these influence and support come from organisations' decision makers the behaviour is likely to be positive.

Based on prior research this study hypothesised that:

H7c: *Organisational influence will contribute positively to the acceptance and use readiness.*

Facilitating Conditions: Removed from analysis to prevent multicollinearity as it loaded on the same component with Organisational Influence.

Compatibility: In this study, compatibility is defined as 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). High compatibility of an innovation with users' needs, and business processes, can result in preferable adoption (Wu et al. 2005).

Based on the above definitions from literature this study hypothesised as follows:

H7e: *Compatibility of Mobile e-Healthcare with existing values and experiences will positively influence healthcare facility's acceptance and use readiness.*

Attitude: In this study attitude is defined as an individual's positive or negative feelings towards the implementation and use of Mobile e-Healthcare (Davis et al. 1989; Fishbein & Ajzen, 1975). The feelings one has towards a technology or its use can be positive or negative; however, one can be dominant in different people. Attitude is an essential factor in explaining human behaviour (Wang & Liu, 2009. Based on prior research, this study hypothesised that:

H7f: *Positive attitude towards Mobile e-Healthcare will significantly influence healthcare facility acceptance and use readiness.*

7 Research Methodology

The above identified constructs were used to design the Mobile e-Healthcare measurement instrument. The study utilised three sources of information: 1) literature review; 2) existing scales of e-Healthcare readiness assessment; and 3) primary data (Focus group interview and e-Healthcare implementers).

To validate and test the reliability of the measuring instrument, a quantitative study using survey method was conducted. Questionnaire, which hand delivered to Healthcare managers, healthcare professionals, (doctors and nurses) in the participating healthcare facilities was used to collect data.

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, to determine the participants' opinion of their healthcare facility readiness to implement Mobile e-Healthcare. 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, 2005; Snyder–Halpern, 2001;

Edwards et al. 2000), and technology acceptance and use studies (Davis, 1989; Davis et al. 1992; Thompson et al. 1991; Moore & Benbasat, 1991; Compeau & Higgins, 1995; Venkatesh et al. 2003).

The statement items were pre-tested in order to check ambiguous statements, negative, double barrelled questions, errors, instruction clarity and duplicate items. In pretesting, the questionnaire was given to 5 PhD students, 5 medical doctors and two healthcare managers to fill and give their inputs. The questionnaire was then restructured based on the feedback from the pre-test. The items found not to be significant or scored below 3 were dropped.

The instrument was designed primarily to assess 7 major constructs: Need Change Readiness **(NCR)**; Engagement Readiness **(ER)**; Technological Readiness **(TR)**; Policy Readiness **(PR)**; Resource Readiness **(RR)**; Community Readiness **(CR)**; and Acceptance and Use Readiness **(AUR).** The following attributes were used to assess **AUR**: *Performance Expectancy (PE), Effort Expectancy (EE), Organisational Influence (OI), Facilitating Condition (FC), Compatibility (CM) and Attitude (AT).*

It was structured as a multiple choice close-ended statement items where respondents were asked to select their level of agreement with each statement. The instrument has a five-point Likert-scale ranging from strongly agree (5) to strongly disagree (1).

8 Data Analysis and Results

A total number of 200 questionnaires were distributed and of this number, 160 were returned resulting in a response rate of 80%. Of the total 160 questionnaires returned, [125 (78.12%)] were found to be useful for analysis. 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 age group 25-34 [34(27.2%)].

IBM SPSS version 23.0 was used in the analysis of demographic data and to compute the mean scores, standard deviation, the skewness of the data collected to ensure a better understanding of each item in the construct operationalisation. IBM AMOS 23.0 was used to perform the Structural Equation

Modelling (SEM) to investigate the inter-relationship between the 7 constructs and the 6 sub-constructs of the model to test the formulated hypotheses.

The constructs were subjected to principal component analysis (PCA) using SPSS Version 23. Prior to performing PCA the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser-Meyer-Oklin (KMO) value was 0.823, exceeding recommended value of 0.6 (Kaiser, 1970, 1974 and Pallant 2013) and Bartlett's Test of Sphericity reached statistical significance, supporting the factorability of the correlation matrix. To aid the interpretation of these components Oblimin a direct oblique rotation was performed, the factors explained 74 % variance with Eigenvalues of 32.6% - 1.8%. PCA shows Facilitating conditions and Organisational influence loading in one component, FC is therefore dropped from the analysis to prevent multicollinearity.

Prior to PCA the questionnaire instrument was tested for reliability. The result showed individual constructs reliability of 0.726 - 0.966, with the overall reliability alpha coefficient (α) of the instrument at 0.961 based on the standardised items.

The Convergent and Discriminant validity were also checked using factor loadings, Composite Reliability (CR) and Average Variance Extracted (AVE). Farrell and Rudd (2009:2) 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., 2006:771).

Hair et al., (2006) explained that discriminant validity should be best assessed by comparing the value of the average variance extracted (AVE) and the squared multiple correlations (SMC) of constructs. They assert that the AVE should be greater than the squared multiple correlations estimate. All the factor

loadings and CR are greater than 0.5. The CR and AVE are calculated manually using the formula below from Hair et al., (2006).

Composite reliability (CR). = [Σ1….n (λ)] 2 / ([Σ1….n (λ)] 2 + Σ1….n (ϵ))

Average variance extracted (AVE) = [Σ1….n (λ) 2]/ ([Σ1….n (λ 2)] + Σ1….n (ϵ))…

Where λ is standardised factor loading, n=number of items and ϵ = indicator measurement error.

Indicator measurement error is calculated as (ϵ) = 1- λ^2. The calculated CR and AVE as well as the estimate of CFA are shown in Table 1.

The confirmatory Factor Analysis (CFA)

CFA is used to confirm the measurement theory, in other words to test whether the measures of a factor are consistent with the study construct and that data fit the a priori measurement model. Before application of CFA, each individual measurement models were assessed and fixed as suggested by (Hooper et al. 2008; Hair et al. 2006; Selim, 2007). The items that scored below .3 are removed. The measurement models were consequently brought together in confirmatory factor analysis (CFA) shown below in Figure 2.

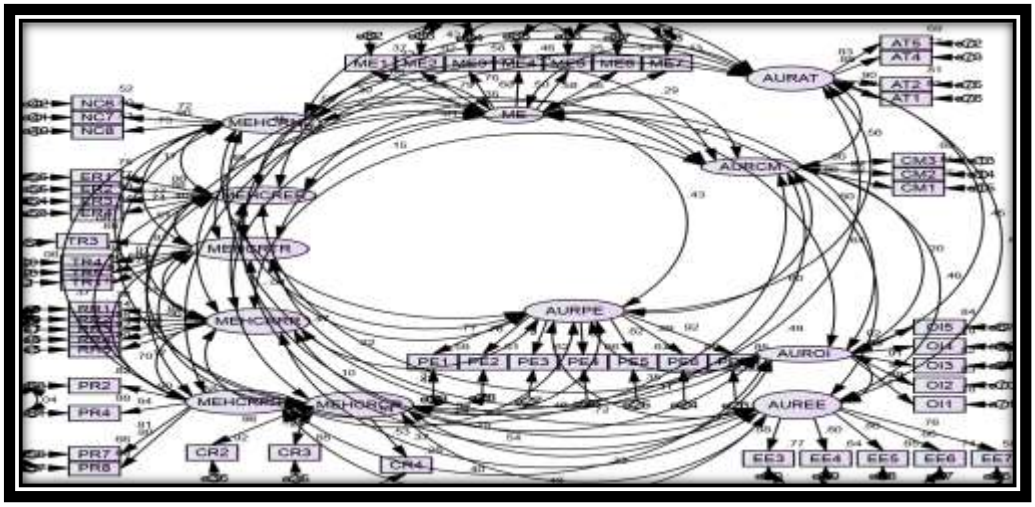

Fig 2 The CFA of the measurement model

Table 1: CFA estimates and results of composite, average variance explained and Cronbach Alpha

Items	Construct	C.R.	P	SRW	SMC	CR	AVE	Cronbach Alpha
NC8	<--- MEHCRNC	7.845	***	.728	.530	.826	.616	**.821**
NC7	<--- MEHCRNC			.896	.803			
NC6	<--- MEHCRNC	7.757	***	.718	.515			
ER1	<--- MEHCRER	9.241	***	.864	.747	.886	.661	**.889**
ER2	<--- MEHCRER	9.387	***	.878	.770			
ER3	<--- MEHCRER	10.894	***	.767	.588			
ER4	<--- MEHCRER			.735	.540			
TR1	<--- MEHCRTR	11.489	***	.789	.622	**.917**	**.736**	**.914**
TR3	<--- MEHCRTR	12.722	***	.832	.693			
TR4	<--- MEHCRTR	15.361	***	.910	.828			
TR5	<--- MEHCRTR			.895	.802			
RR1	<--- MEHCRRR	17.293	***	.883	.780	**.964**	**.842**	**.966**
RR2	<--- MEHCRRR	15.879	***	.859	.738			
RR3	<--- MEHCRRR	21.446	***	.936	.877			
RR4	<--- MEHCRRR	23.901	***	.959	.919			
RR5	<--- MEHCRRR			.947	.897			
PR2	<--- MEHCRPR	9.520	***	.905	.818	**.923**	**.749**	**.933**
PR4	<--- MEHCRPR	10.166	***	.936	.876			
PR7	<--- MEHCRPR	17.303	***	.809	.655			
PR8	<--- MEHCRPR			.804	.646			
AT5	<--- MEHCRAT			.832	.692	**.911**	**.721**	**.908**
AT4	<--- MEHCRAT	12.098	***	.876	.767			
AT2	<--- MEHCRAT	14.020	***	.901	.811			
AT1	<--- MEHCRAT	10.189	***	.782	.612			
CR4	<--- MEHCRCR	6.502	***	.530	.281	**.859**	**.682**	**.810**
CR3	<--- MEHCRCR			.920	.846			
CR2	<--- MEHCRCR	15.440	***	.959	.919			
PE7	<--- AURPE		***	.922	.849	**.938**	**.685**	**.938**
PE6	<--- AURPE	16.157	***	.893	.798			
PE5	<--- AURPE	13.166	***	.821	.674			
PE4	<--- AURPE	12.882	***	.812	.660			
PE3	<--- AURPE	12.036	***	.786	.618			
PE2	<--- AURPE	11.836	***	.780	.608			
PE1	<--- AURPE	11.492	***	.768	.590			
EE7	<--- AUREE	10.027	***	.764	.584	**.916**	**.685**	**.912**
EE6	<--- AUREE			.861	.741			
EE5	<--- AUREE	10.878	***	.805	.648			
EE4	<--- AUREE	10.736	***	.800	.640			
EE3	<--- AUREE	10.414	***	.878	.771			
OI5	<--- AUROI	15.875	***	.917	.841	**.956**	**.814**	**.959**
OI4	<--- AUROI			.890	.793			
OI3	<--- AUROI	22.288	***	.907	.822			
OI2	<--- AUROI	15.641	***	.911	.830			
OI1	<--- AUROI	14.618	***	.885	.784			
CM3	<--- AURCM			.804	.646	**.898**	**.763**	**.894**
CM2	<--- AURCM	11.667	***	.919	.845			
CM1	<--- AURCM	11.027	***	.866	.750			
ME1	<--- MEHCR			.605	0.365	**.911**	**.500**	**.859**
ME2	<--- MEHCR	6.675	***	.787	0.619			
ME3	<--- MEHCR	6.575	***	.764	0.584			
ME4	<--- MEHCR	6.128	***	.676	0.456			
ME5	<--- MEHCR	4.752	***	.500	0.247			
ME6	<--- MEHCR	5.458	***	.581	0.338			
ME7	<--- MEHCR	5.914	***	.655	0.429			

The CFA showed a satisfactory overall model fit, therefore it can be said that model theorised fits the data. Next the Structural Equation Modelling is used to test the hypotheses formulated and to determine the overall fit of model to data. The structural model is shown in Figure 3 below.

Structural Equation Modelling (SEM) consists of two paths, the measurement model and the structural model. CFA mostly concentrates on validating the measurement model, and structural model specifies the relationship between the constructs.

In determining the result of SEM multiple factors were considered because of conflicting conclusions from the fit indices. According to Schermelleh-Engel et al. (2003), it is essential to take multiple criteria into consideration and 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. In the same vein Chin (1998) asserts that many researchers are over relying on goodness of fit measures for SEM studies to the detriment of other measures. Chin further explained that 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. Below in Table 3 is the result of the hypotheses

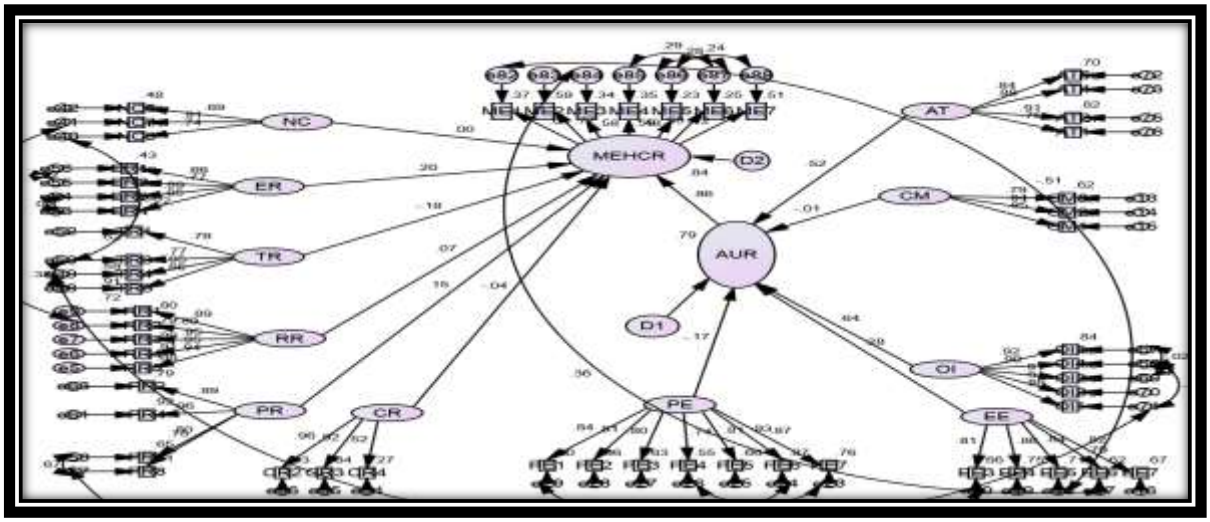

Fig 3: The Structural Model

Table 3: Regression weights and Hypothesis result (MEHCR model)

Relationship direction			Estimate	S.E.	C.R./Z	P	Hypothesis result
AUR	<---	MEHCRPE (H7a)	-0.122	.060	-2.020	.043	Supported
AUR	<---	MEHCREE(H7b)	0.207	.064	3.215	.001	Supported
AUR	<---	MEHCROI(H7c)	0.327	.056	5.806	***	Supported
AUR	<---	MEHCRCM(H7d)	-0.008	.062	-0.136	.892	Not Supported
AUR	<---	MEHCRAT(h7f)	0.368	.074	4.974	***	Supported

MEHCR	<---	AUR (H7)	1.000				
MEHCR	<---	MEHCRCR (H6)	0.035	.058	-0.595	.552	Not Supported
MEHCR	<---	MEHCRPR(H5)	0.109	.052	-2.115	**.034**	Supported
MEHCR	<---	MEHCRRR(H4)	0.033	.034	0.981	.326	Not Supported
MEHCR	<---	MEHCRTR(H3)	-0.098	.040	-2.446	***	Supported
MEHCR	<---	MEHCRER (H2)	0.146	.065	2.247	**.025**	Supported
MEHCR	<---	MEHCRNC (H1)	-0.002	.051	-0.032	.974	Not Supported

*** Significance at the 0.001 level 2-tailed.

Key: S.E: Standard error; **C.R.** = Critical ratio (the z value), **P**= P-value (the significance value should be less or equal to .05 to be significant)

The strongest relationship is between Organisational Influence (OI) and Acceptance and Use Readiness (AUR) with regression weight of .327 and z-value of 5.806. (z = (estimate /standard error (S.E)). This is followed by the relationship between AUR and Attitude with regression weight of .368 and (C.R =4.974). The overall model constructs accounts for 84% variance in Mobile e-Healthcare readiness. Organisational Readiness, Ease of Use, Attitude and Performance Expectancy are significant in determining Acceptance and Use Readiness, in other words they are indirectly predicting Mobile e-Healthcare Readiness. Whereas Technological readiness, Engagement Readiness and Policy readiness were identified to be significant in determining Mobile e-Healthcare Readiness. This resulted in the modified model Figure 4.

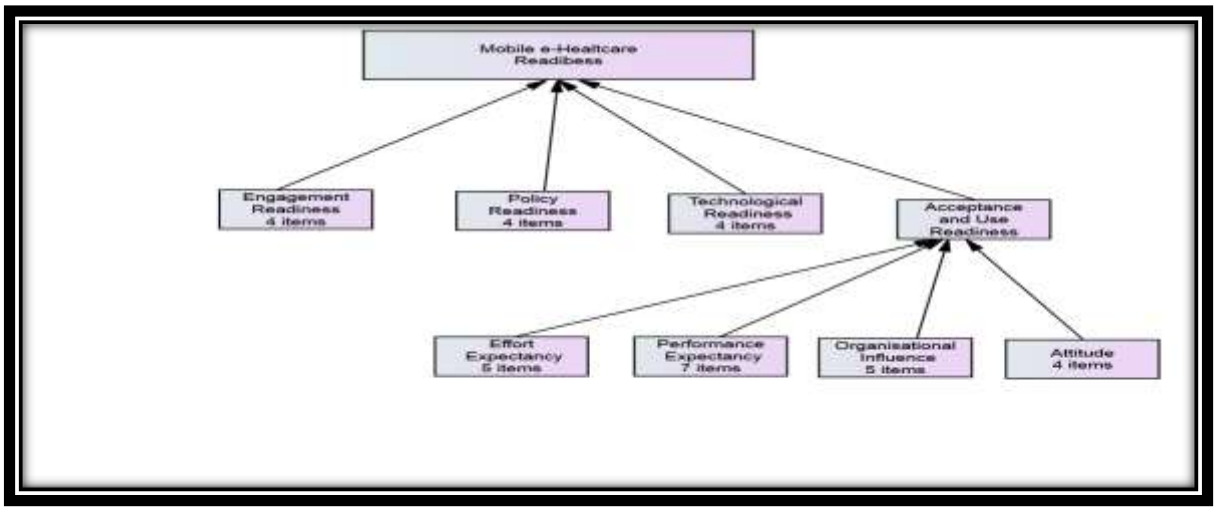

Fig 4:The Mobile e-Healthcare assessment framework

The result of the overall evaluation of all the samples collected for the Mobile e-Healthcare readiness model (MEHCR) showed that the respondents fairly agreed with the Mobile e-Healthcare readiness. It also showed that the healthcare facilities are moderately ready to implement m-Healthcare, with the mean score of 3.47 for readiness and intention to accept and use Mobile e-Healthcare, which is slightly over the midpoint of the five-point scale.

The result also shows high score for *Performance Expectancy* followed by *Attitude, Effort Expectancy, compatibility, Need Change Readiness and Engagement Readiness* with the mean scores of; 4.26, 4.17, 4.03, 3.86, 3.79 and 3.75 respectively. The participants showed overall positive attitude for Mobile e-Healthcare with mean score 4.17.

9 Discussion and Conclusion

This paper discussed the process of developing of Mobile e-Healthcare readiness assessment tool (MEHCRAT). The paper identified e-Healthcare readiness assessment factors, and use them to develop a framework, which healthcare facilities can use to assess their readiness to implement a Mobile e-

Healthcare. The resultant tool was used to assess the Limpopo Department South Africa readiness for implementing a Mobile e-Healthcare system.

This tool is designed in such a way that it will extensively assess Mobile e-Healthcare readiness of healthcare facilities in South Africa by addressing the major barriers of m-health in developing countries, the determinants of e-Healthcare readiness and South Africa e-Healthcare strategic priorities. Although mobile technology especially mobile phones are ubiquitous their use in healthcare processes are still not as widely used or accepted as to make significant impact on the challenges of healthcare delivery in general. Hence in planning of Mobile e-Healthcare system, consideration of the issues raised, such as how the change messages are communicated, the infrastructure requirements, issues around security and issues of socio economic and gender will allow greater acceptance and use.

The Mobile e-Healthcare readiness assessment tools developed and validated in participating healthcare facilities of Limpopo Province of South Africa are intended for managers and healthcare professionals to use when planning for Mobile e-Healthcare systems 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. The tool was tested for validity and reliability in participating healthcare facilities in Limpopo province of South Africa.

Having tools that could be used in the assessment of Mobile e-Healthcare readiness should help in improving the quality of planning of 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.

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