M-Health adoption and sustainability prognosis from a Care givers' and patients' perspective

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ABSTRACT

The penetration of mobile phones and mobile technologies in developing countries has led to innovative developments of various m-Health applications. These applications have proven the potential of mobile technologies for improving the quality of health care service in general and the fight against HIV/AIDS in particular. However, to achieve greater impact on the ground level (e.g. in an antiretroviral (ARV) treatment clinic) in a developing country's context, these applications have to be adopted and their utilization sustained. A study was undertaken to investigate sustainability and scalability challenges of mobile phone-based applications/projects for HIV/AIDS care in developing countries and the adoption and sustainability prospects of such m-Health applications in an ARV clinic in Pretoria. The findings presented here, are that from a care givers' and patients' perspective, adoption and sustainability of these applications is not merely dependent on the proposed technology's capabilities to enhance service delivery. Adoption and sustainability is however, mostly dependant on: (1) the care givers and patients' willingness and capability to incur any technological adoption and continuous use costs and, (2) their pre-conceived notions of government or sponsor-supported service provision.

These technologies have the potential to improve access to health care services [43] particularly in developing countries where mobile phones are more prevalent than ICTs such as landlines, telephones and the internet [21-39]. In these regions the healthcare system constantly faces challenges such as infrastructural deficit, resources shortages, tropical diseases and the burden of widespread diseases such as the HIV/AIDS epidemic [43]. The magnitude of the HIV/AIDS pandemic in developing countries combined with the contextual healthcare provision factors in many ARV clinics has raised the need to develop innovative ways to tackle the complexity that involves the provision of adequate health care in such circumstances.

The exploration of the potential of mobile phones in the fight against HIV/AIDS has led to the establishment of mobile phone-based projects for HIV/AIDS care and the development of mobile phone-based applications for health care in developing countries such as South Africa, India, Rwanda, Peru, Uganda, etc [39]. These applications fall in the following utilisation areas: Education and Awareness, Remote Data Collection, Remote Monitoring, Communication and Training for healthcare workers, Disease and Epidemic Outbreak Tracking, and Diagnostic and treatment support [39]. White [42] and Fynn et al [11] note that these applications take advantage of the mobility and flexibility that mobile phones provide, in combination with other ICT technologies such as the internet and database technologies, the potential to overcome many of the barriers of distance and cost facing developing countries.

Although these applications have proven the potential role that mobile technologies can play in strengthening the response to and the fight against the HIV/AIDS pandemic, it is necessary to ensure that these applications are widely adopted in as many care centres as possible and that their use is sustained over long periods of time. This will eventually lead to a greater impact and envisaged improvement in the healthcare sector in these countries.

Wide adoption and long term use of these applications have been reported as being a big challenge for achieving the sought healthcare service improvement goals [39-42]. Hence this study has been undertaken to explore the plausibility of mobile phone-based applications for HIV/AIDS care adoption and long term use from a care givers' and patients' perspective. This has contributed towards knowledge development about the care givers and patients' contextual realities; their perception about the technology; their expectations about the technology adoption and long term use cost; and the implication of these factors if adoption and sustainability of mobile phones for HIV/AIDS care are envisaged and have to be achieved.

The findings from this study suggest that from a care givers' and patients' perspective, adoption and sustainability of these applications are not merely dependent on the proposed technology's capabilities to enhance service delivery. Adoption and sustainability are mostly dependent on the care givers' and patients' willingness and capability to incur any technological adoption and continuous use costs and also on their pre-conceived notions of government or sponsor-supported service provision. These findings have been derived based on an analysis of the case study using the following extended versions of the Technology Adoption Model (TAM) [8]: The Task Technology Fit (TTF) model, the Fit between Individuals, Tasks and Technology (FITT) framework and the Unified Theory of Acceptance and Use of Technology (UTAUT) model. These models were used to investigate the fit between the technologies response to a particular need, and the expectations of the users when it comes to the continuous use of the technology.

It is arguably inevitable to identify other technology adoption factors in contexts different from the typical management-driven organizational ICT adoption (where management foresees, plans and budgets for any ICT adoption costs) context in which most technology adoption models were developed. Unlike typical organizational ICT adoption, a mobile phone-based application for HIV/AIDS care adoption is envisaged in an environment where the bearer of the adoption costs is not well determined. This brings to fore the question of who must support, manage and maintain the continuous use of technology and what is the financial model behind the scalability and sustainability of eventual technology adoption.

The rest of this paper is structured as follow: the next section provides a short background description of mobile phones, mobile technologies, m-Health emergence and issues around mobile phone-based applications for HIV/AIDS care deployment. This description is followed by the presentation of the research methodology that was used in the study. The case study and the findings are presented next, followed by the discussion of the study results. Lastly, an overview of m-Healthcare and mobile phone-based application for HIV/AIDS adoption and sustainability suggestions and future research direction is presented in the concluding section.

2. BACKGROUND:

This section provides an overview of how mobile technologies have revolutionized different aspects of our lives (including health care), how the m-Health concept has emerged, the impact of m-Health in the quest for improved HIV/AIDS care in developing countries, some of the challenges and issues in the adoption of these innovative solutions, and the issues around existing ICT utilization models (and theories) and the study of ICT use and diffusion.

2.1 Mobile phones, Mobile Technologies and m-Health Emergence

Mobile technologies have revolutionized different industries and the health care is no exception. The use of mobile phones and mobile technologies is well documented in fields such as the banking sector [3-22], distance learning and mobile learning [35-36], the marketing sector [3-4], and in the health care sector [31]. The use of mobile technologies in health has led to the development of m-Health [31-37].

M-Health is shortly defined by Istepanian and Zhang [16] as "mobile computing, medical sensor, and communication technologies for healthcare". Apart from the inherit technology capabilities of mobile phones (e.g. 2G, 2G+, and 3G [36]; SMS, MMS, Voice applications [19-39]), m-Health includes sensor technologies that allow the creation of a body area network (BAN) of sensors that can wirelessly transmit physiological parameters to a remote monitoring device [32]. There are other potential mobile technologies such as the fourth generation (4G) network and Worldwide Interoperability for Microwave Access (WiMAX) that are considered to be the future of wireless communication and that will be of relevance in the health sector [31]. Thus m-Health systems could generally be categorised in 5 groups according to the following dimensions proposed by Olla and Tan [31]: Communication Infrastructure, Device type, Data display, Application purpose and Application domain. In the case of mobile phone-based applications for HIV/AIDS care, the categorisation can be made according to the following applications areas proposed by Vital Wave Consulting [39]: education and awareness, remote data collection, remote monitoring, communication and training for healthcare workers, disease and epidemic outbreak tracking, and diagnostic and treatment support.

M-Health applications are particularly becoming enabling technologies that are most frequently used in difficult and remote locations in developing countries [14]. In developing countries, m-Health is having a positive impact in terms of "increased access to healthcare and health-related information in remote areas, improved ability to diagnose and track diseases, timelier health information and expanded access to ongoing medical education and training for health workers" through innovative use of mobile phones [39]. In the treatment of tuberculosis and HIV/AIDS for example where adherence to treatment is of key importance, mobile technologies have been used to improve adherence to treatment through the use of reminder messages [11-19]. Messages particularly have a great potential and according to Bønes et al [7] they are effective and suitable for instant notification because messages are delivered immediately and have become a valuable communication media very familiar to users in developing countries.

However there are also limitations such as the following proposed by Kaplan [19] that could hinder the use of mobile phones for improved healthcare service: cost issues, information carrying capacity, language and illiteracy. In spite of these limitations, mobile phones have been identified as the appropriate technology to improve healthcare services in developing countries [39]. Despite the hype around m-Health, its future and the future of health care service provision, there are various further challenges that m-Health solutions face as suggested by Yu et al [45]. The following have been identified as being "major obstacles" to m-Health adoption [17]:

(#1). "Objective obstacles: deficiencies and limitations of the current technology, specifically interoperability, compliance to widely accepted standards and security"

(#2). "Subjective obstacles: Reluctance of healthcare professionals to abandon traditional mostly paper and voice based workflows to new practices based on highly technological appliances".

(#3). "The need to comply with usually very restrictive regulations".

(#4). "Technical aspects and existing constraints such as screen size, resolution, and battery life".

(#5). "Security issues regarding authentication of the user as well as encryption of transmitted data".

It is difficult to effectively classify these challenges. Yu et al [45] propose seven categories of challenges:

Table 1. Challenges for m-Health solutions (adapted from Yu et al [45])

Major challenge category	Sub-category
1. People	Clinician's work habits and the kind of mobile devices that best match their needs Convenience of patients
2. Process	Challenges for building a compelling business case and measuring ROI for m-Health. Integration into clinician's workflow. Managing cultural change associated with technology adoption. Managing change faced by hospital IT department The application development process
3. Technology	Coverage of networks including Wifi, Bluetooth and cellular network Applications Web-based, portal technology One vendor software product or best-of –bread solution RFID and bar code technology
4. Mobile phone currently available on the market	PDAs Table PC Mobile clinical cart Podcast on iPod Battery life
5. Computing standards for m-Health	
6. Security and Privacy consideration	
7. Electromagnetic compatibility	

These challenges need to be addressed [17] before sustainability is achieved. Any of these challenges (and other possible challenges not listed in this table) should be carefully considered for the effectiveness of m-Health solutions. Specific measures to address these challenges should be planned for and/or put in place when considering the deployment of m-Health solutions.

It should be noted that despite these challenges, there have been successful m-Health deployment and/or use cases worldwide. In the following section, the innovative use of mobile phones and mobile phone-based applications in the fight against HIV/AIDS in developing countries is described as one example of an m-Health solution in developing countries.

2.2 Mobile Phone-based Application for HIV/AIDS care: a m-Health Solution in Developing Countries

There are various HIV/AIDS treatment and care provision challenges that affect both care givers and patients in a "resource-limited setting" [34]. These include but are not limited to high volume of patients, shortage of care givers, infrastructural deficit, lack of appropriate skills, ARV distribution and logistical problems, patients' follow up, cases of resistive viral infection, etc. The existing examples of mobile phone-based applications for HIV/AIDS could assist in addressing some of these challenges if they were implemented, adopted and maintained. Mobile phone-based applications for HIV/AIDS care could therefore be said to be a good example of a m-Health solution in developing countries.

A good illustration of the potential of mobile phones for health and HIV/AIDS in developing countries is provided by the Vital Wave Consulting's [39] study of 51 mobile phone-for-health projects in developing countries. Table 2 below illustrates examples of mobile phone-based applications for HIV/AIDS care described in the study.

Table 2. Example of mobile phone-based application for HIV/AIDS (adapted from vital wave consulting [39]

Application area	Mobile phone-based applications (Country, project and HIV/AIDS focus)
Education and awareness	South Africa, project Masikule: Promotion of testing and treatment via SMSs Uganda (Text-To Change (TTC) project: HIV/AIDS awareness through an SMS-based quiz Georgia, HIV/AIDS awareness video distribution on mobile phone India, Freedom HIV/AIDS project: HIV/AIDS awareness enhancement through mobile phone-based HIV/AIDS games
Remote data collection	Rwanda, TRACnet project: Patients' HIV/AIDS information management, ARV distribution monitoring South Africa, Dokoza project: Patients' HIV/AIDS data, treatment and adherence
Remote monitoring	India, Mobile Care, Support and Treatment Manager (MCST): Patients' HIV/AIDS Lab results access and medical history report; Nutritional planning and medication reminder Peru, Colecta-PALM: ART adherence information and patient's behavioral actions that is potential to wide spread of HIV/AIDS South Africa, Cell-Life's "AfterCare": monitoring of patients' medical status, medication adherence and other factors.
Communication and training for health care	Uganda, Mobile HIV/AIDS Support: Provide training regarding clinical care, research and prevention of HIV/AIDS
Disease and epidemic outbreak tracking	NO RECORDED PROJECT in this category. However TRACnet provides capabilities to track the HIV/AIDS pandemic
Diagnosis and Treatment tracking	South Africa, Dokoza project: HIV/AIDS Lab results access South Africa, HIV mobile Decision Support: Patients' screening and medical needs determination using mobile phones and/or

	mobile devices

From table 2 above, it is evident that different developing countries in different regions of the world, including Asia, Africa and South America, have experienced the use of mobile phone-based applications in the fight against HIV/AIDS. However, it should be noted that most of the described cases are pilot or research projects that have not been widely deployed and or adopted. In the following section, the barriers to wide deployment mobile phone-based applications for HIV/AIDS care in developing countries are explored.

2.3 Mobile phone-based Application for HIV/AIDS care's Adoption and Sustainabilty Challenges

Although ICTs have generally being identified as critical for achieving development, ICT investment and adoption is still very low in most developing countries [29]. In the health care sector, Gordon and Hinson [13] note that there are several factors that affect the adoption and sustainability of ICT-based health information systems in developing countries. They highlight the implications of the following factors in sustaining HIS in developing countries: poor infrastructure, approach to systems development, inappropriate donor policies and strategies, uncoordinated donor efforts and human resource capacity. In a study of HIS in Mozambique and Tanzania, Kimaro and Nhampossa [20] found that the lack of alignment of the interests, roles and responsibilities among stakeholders was a major sustainability challenge. Most of these issues have implications for the adoption and sustainability of m-Health and mobile phone-based applications for HIV/AIDS care in developing countries.

It has been generally observed that despite the potential use of mobile phone-based applications for HIV/AID care, there are major issues in sustaining and scaling up the use of these applications [39]. These two issues are common in the deployment of ICT in developing countries and should be addressed in conjunction [41]. Scalability on the one hand is concerned with the replication of the output of a pilot study (or project) over a wide area and the expansion or extension of the outcomes of the pilot to more beneficiaries. Sustainability on the other hand is concerned with the likelihood that the benefits from an intervention will be maintained at an appropriate level for a reasonably long period of time after the withdrawal of donor/project support [15].

Apart from the above mentioned issues, there are various other challenges that hinder the wide deployment of these applications in developing countries. For example there are some generic challenges in the use of mobile phone-based applications for health [32]. These challenges would implicitly affect mobile phone-based applications for HIV/AIDS care. Two major barriers as described by Patrick et al [32] are those of security and confidentiality seen that mobile phones can be easily lost, shared or misplaced which could result in big confidentiality and data security threats. In the case of HIV/AIDS this would be a major problem because of the sensitivity of HIV/AIDS related patients' data and the social implications of unauthorized access to and diffusion of a patient's data. One major societal impact of HIV/AIDS is stigmatization [18] which can have ramifications to discrimination, exclusion and psychological traumatism [24]. Mobile phone-based application deployment would therefore be affected by the patient's perception of whether data security and confidentiality would be jeopardized or not by the use of mobile phone-based applications.

One other issue is that of interoperability with existing Health Information Systems (HIS) [17]. This is a critical aspect in the integration of mobile phone-based application for HIV/AIDS care into existing HIS within hospitals. There are possibly many more issues that are not described here and that should be taken into account.

This study aimed particularly at analyzing the adoption and sustainability prospects of mobile phone-based applications for HIV/AIDS care among patients and care givers in a developing country's context. This has provided an understanding of the factors that would possibly dictate the adoption and long term use of these applications, particularly from the point of view of the ultimate users of the technology. In the following section, a short account on adoption and innovation diffusion models and their applicability in the context of developing countries is provided.

2.4 Adoption Models and the Study of the Complexity of ICT Utilization

The field of Information Systems has seen various theories and models developed in the study of different aspects of ICT utilization. These models and theories include but are not limited to Roger's Innovation Diffusion Model [33], DeLone and McLean model of Information Systems Success (ISS) [9], Davis' Technology Adoption Model [8], TAM derivative models such as Technology Transfer Model (TTM) [5], and the Unified Theory of Acceptance and Use of Technology (UTAUT) [38]; and models such as the Task Technology Fit (TTF) model, the Fit between Individuals, Tasks and Technology (FITT) framework [1]. A broad review of ICT utilization models is provided by Venkatesh et al [38]

These theories and models have been used in various IS studies. However, there have also been some critics regarding the appropriateness of these models in exploring the complexity of ICT utilization. Existing adoption and diffusion model have, for example, been criticized for: lacking in theoretical generalisability [10-23], focusing on one utilization aspect [6] and failing to consider other influential factors [25] such as the context within which adoption takes place [10].

There have been different studies that have tried to address some of these critics. Looking at existing models' limitations, Goodhue and Thompson [12] for example noted that the "Task-Technology fit" concept was not taken into consideration in previous models. They consequently developed the Task-Technology-Fit model which has also been extended to take into account the individual users characteristics [1]. Lucas Jr et al [23] also noted in their examination of the TAM model that the model has limited many IS researchers' focus on the perceived usefulness and Perceived ease of use constructs at the expense of other possible aspects of technology use and diffusion. This has resulted in the modification and development of much more inclusive models such as the UTAUT model which was developed to account for factors such as performance expectancy, effort expectancy, social influence and facilitating condition [38]; and the FITT model which advocates the fit between the attributes of individuals, task and technology [1]. Musa et al [26] for example have proposed a revised version of Davis' TAM model for developing countries. Their proposed model "accounts for inadequate accessibility and exposure to technology and captures individuals' perception of the negative and positive impact factors".

The study of the complexity of ICT utilization necessitates careful consideration of a theory development context and innovation adoption at study's context [10-23]. It is therefore critical that a theory or model's constructs and assumptions are appropriate to a particular context of study. Fichman [10] suggests that there is a need to develop "middle range theories tailored to specific classes of technologies and/or particular adoption contexts".

We therefore aim to contribute to the development of a sub-theory regarding the adoption and sustainability of m-Health in developing countries' context. Constructs from the following extended TAM models: TTF, FITT, and UTAUT have been referred to in the context of this study. The TTF model advocates the fit between task and technology [12]; the FITT framework emphasizes the need for a fit between the attributes of individuals, the attributes of task, and the attributes of technology [1]; while the UTAUT model emphasizes the following factors: performance expectancy, effort expectancy, social influence, and facilitating conditions [38]. Roger's IDM , Davis' TAM model, and Delone and McLean ISS model were overlooked as their constructs wouldn't provide good lenses for exploring the complexity of adopting and sustaining mobile phone-based applications for HIV/AIDS care in an ARV clinic in a developing countries' context. The following section provides an elaboration of the research methodology that was used in this study.

3. METHODOLOGY

This has been an interpretive qualitative study following a case study approach to generate data and using interviews - an important data collection technique in interpretive studies [27-40] - to collect the data. Interpretive studies in Information Systems have now become well established [40]; they entail developing an understanding of social phenomena within a socio-cultural context through individual and inter-subjective interpretation [28].

An ARV clinic had to be selected based on the following: being established in a developing country, possibility of having permission to conduct a research study at the ARV clinic granted, provision of all aspects of HIV/AIDS treatment services (HIV/AIDS awareness, counseling, testing, ARV treatment, ARV distribution, patients' follow up, treatment adherence enforcement), receiving a minimum of 100 patients per day, and the possibility of being explored cost effectively. Given these requirements an ARV clinic in Pretoria was selected and permission to conduct a study at the clinic was requested. The criticality and the sensitivity of conducting a study at an ARV clinic and dealing with patients required that ethical approval be granted before the study could begin and that participants' consent and voluntary participation be obtained.

Structured interviews were conducted with 42 patients and 13 Staff members or caregivers at the ARV clinic with the aim of assessing whether the adoption and sustainability of mobile phone-based applications for HIV/AIDS care can be envisaged from a patients' and caregivers' perspective. Two interview questionnaires (one for the patients and one for the care givers) were compiled in English and administered at the clinic. The questions principally explored care givers' and patients' contextual realities, mobile phone possession and potential for use as an enabling technology and mobile phone-based applications adoption costs and sustainability implications. The interviews were mostly conducted in English. However for the participants who could not speak English, a volunteer staff member assisted with the translation (from English to the appropriate local South African language) and explanation.

The analysis of the findings from these interviews was informed by an inductive thematic analysis. This approach entails categorizing observations from the collected data by using theme analysis and theme development [30].

In the following section a description of the ARV clinic and the interview findings is provided.

4. CASE STUDY AND FINDINGS

This study is part of a bigger study that has been conducted in three different developing countries to assess sustainability and scalability of mobile phone-based application for HIV/AIDS care in developing countries. The findings presented here are based on structured interviews that were conducted at an ARV clinic in Pretoria/South Africa to analyze m-Health adoption and sustainability future from a patients' and care givers' perspective. In this section, a short description of the ARV clinic settings where interviews were conducted is provided; an elaboration of the interviews' findings is also provided.

4.1 ARV Clinic Dynamics

Located in Pretoria/South Africa, the clinic receives around 180-220 patients per day and it is operated by 5 doctors, 6 nurses, 1 pharmacist, 11 counsellors, and 14 administrative personnel. It provides the following HIV/AIDS service: HIV/AIDS awareness, HIV/AIDS counseling, HIV/AIDS testing, ARV treatment, ARV distribution, patients' follow up and treatment adherence enforcement. The clinic has the following existing infrastructure that can be advantageous to the deployment of ICTs for improved service delivery: Electricity, fixed telephones, few computers and an internet connection. However the internet connection is limited and mostly not functional. All the patients get HIV/AIDS related information, test results, treatment recommendation, etc. at the clinic. For awareness raising and information purposes, there are posters at the clinic as well as few free HIV/AIDS magazines.

4.2 Findings

In this sub-section, the outcome of the interviews is described with a focus on the following main aspects: the potential users' contextual challenges and the potential for mobile phones' use as a service improvement enabling tool, the potential for mobile phone-based applications for HIV/AIDS care use at the clinic, and the prospects (readiness and willingness to bear any adoption costs) for adoption and sustainability of these applications among patients and caregivers.

4.2.1 Care givers' and Patients' Context and Challenges

In the assessment of care givers' and patients' contextual realities the interviews revealed that there are various service provision and access challenges that exist. All patients travel to the clinic to get any HIV/AIDS service. Some patients come from as far as 200 km or more from the clinic but most patients reside between 5km to 50 km away from the clinic. They travel mostly by taxi (33/42). Other transport means include buses (4/42), walking (3/42) or using their own transport (2/42). These patients are mostly unemployed (19/42 employed and 23/42 unemployed); have mostly qualification levels that is below matric level (1/42: degree, National diploma: 2/42, Matric: 13/42, between Grade 11 and grade 4: 26/42) and have mostly a high school education level (Primary school: 8/42,

High school: 31/42, Tertiary: 3/42). Patients in general (34/42) are happy with the service that the clinic provides but some of them (8/42) suggested that waiting in long queues can be inconvenient sometimes.

The Care givers interviewed included: Medical officers (3/13), Nurses (3/13), one counsellor (1/13) and Administrative clerks (6/13). They have the following education level: University (5/13) and High school (8/13). Their qualification levels are: Masters (1/13), Degree (4/13), National diploma (1/13) and Matric (7/13). Some of the challenges encountered by staff members included: high volume of patients, lost files, difficulties in tracing lab results, difficulty in reading colleagues' hand writings difficulty in providing feedback to patients, patients providing incorrect contact details or changing contact detail without informing the clinic, communication problems with unstable or very weak or deaf or mute patients.

4.2.2 Mobile Phones as a Potential Tool for Service Provision Improvement

In exploring the potential of mobile phone usage, it emerged that mobile phone possession among all participants is very high (51/55) and that most of them would use their mobile phones as a tool to improve service provision / access (46/55) (see table 4). However, mobile phones were not the preferred service improvement proposition. From the staff members' perspective, the following could be done to improve the quality of service: provide more training (7/22 proposed improvement measures), hire more staff (5/22), use appropriate technology (3/22), get more financial support (3/22), involve community members (3/22), and volunteering (1/22). Table 3 below provides an overview of the proposed way of improving service delivery**.**

Table 3. Service provision improvement suggestions by staff members (There were 22 suggestions collected from the 13 staff members)

Service improvement possibilities (Total suggestions: 22)	Observation	Percentage
Provide more training	7/22	31.8 %
Use of Appropriate technology	3/22	13.6 %
Hire more staff	3/22	13.6 %
More financial support	3/22	13.6 %
Involve community members	3/22	13.6 %
Volunteering	1/22	4.5 %

Despite the great potential for mobile phone use as a tool for service improvement, there are also some issues that need to be taken into consideration. Issues of privacy, mobile phone data storage capacities and mobile phone loss cannot be ignored Following are some of the interviewees' concerns regarding the use of mobile phones.

Interviewee A:

"I don't want to use my mobile phone because I personally think that someone might steal my phone and this person is going to get that message containing my information"

Interviewee B:

"I don't want to use my mobile phone. What if my phone is lost or stolen, or doesn't work, if I don't always have the mobile phone with me? And I can't use SMSs, I only make calls or receive calls"

Interviewee C:

"My phone is for personal use, health information, lab results, medication reminders can be accessed at the clinic, moreover the mobile phone' memory capacity cannot accommodate all the patient's information"

4.2.3 The Potential of Mobile Phone-based Applications for HIV/AIDS Care

From the conducted interviews, it emerged that most patients and care givers are aware of the existence of innovative mobile phone-based applications for HIV/AIDS care and that they would consider using these applications as a tool to improve the quality of healthcare service. However there were a few care givers and patients who were not aware of the existence of these technologies. Table 4 below summarizes the potential use of mobile phones and mobile phone-based applications for HIV/AIDS care from a patients' and care givers' angle.

Table 4. Potential for mobile phone and mobile phone-based applications for HIV/AIDS care

Potential for mobile phone-based applications use at the ARC clinic	Observation		Percentage
Mobile phone in possession	Yes	51/55	92.7 %
	No	4/55	7.3 %
Knowledge about existence of mobile phone-based applications for HIV/AIDS care	Yes	31/55	56.4%
	No	24/55	43.6%
Consideration to use mobile phone and/or mobile phone-based applications for HIV/AIDS care	Yes	46/55	83.6 %
	No	9/55	16.4 %
Willingness to provide financial contribution for use of service	Yes	21/55	38.2 %
	No	34/55	61.8 %
Believe technology can improve service	Yes	49/55	89 %
	No	6/55	11 %

4.2.4 Adoption and Sustainability Prospects

Some of the interviewed individuals (21/55) are prepared to contribute financially for the use of mobile phone-based applications but some of them (34/55) are not prepared to contribute financially. Some of the individuals interviewed believe that such a service would either be free (18/43 suggestions), supported by the government (18/43), supported by the donors (6/43), or supported by the clinic management (1/43) as shown in table 5 bellow.

Table 5: Proposed source of financial support for project

Nature of service and service Support (Total opinions :43)	Observation	Percentage
Government	18/43	41.7 %
Sponsor	6/43	13.9 %
Free	18/43	4.7 %
Clinic management	1/43	2,3 %

As summarized in table 5, Healthcare service is expected to be free and financial support expected to be made by government or possible sponsoring organizations even though the possibility those users can contribute towards financial sustainability of the projects cannot be excluded.

It is evident that mobile phones and mobile phone-based applications can play an enabling role at this clinic. However, it is important to consider how the technology could be adopted and sustained and who should incur the cost of usage. From the patients' and care givers' perspective, the following observations have been made from these findings regarding prospects of adoption and sustaining mobile phone-based applications for HIV/AIDS care:

(#1). There is a great potential for mobile phone and mobile phone-based applications use to enhance healthcare service delivery processes and to improve access to healthcare services

(#2). There is a great enthusiasm about the proposed mobile phone-based application even though knowledge about these applications is not proportionate. However the proposed technology is not the only service improvement possibility.

(#3). It is possible that few users would be prepared to incur some minimum costs. But the perception is that government should bear the cost of adoption and prolonged use

5. RESULTS DISCUSION

It has emerged that mobile phone-based applications for HIV/AIDS care could be adopted by both patients and care givers for the following reasons: these applications would support different service provisions tasks; most patients and care givers are in possession of mobile phones (on which these applications could be loaded); a good portion of patients and care givers are aware of the existence of these applications and they are willing to use their mobile phones; they perceive these applications as service delivery enhancement tools, and most mobile phone-based applications for HIV/AIDS care are easy to use. There is therefore a fit between the technology, the tasks and the users. This fit is regarded as key to technology adoption in a clinical environment where the interdependence between attributes of the intended users, the characteristics of the technology and the attributes of the process and tasks to be supported have to be well understood and managed in envisaging a technological adoption [1]. It should be noted that the notion of 'fit" can be enhanced at all three level (Users, Tasks, and Technology) by "influencing the attributes of users, tasks and technology" as suggested by Ammenwerth et al [1].

There could be instances where this fit is not that high and where this could be of a great risk. For example, it was noted that few patients are concerned with the fact that mobile phone-based applications' security and confidentiality can not guarantee. This confirms what Patrick et al [32] noted regarding the use of mobile phones use health care. It was also noted that some staff members regarded mobile phones as not having the appropriate memory (storage) capability. This could be a major challenge for m-Health future adoption in the sense that there would be no fit between the technology characteristics and the users' attributes.

Although the notion of fit has been observed regarding the potential adoption of mobile phone-based applications for HIV/AIDS, this does not guarantee that the users will be prepared to undertake any technological adoption and sustainability cost. This is in part related to the fact that the existing technology adoption and innovation models don't take into consideration other adoption influential factors [25] such as the context within which the technology has to be adopted [10]. In the specific context of this study, it was identified that although mobile phone-based applications for HIV/AIDS care are relevant, both care givers and patients have a different perception on how mobile phone-based applications should be deployed. It emerged that potential users have the perception that government and sponsors should mainly bear all the cost of mobile phone-based applications for HIV/AIDS care adoption and sustainability, and that the service should be freely provided. Most of them perceived that government and sponsors should be responsible for the cost of adoption and sustainability of these systems.

The following five points have been noted as critical in the potential adoption and sustainability of mobile phone-based application for HIV/AIDS care from a patients' and care givers' perspective:

(#1). The chosen technology should be appropriate: Mobile phones possession for example is high; and in comparison to other available infrastructures such as the internet, mobile phones are used by patients as well as staff members.

(#2). Even though technology can improve service delivery, it is not always the best solution. Users' perception about the importance of the technology can impact whether the technology is accepted or not.

(#3). Patients' and care givers' willingness to use the technology does not imply that they are prepared to incur any adoption or sustainability costs. It is therefore important to define beforehand whether users' contribution should be accounted for in the deployment of these applications.

(#4). Government and donor support is critical to ensure free service (use of mobile phone-based applications for HIV/AIDS) delivery. This is linked to the fact that people expect health care services to be free or to be provided at a low cost with the support of government and donor funds.

(#5). A financial sustainability model for usage beyond pilot level must be investigated before project initiation to understand who will eventually support, maintain and manage the use of the technology.

6. CONCLUSION

As m-Health becomes more and more being seen as the "mandatory" technology that will contribute tremendously to the improvement of healthcare service delivery in developing countries, particularly regarding mobile phone-based applications for HIV/AIDS care, it is necessary to understand

its influential adoption and sustainability factors. These factors are critical as the adoption and sustainability of these applications is envisaged for a greater health care improvement impact. From a care givers' and patients' perspective in a public ARV clinic in a developing country context, even though mobile phone and mobile phone-based applications match the needs of patients and care givers, adoption and sustainability of these applications will be dependent on how the adoption costs can be managed. The question of financial support, management and maintenance must be investigated prior to project launch. With the high perception of free or government-supported health care service delivery among patients and care givers, it is unrealistic to expect successful m-Health deployment (adopted and sustained) unless an appropriate m-Health business model is developed and adhered to. This study has contributed to the body of knowledge on innovation diffusion and technology adoption. There is still a lack of a general theory on innovation [7] and 'even a small assemblage of sub-theories that complement each other" [18]. As such, undertaking to develop a business model for the adoption and sustainability of m-Health initiatives in developing countries should be an interesting future research endeavor.

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