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Providing Home-based Care Using Text Messaging

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Abstract. The increasing miniaturization of mobile devices marks an important opportunity for the next generation health care delivery. Mobile health (mHealth), existing at the nexus of health and technology provides a singular opportunity to take health where it is needed the most. Having had nearly mainstream adoption, may explain why the developed world is in tandem with health-related Millennium Development Goals (MDGs). On the other hand, developing countries still lag behind in meeting the same health-related goals, yet they continue to report successful stories of mobile technology growth and adoption but no major usage of the same to deliver healthcare. This research sought to explore existing mHealth applications to establish their suitability for use in developing countries such as Kenya to provide home-based care. This was done by a survey of existing literature and mHealth models, and an architecture developed in light of local communication infrastructure and local mobile phone abilities. It was established that for developing countries to take advantage of this leapfrogging technology in health, they would have to take advantage of the Short Message Service (SMS) that is cheap and accessible to all. A relationship amongst mHealth stakeholders was considered as key to enhancing the adoption of mHealth in such countries.

Keywords: mHealth, Short Message Service (SMS), Home-based care

1. Introduction

Healthcare is a huge problem in the developing world and improving health of individuals and communities and strengthening health systems, disease detection and prevention are crucial for poverty reduction and development of any country in these regions. Mortality rates are still high compared to World Health Organization (WHO) standards with diseases like AIDS still being the number one rated cause of death. Kenya's health sector development has and is still guided by four major strategic plans; the Kenya Health Policy Framework paper (KHPFP) since 1994, the National Health Sector Strategic Plan (NHSSP), Kenya's long-term government policy vision 2030 and the Millennium Development Goals. All four clearly describe the country's vision for the health sector. The overall goal of the Kenyan health sector policy is to promote and improve the health of all Kenyans through the deliberate restructuring of the health sector to make all health services more effective and accessible and affordable for all. The restructuring should result in decentralized management of health care service provision and should transform the role of the Ministry of Health (MoH) from provider of services to that of policy maker and regulator of service provision [3]. The main obstacle that the poor face in such countries is the health burden of cost that mostly includes medication and travel expenses.

With an approximate population of about 39 million in 2009, the number of physicians for every 10,000 people remains at 1[1] with approximately 14 beds (both maternity and inpatient) for the same number of people. Though the health situation still appears impoverished, there seems to be another technological wave that is changing the lives of many in Kenya. There has been an increasing trend in the growth of mobile phone usage in the Kenyan market and other emerging economies. Safaricom, the biggest mobile service provider in Kenya recorded an active subscriber population of 17.4 million as at June 2009[2]. The overall

[1] http://www.who.int/whosis/en/
[2] Sector Statistics Report Q4 2008/09. http://www.cck.go.ke/resc/statcs.html.

penetration rate is still lower in Kenya as compared to other developed countries that have already surpassed, the 100% mark, though what remains amazing is its tremendous growth. There is therefore high possibility that mHealth could just as well be the answer to Kenyan health problems and expedite the accomplishment of the MDGs set by WHO.

The rest of the document is organized as follows: Section 2 presents a study of existing literature which is followed by a brief description of the mobile environment in Kenya in section 3. Section 4.1 shows the extraction of a mHealth application case based on an identified mHealth model and the proposed architecture is thereby presented in Section 4.2. This is followed by a discussion of the study in section 5 and finally the conclusion and recommendation for further research in section 6.

2. Related Literature

Existing technologies like the Internet can be used to help doctors working in isolated rural villages to access up-to-date medical information and communicate with colleagues, and even to diagnose illnesses and treat patients. But in developing countries these health workers who care for 80 to 90% of the populations live in rural areas that are at times impassible and have no meaningful access to the Internet [4]. The rapid growth and widespread use of wireless technologies provides the best opportunity to reach these isolated health workers.

The term mHealth has been described extensively by several authors [13, 14]. Generally the term refers to the use of mobile telecommunications in provisioning healthcare. Preliminary research has already shown that the application of mobile devices within the health sector is promising. Literature presents the use of mobile devices in health [1,2,8,15] though those that seem to have drawn keen interest especially for use in developing countries are those that implement text messaging [6,9,10,16,17,18] a feature of mobile phones, commonly known as SMS.

Text messaging seems to have been successful for various reasons. Aside from being cheap and having low bandwidth requirements, it is also easy to use and is supported by all cellular phones; both feature and high-end.

The minimal usage of mobile devices mainly the Personal Digital Assistant (PDA) in health in Kenya has been evidenced in the areas of data gathering, disease surveillance and epidemic tracking [5] yet the use of the mobile phones as shown in existing literature to have been useful in delivering healthcare services elsewhere has been left largely unexplored.

3. Mobile Telecommunications Environment in Kenya

Although high-end and java enabled low-end mobile phones generally have the capabilities to support multimedia services, a larger population in Kenya own low-end phones that generally support basic features and basic multimedia services. Mobile phone subscribers largely use their devices for calling and text messaging[3]. It therefore appears that compared to other technologies, mobile phones appeal better as they require lower level of skills than those needed for computers or the Internet and hence serve a larger illiterate majority. Although 3G technologies are already being rolled out, a larger part of the network is based on GSM (Global System for Mobile communications) technologies with some general packet radio service (GPRS) capabilities. 3G is still restricted to populations in major towns and services are still relatively expensive hence attracting fewer broadband subscribers. Therefore, in developing countries like Kenya, the applicability of text messaging in health presents a great opportunity for mHealth.

The status of the communication infrastructure and the capabilities of mobile phones in this region provide a good basis for the use of SMS for healthcare delivery. Such phones also present inherent limitations in terms of display size and computational power and battery life [7,8,12,15] and hence, these would be key design requirements to be considered in developing mHealth applications.

4. Design

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[3] Communications Commission of Kenya (CCK) 2009 *Sector Statistics Report Q4 2008/09:* http://www.cck.go.ke/resc/statcs.html.

4.1. The mHealth Scenario

A five dimensional reference model [11] has been proposed to assist mHealth system implementers and business stakeholders for understanding the various components of mHealth systems. The five components are communication infrastructure, device type, data display, application purpose and application domain. This research proposes to add a sixth component: data protection as an explicit technical consideration in considering mHealth applications because of the inherent privacy nature of health information data. Using the model, this research presents a sample home-based care mHealth scenario for HIV/AIDS (Table 1).

Table 1: Combination of Parameters based on Taxonomy areas

System	Purpose	Data	Network	Device	Application Area	Data Protection
HIV/AIDS Home – Based Care and Support	Patient Primary Care	Textual	GSM/GPRS	Cellular Phone	Home-Based Care	Encryption

- Sensitive data sent must be encrypted on senders device and decrypted on receiver's device (end-to-end) and vice versa
- Encryption scheme must be viable for cellular phone

4.2. The mHealth Architecture

The proposed architecture (Fig. 1), shows how text messaging can be used to provide home-based care. The patient is able to remain in contact with the health practitioners at the health care centre, without necessarily having to spend the already scarce resources and time to appear physically at the clinic.

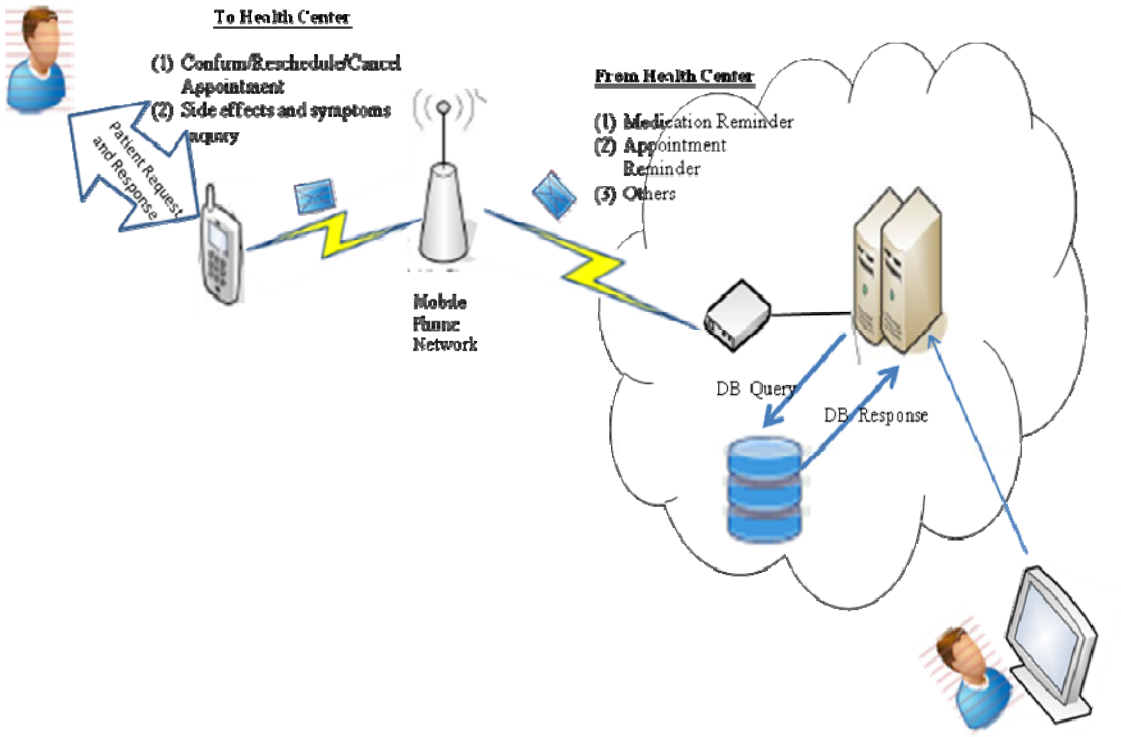

Fig. 1: Proposed mHealth Architecture

Patients are also able to enquire on any drug side effects that they may be experiencing by sending the symptoms in form of a message to the mHealth server, which is then able to respond with possible solutions to the problem and further advice the patient on whether or not they need to report back to the health centre for further investigations or a change of medication. This provides for medical support and consultations. Besides, patients are able to benefit from remote drug administration by receiving medication reminders and appointment reminders for treatment follow-up to ensure that they adhere to their medication regimen. This becomes extremely important for terminal and lifelong illnesses like HIV/AIDS, tuberculosis (TB) and cancer that require strict adherence to medication regimens.

5. Discussion

In determining the devices to be used in delivering mHealth, one must consider the inherent design features: display size, processor speeds and memory capacity and how they affect the other technical choices made. The data protection to be used depends largely upon the devices and their inherent design limitations, upon the data type and upon the acceptable level of computational overhead that can be sustained without incurring losses or major delay inconveniences for users. For pull messages it is important to consider using message formats so that retrieval of information is made much easier. Security and usability are key design requirements to be considered when developing mHealth applications.

Use of mobile phones for home-based care heralds new hope for the health sector, particularly in Africa where communities live in rural areas and health care is sparse. However, the persistence of poor infrastructure, poor investment, and lack of political support continue to hamper its growth. The adoption of mHealth has been and continues to be successful in developed countries; but these efforts lack coordination and a platform to enable the experiences to be used to meet local needs. Collaboration (Fig. 3) is identified as key to ensuring the successful and sustainable implementation of mHealth applications. This would require the MoH to serve as an umbrella under which this collaboration is managed.

6. Conclusion

It is acknowledged that hard decisions remain, particularly for policymakers and other decision makers faced with many competing priorities and limited budgets. However, it is the harsh truth that for mHealth to succeed in Kenya, it will be important that there is support from the government of Kenya and from the MoH. Key stakeholders have to be able to collaborate with the aim of ensuring that the formulation of strategy and frameworks is top down while innovation is bottom up to ensure sustainability and relevance.

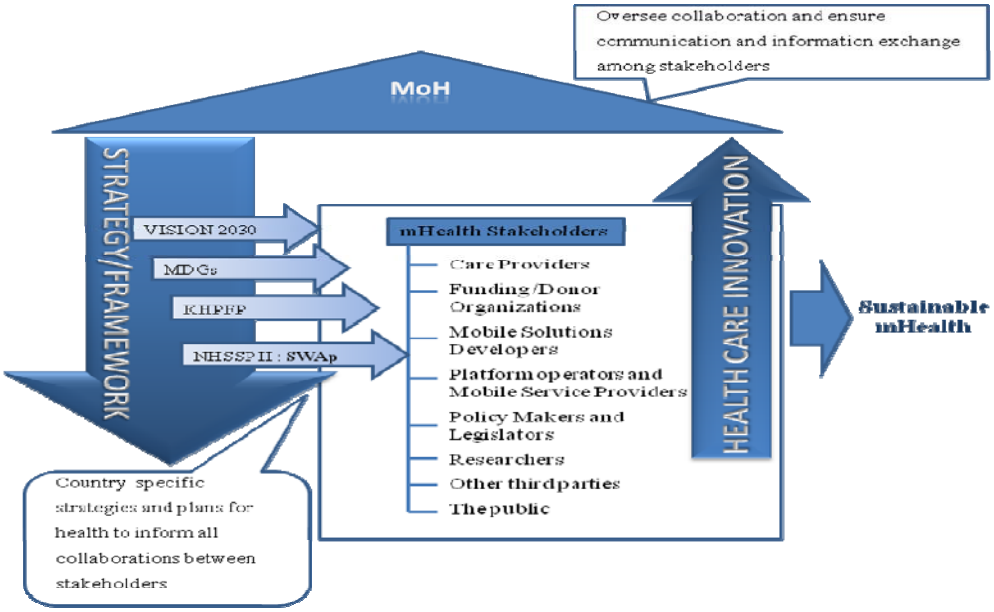

Fig 2: Collaboration between mHealth Stakeholders

The authors recommend that the same architecture be tested in other health domains and application areas. We also recommend the real implementation of a data encryption scheme like the one time pad to determine impact on computational power and processing overhead.

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