



**e-health and m-health in Mozambique:
innovations likely to lead to increased
retention and performance of Community
Based Agents (CBAs)**

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Abstract

The development of ICTs promises endless opportunities to improve individual well-being. The use of ICTs in the healthcare sector can transform the traditional ways of healthcare delivery, above all it can help to reach people living in very remote areas and provide better ways of delivering health care. This article explores innovative ways in which community based agents can take advantage of these technologies in Mozambique. Findings from this paper were drawn upon a literature review about community based health care provision, e-health and m-health and interviews conducted with health care providers (medical doctors, CBAs, IT personnel employed in the health sector).

Keywords

e-health, m-health, Mozambique, CBAs and APEs

Introduction

Every person in the world should have healthcare access regardless where he/she is geographically located and her/his socio-economic condition. Healthcare access is a human right. However, it has been a challenge for governments to provide healthcare to their citizens especially to those in remote areas in developing countries, for many reasons, such as the lack of material and financial resources, poor communication facilities, lack of skilled human resources, political reasons including wars and others. To overcome this challenge, one of the approaches drawn in order to increase coverage of healthcare provision applied by some of those governments has been to involve the communities, which in Mozambique those specific members of the community are called Agentes Polivalentes Elementares (APEs), in English, Community Based Agents (CBAs).

Another approach in place has been the use of Information and Communication Technologies (ICTs), especially Information Systems (IS) in the provision of healthcare, commonly known as e-health (Eysenbach 2001). Within this approach, there is a growing recognition by international agencies (notably the World Health Organization—WHO), government authorities, and researchers from different domains, development theories and public health, that the usage of electronic means, can significantly contribute to help address health service delivery problems (Braa et al. 2004). With the emergency of mobile technologies or m-health, which is the provision of health-related services via mobile communications (Vital Wave Consulting 2009), expectations to increase the access to health care services have grown.

Meanwhile, mechanisms to maximize the interventions of both approaches integrated (APEs and e-health/m-health) to improve healthcare provision to the community is an emerging phenomena; but with a great potential to bring changes in the healthcare sector, therefore, there is a need to identify such mechanisms, which can have a face of innovations.

It is under this context that this research was designed aiming to propose innovative ways of provision of healthcare through e-health or m-health by Mozambican APEs. This study aims to cover the areas of provision of health care services in malaria, diarrhoea and pneumonia.

Exploring e-health and m-health innovations likely to lead to increased retention and performance of Community Based Agents (CBAs) in Mozambique

Our field data is essentially qualitative, and the process of data collection was divided into two phases. We took the first 7 days to first understand the problem and second, to conduct a literature review on community based health care provision, e-health and m-health. In addition, we attended a presentation of a Professor from University of Melbourne, who is developing some m-health applications to be implemented in Mozambique. Attending this presentation provided us with awareness of experiences of e-health and m-health around the world, especially in developing countries, the role of CBAs in health care provision, hints and possible ways on how CBAs in Mozambique can use e-health and m-health innovatively.

In the following 8 days of the work we conducted some interviews to complement phase one and fill in the gap of what we did find in phase one. For example, in this phase, we found little written or documented about m-health experiences in Mozambique. The literature found was restricted to the experience of using PDAS in Mozambique and innovations based on mobile phones being built by the University of Melbourne to be implemented in Mozambique.

Given the short time to conduct this research, a small survey using mobile phones was conducted in order to obtain Mozambican experiences in the use of m-health or e-health by the APEs and related healthcare providers. In this survey, we interviewed APEs from remote areas. In addition informal interviews were conducted were interviewees comprised of, ICT technicians from the Ministry of Health and medical doctors working in Maputo province. It was not possible to conduct a formal survey as it would take longer to obtain at least an approval from the healthcare authorities. Table 1 summarizes the number and some profile of the interviewees.

The conducted interviews confirmed what we found in the literature review, that, less is know from formal documents reporting experiences of m-health usage in Mozambique although the use of mobile phones is booming and there is considerable use of computer based applications. Notwithstanding, we collected live experiences of using m-health in the country.

Health care providers	Number	Location
Medical doctors (and/or health care managers)	4	Maputo City
IT Personal	2	Ministry of Health
CBAAs (APEs)	10	Inhambane province
IT consultant of implementation of PDAs in Mozambique	2	Maputo city

Table 1 - Interviews conducted

Data analysis was done through analysis of the notes taken from the interviewees. Following is presented the study context.

e-Health in Mozambique

Prior to 1992, the Mozambican health information system was completely paper-based (Braa et al. 1991) covering the whole national health system that is built upon the national, province and district level including multiple health programs such as malaria, mother and child, family planning, immunizations, tuberculosis and others. After 1992, computer-based systems started to be used. SISprog was the first electronic database (Braa et al. 1991). It was installed in all the provincial directorates. As it did not support all the existing health programs and interest in using electronic systems was growing, many other electronic databases came into play. Today there are several electronic systems to support health care provision, used in the national health system, some implemented in each vertical program, some supported by different international donors, for example, HIV/AIDS programs have their own information system. The situation is described as “spaghetti” of various health information systems operating in Mozambique (Kimaro and Nhampossa 2005).

Most of the systems in use they do collect aggregated data and report to the upper levels. In general, at the health unit level, data is collected on paper based forms, sent to the district directorates (Mozambique has 128 districts), the district aggregates all the information from the health units and send to the province level (Mozambique has 10 provinces). Then the province directorates aggregate data of all the districts under its responsibility and send to the national level (the Ministry of health).

Although proliferating all over the country, e-health systems are still used at the management levels and less at the individual level, for treatment for example. Macueve et al. (2009) describe the use of computer-based systems, email and internet at the individual level as promising tools – but currently less revolutionary in a rural context, because to their users, they do not bring direct benefits such as healthcare, education, assets and abilities in the areas most valued by these people, namely their survival and social issues. In contrary mobile technologies are bringing uncountable benefits to populations in remote areas, specially. Following is described the use of mobile phones in the country in general and in healthcare provision in particular.

m-Health in Mozambique

In general, mobile technologies especially, the mobile telephone company started to operate in Mozambique in 1997. The use of mobile telephones is exploding exponentially in the country. Until 2008 there were more than 4 millions of subscribers in the country, which is 21 percent of the population, and this number has growing in 50% per year (Panos London 2010).

Mobile telephones have a direct added value to Mozambican individuals. People find it useful for communication, business and reduction of travelling costs. Even in the most remote areas where resources are scarce, people are willing to pay for it in order to have these benefits and others (Macueve et al. 2009, Gaster et al. 2009 and Panos London 2010). It is amazing, how you can find a mobile phone with people even in the very remote areas where there is no electricity to charge the phone, where literacy is very low, where the network is erratic.

This is the situation in general. With regard to the use of mobile phones in the health sector we found that healthcare providers use mobile phones for healthcare provision although not perceiving it sometimes, specially to mobile phones. Mobile phones are used by APEs to communicate remotely with their managers and patients. In their conversations they often send a “please call me” – a service from mobile operators that allow you to send a message to someone asking him/her to call you back. They send “please call me” SMS as much as they can until the health manager answers to them. Barriers faced in this communication include money to buy airtime, availability of communication network, literacy, tradition (predominantly oral than written speech). Strengths include the facility of reducing

the long distances between the APEs and their health managers, and between these their patients, lowering costs of transport, and remote assistance.

With regard to PDAs, documented experiences reveal that Mozambique has a record in the use of PDAs (Macanze 2007). A malaria control programme involving the Lubombo Spatial Development Initiative (LSDI) with support from the International Development Research Center (IDRC) from Canada in partnership with an organization named SATELLIFE based in United States of America (responsible for training and provision of technology), introduced a data collection mechanism using ICTs based on the use of a) PDAs for data collection and storage and b) GPS for collecting and reading geographical coordinates and c) cell phone for sending data remotely to a central database located at LSDI.

Initially it was piloted in Maputo province, then in Gaza, Inhambane and Zambézia. Currently, the use of PDAs t control of epidemiological diseases is being expanded to the other provinces of the country.

The experience of using PDAs showed to be innovative in the data collection process and reporting, although with some problems to take into account when running such kinds of experiences. For example it was difficult to get spare parts of the PDAs; the network was not compatible with the equipment, etc.

APEs in Mozambique

An APE is a community member selected by this community and trained by the national health system or NGOs to provide fist aid, preventive and curative healthcare to these communities.

APEs are required to have minimum education of the primary school degree. They leave far from the heath units, in some cases 30km or more far from the health unit of that community. The number of APEs varies from district from district.

APEs are not paid salaries by the national health system. They provide basic healthcare services as voluntaries that are rewarded sometimes by the communities that selected them. In addition, APEs are community's mobilizers and educators on health related issues. They do act as health activists, midwives and other roles related to traditional healing.

APEs are there in the Mozambican health system due in part to the existence of limited human resources, poor health infrastructure and other means that promote well-being regarded to health. APEs solve in part the problem of access to healthcare related to long distances between the health units and the communities (administrative posts of the districts and villages).

After this short presentation of APEs, following are presented some experiences on e-health and m-health from other countries, especially, developing countries and proposed innovations to be applied in Mozambique. Table 2 summarizes innovations proposed to be applied in Mozambique.

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Education and Awareness

In Uganda, South Africa and India, SMS messages have been used to increase awareness in the population about HIV/AIDS, to provide preventive healthcare information and to provide information about monitoring diseases (Vital Wave Consulting 2009, AIC and TTC 2009). SMS Message Campaigns by mobile telephones are used to spread text messages about health to the population.

We suggest that in Mozambique, for malaria, cholera and pneumonia programs, these SMS messages can be used by APEs to spread basic principles or instructions to the population about prevention methods against them. SMS campaigns can include information about earlier symptoms of these diseases for the population to be aware of; orientations on how to contact healthcare provides at the closest place or call the APEs for immediate interventions when needed can also be provided.

SMS messages about modern health care provision methods can also be sent by healthcare tutors/managers of the APEs. To some extent, this can motivate the APEs in their daily activities.

SMS campaigns with educative messages can also be sent by mobile operators in 'please call me' kind of SMS to the population.

A two way kind of interaction via SMS can provide facilities for families to call or SMS to the APEs to intervene or provide first aid before the doctors or specialized health

care providers when needed. It can also provide facilities for APEs to share experiences among them and with the doctors.

SMSs can also be used to spread information and warning to people to use mosquito net and prevent malaria, to keep the environment clean so that cholera is avoided.

Well, this information can go either by text, pictures or/with sound, in order to cover people with different characteristics including illiteracy.

One of the healthcare objectives is to spread as far as possible information about preventive ways to avoid some diseases, so using mobile phones, a tool that we said that has reached in Mozambique even the most remote areas; it makes possible such kind of information to reach places where seldom healthcare providers go.

Malaria is one of the causes of deaths in the country. One of the major challenges of the fight against malaria and diarrhoea is that people do not adhere to basic preventive steps, such as the use of clean water, use of mosquito net, pulverization, elimination of puddles. Education and warning information can be sent every day to the population. Through SMS messages attached to the “please call me” the population can receive information that can help them to build some awareness on these preventive ways for malaria, diarrhoea and pneumonia and hints of first basic aid when they get this disease.

The use of SMS messages for campaigns and educations is to some extent cost-effective as it does require no training for the users. The most used features in the mobile telephones are voice call and SMS messages. If preventive messages will come along with “please call me” messages, then it will be much easier because this population will not need to write these messages.

Mobile services providers often send information through SMS messages to the population, about other things like games and social events. How suggestion is that these operators can contribute to the well-being of the population in the health sector by promoting this kind of educative messages. And, another suggestion is that SMS sent for the sake of good health for the Mozambicans can be subsidize by the mobile services operators or made it for free. So, the ministry of health and organizations willing to promote such initiatives can work together with mobile services operators to achieve this goal.

One of the problems that we found in the field is that the APEs are not receiving any incentive to buy air time to use the mobile phones in their daily activities. This fact limits to some extent the exploration of possible ways in which they could use in the healthcare provision. Any initiative to use the phone, even for a simple call is a cost that is debited into their accounts.

The use of mobile phones in the health care systems can also makes effective activities of monitoring APEs. It can save costs of travelling for managers. APEs are in very remote areas, in which their supervision requires big cars to manage the road and all associated costs.

With regard to privacy and data sharing, under education and awareness, it is not an issue to take into account given that information circulated is to reach everybody.

Analysis, Diagnosis and Consultation

According to Vital Wave Consulting (2008;2009) and Black (2009), the University of Melbourne is developing mobile applications that can provide respiratory rate or pulse, rate counter, gestational dates calculator, drug dose calculator, drip rate calculator, and drug reminder alarm are installed in a mobile and in some cases linked to a sensor.

Healthcare providers use mobile phones to record information about the patients' medical status, medication adherence, and other relevant factors. On some cases, the healthcare person can provide treatment by him/herself at the moment of collecting data. On other cases, via SMS messages, data is sent to the central database, through a web-based application for managers to access and monitor incoming patient information. There are in self-health care solutions in which the individual completes a questionnaire with basic information about him/herself. Based on these answers, the individual is evaluated. From this assessment the individual begins receiving educational messages encouraging him/her to exercise and eat healthy.

Under the umbrella of diagnosis and consultations, although APEs are allowed to use rapid malaria tests, they are not empowered in the national health system to diagnose pneumonia and prescribe medication. Accordingly, mobile technologies are not advisable for the APEs to undertake such activities.

A great contribution according to one of our interviewees would be the creation of a device that makes a patient haemogram. Healthcare units in very remote areas do

not have technologies to make the patients haemogram, so every time it is needed the patient has to travel kilometres and kilometres to get to those health units, and sometimes, the patient does it while in very critical situations. Such innovation, a mobile application for haemogram would help not only the healthcare providers in very remote areas but also APEs. APEs would take the haemogram of the patient and send it to the medical doctor for decision making. Another alternative would consist in training APEs at least to use haemogram and empower them to take decisions from the respective information.

Monitoring/Medication Compliance

According to Wave Consulting (2009); SIMpill (2008); Blynn, E. (2009) and Black (2009) mobile telephones has showed to be effective in monitoring patients prescribed medication, especially in tuberculosis and HIV/AIDS programs. South Africa - increased compliance rate in a trial with tuberculosis patients in South Africa. In Thailand a study done in 2007 showed that TB patients who received daily text message medication reminders jumped to over 90% adherence.

In malaria, diarrhoea and pneumonia programs, an innovation that combines both the application to produce the haemogram and monitor medication compliance would add more value to the healthcare providers. In malaria cases, after it has been diagnosed and the patient medicated, often the doctors schedule another meeting for monitoring the patient. This patient is required to come later after finishing the medication to monitor his/her status. Unfortunately, often, the patient does not return to the hospital when feels better, so having this innovation, actually it would reduce the obligation for the patient to come back to the hospital, a remote follow up could be done by the APEs.

In environments where doctors are scarce, monitoring issues can be left to the APEs. With some training they can handle monitoring and medical doctors can concentrate their energies to more complex case. But the dangerous is that the more responsibilities we leave to the APES, increases the need to pay them in an official system.

A video conferencing application in the mobile phone in which the doctor and the patient could have the chance to interact, could be another very useful innovation, in which to some extent the patient, the doctor and the APEs would interact remotely. However, this solution would require some training, good communication

bandwidth and specific mobile telephones with video functionalities or a PDA could also replace the mobile phone or work together with mobile phone to achieve better results. Meanwhile, PDAs showed to be complex when piloted in Maputo for monitoring malaria (see Macanze's study 2007).

Disease emergency tracking

Warning systems improve decision making. For example, in India, Andra Pradesh, Incidents of Japanese Encephalitis were tracked on real-time basis with the support of a combination of mobile phones and web-based technologies. The government used the information to better prioritize vaccinations based on evidence of clusters of outbreaks (Vital Wave Consulting 2009).

In Mozambique, outbreaks of malaria and cholera often take place in different regions. Mobile telephones can be used by APES to report to the headquarters outbreaks observed in their communities of suspected situations that can lead to them. Daily statistics of cases can be part of the information to be delivered using SMS. In addition APES from one region can inform APES from other regions about outbreaks, inform the media (radio and TV) via SMSs and help the receivers of this information to spread to others. Currently, the number of cases of cholera is sent everyday to the Ministry of Health by the province, district directorates and other health units. Cases of cholera reported to Ministry are those from the prior day to the one that information is sent.

APES are aware of the places and seasons where outbreaks of these diseases take place. In order to avoid these or minimize their impact, APES can anticipate it by sending educative information to populations on how to prevent or handle these diseases.

In places where internet is available, a web page, would be useful and give opportunity of this information to be sent online and seen by the population for awareness.

Health/Administrative Systems and Data, Health Record Access

Mozambique has a number of experiences of using computer based applications for health/administrative to support the collection of health data and statistics for analysis, dissemination and use to support decision making and handheld (PDAs) technologies for health record access. For example, the implementation of DHIS

(Vital Wave Consulting 2008, WHO 2010) was piloted in three provinces of the country and for several reasons it did not pass the piloting phase (Macueve 2008). Today is in place implemented in all provinces the system called “módulo básico” with the same philosophy as the one of DHIs. Módulo básico is installed in all the provinces and districts, but is still a standalone system. The first pilot of PDAs for monitoring malaria also faced its challenges (Macanze 2007) that lead to the redesign of the application and now installed at all provincial directorates.

Innovative ways that we suggest of the use of these applications would consist in making current systems working online, replicate data entry forms in mobile telephones so that even in remote areas the system could still be used by other people like the APEs. APEs can benefit from this kind of systems in a mobile version to collect, analyse and disseminate data about their health activities and receive reports with aggregated information of other districts for awareness for example. A functionality that allows scanning or picturing via mobile phone data collection forms filled and reports would facilitate those who don't have computer facilities to collect, send and receive data on time. This would be offering an added value to the government, which would have all the data integrated and a really picture of health care provision in the country.

This solution would help to eliminate the “spaghetti” situation that we discussed earlier in this report. In this solution, we would not have the situation of many national systems, but rather different artefacts to collect data that would be stored in one central national database. However, the functioning of the system requires pragmatism in the improvement of IT infrastructure.

Conclusions and Recommendations

From the literature review and reported experiences, e-health and m-health have a great potential to make health accessible for all. And, from the field, we found that in Mozambique such initiatives are taking place, some in a very formal ways (for example the project of PDAs and computer based information systems) and others in a non official way, APEs calling to the their healthcare managers or those calling to the APEs, however, a new dynamic needs to be implemented in order to bring changes to people's life and bring well-being and direct outputs and impact in what their daily lives. In this report with have proposed 1) the use of SMS for health education and awareness; 2) the use of mobile phones to monitor activities of the APEs and strengthen the link between them and doctors, and APEs with patients; 3)

the implementation of a mobile application that creates a haemogram; 4) the creation of a video conferencing application for mobile phones to enhance communication between the different healthcare provision stakeholders; 5) a webpage for sharing disease outbreaks information and lastly 6) a national integrated health information system that collects data from different artefacts (computers, mobiles, PDAs) stores data in a unique database that can be accessed by different users.

The implementation of these innovations requires not only technical solutions but, also a set of other non-technical actions as we recommend:

- 1) Motivate APEs by paying them formally an incentive;
- 2) Observe the laws and culture of what is allowed locally or not in order to build appropriate technologies. (for example, diseases like pneumonia are not managed by APEs; people do not like to be pictures or recorded in video while sick);
- 3) Train APEs and pilot these technologies. The training program of the APEs includes scholar programs and specific courses healthcare management and provision;
- 4) If possible distribute these technologies for free for them to use for the sake of good health in Mozambique. Currently, APEs are using their own mobile phones and air time to communicate with patients and other healthcare providers;
- 5) By the side of e-health, existing computer based applications should be extended to levels of healthcare provision where APEs are based and integrated to other information and communication technologies like mobile phones.
- 6) To lower the costs of communication and create partnerships between the national health care systems and mobile services providers and internet service providers, to deliver via electronic and mobile means information about health care prevention and cure. And, as social responsibility of electronic and mobile service providers, some health care information could be circulated within their networks for free;

- 7) Improvement of the quality and expansion of the communication network is also an issue for greater consideration;
- 8) A mixed approach of bottom-up and top-down in the design of IT solutions have to be observed, where in order to find out what are the real needs on the ground a bottom-up approach is used and to show new innovative ways of using technologies for people's well-being a top-down approach is used.

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