Helpdesk Research Report: Mobile Telephony for Improved Health Service and Data Management

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Query: Please identify recent innovations and emerging best practices in the use of mobile telephony to improve health service outcomes and data management in post-conflict settings. Particularly interested in learning about simple / low-tech opportunities or programs that have helped improve drug distribution, health human resource or health information systems, and which may possibly be applied in the Solomon Islands in future years.

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1. Introduction

This report provides some recent examples of the use of mobile telephony to improve health service outcomes. There is significant potential for the use of mobile telephony to improve health service outcomes and data management. Opportunities include: serving as a less costly substitute for existing interventions; providing interactive functions that multiply the power of existing interventions; and serving entirely new functions. The use of mobile technology in health services (mHealth) has the potential to create more than 5 billion points of contact between consumers, healthcare workers, health system administrators and firms in supply chains for health commodities (Qiang et al., 2012). As Isaac Holeman observes, 'the key to understanding how mobile health services can proliferate is

in understanding what technologies these communities are already using... For the urgent change-maker, cutting-edge technologies are hardly relevant, ubiquitous technologies should be captivating.'

Significant areas in which mobile technology is being applied to health services include the following.

- Information management, including patient tracking and record keeping. Data standards and interoperable platforms are important to ease the flow of information. The adoption of unique health identifiers monitored by electronic devices can promote better coordination across health systems and enable improved epidemiological profiles. Ranck (2011) recommends developing a culture of data and information using designers to develop creative systems.
- Drug distribution: using mobiles to reduce stock-outs of drug supplies. SMS text messaging has proved to be useful for this, as shown in the examples of mTrac in Uganda and the SMS for Life project in Tanzania.
- Human resource management: connecting community-based health workers to medical advice, guidelines and training.

Countries recovering from conflicts and reinstating key functions of state administration can benefit from the utilisation of information and communications technology (ICT), which allows for more quick and efficient service delivery to citizens (Virhiä, 2010).

Rural settings pose challenges for implementing mHealth services, because skilled workers and the data needed to design business models are scarce. In addition, poor network coverage can constrain models and services, because there are fewer customers to attract mobile network operators.

mHealth services are most effective and most likely to be scaled up when they address the most pressing needs of public and private healthcare providers. Such services will grow faster and more productively if public and private leaders (including non-profits) recognise the role of strategic financing and interventions. Funders, governments and financial institutions should collaborate to explore needs-based financial and policy interventions that can support the scale and sustainability of successful models, helping them tap into public health budgets.

Effective policy will become increasingly important as the field of mHealth matures. Data security is a particularly important issue to address within the area of policy. There are legitimate concerns about the security of citizen information by programs using mobile health technologies. In particular, message transmission security and data storage security can put citizen information at risk if the necessary precautions are not taken. Policymakers and programme managers need to be made aware of security issues in the mHealth domain so appropriate policies and strategies can be developed and implemented. Policies will also be vital to efforts in harmonising eHealth (the use of ICTs for health services and information) and mHealth initiatives and directions in the short- and long-term (WHO, 2011).

2. Selected examples from post-conflict contexts

Health systems in the aftermath of violent conflict often require urgent rehabilitation. There is 'a growing consensus that in many circumstances donors can best address the health crises stemming from war by moving as quickly as possible from providing emergency health services to supporting the capacity of the state's ministry of health to plan, implement and oversee a comprehensive and transparent system of health services... that includes elements such as disease surveillance, disease prevention (including vaccinations), health services, health information systems, supply chain management, human resources for health, and monitoring and evaluation' (Rubenstein 2009, p. 3).

Improvements in health systems can also help promote stability as part of the peace dividend (Waldman 2006, p. 4), principally by enhancing state legitimacy (Rubenstein 2009, p. 6).

Countries recovering from conflicts and reinstating key functions of state administration can benefit from the utilisation of ICT, which allows for more quick and efficient service delivery to citizens (Virhiä, 2010). Insecurity and conflict *per se* are not necessarily barriers to the growth of mobile phone usage. Michael Best finds no statistically significant correlation between mobile phone penetration and security: 'mobile phone penetration is sensitive to money, politics, and social development – but seems immune to security concerns' (2011, p. 17). This suggests that it may be feasible to rely on mobile phones in post-conflict environments, provided that networks can be built sufficiently quickly.

Crisis Management Initiative (CMI) and the Liberia Ministry of Health and Social Welfare have developed an ICT based solution with a view to supporting the state to strengthen its capacities in service delivery and thereby strengthen peace in the society. The solution was developed to support the reinstating of birth registration by developing a solution which addresses the need to access, collect, transfer and store Birth Registration data with smartphones to complement a parallel process of using paper forms. The birth registration data is transferred by using the existing mobile networks, which cover almost the entire country while landline infrastructure does not exist. At the practical and technical core of the Mobile Birth Registration project is the use of the Nokia Data Gathering (NDG)[1] Solution to collect birth registration information through tailor-made information collection software forms and to transmit this information via General Packet Radio Service (GPRS) to the main birth registration service (Toivanen et al., 2011).

The medical system of Kosovo was largely destroyed during the conflict in 1999. Latifi et al. (2006) find that redevelopment of a medical system in the aftermath of a war ravaged country presents special and unique challenges. There is no reason to follow the evolution of other medical systems. Instead, many of the steps in the evolution of the model system may be eliminated and the renewal of the system may leap into an advanced stage of development using technology. Kosovo has had no problem embracing information technology and telemedicine as a reasonable tool as medical authorities rethink priorities and seek the quickest ways to re-establish medical care. (Latifi et al., 2006)

In Haiti, SIM cards' position data were used to track and estimate the magnitude and trends of population movements following the 2010 earthquake and cholera outbreak (Bengtsson et al 2011)[2]. This may be useful in post-conflict situations. The US army have been using an outreach effort, called mCare, which uses secure text messaging to communicate with wounded soldiers and helps to evaluate whether the patient should stay on active duty or retire.[3]

3. Information systems

Around the world, countless lives are lost due to insufficient access to quality health information. The availability of accurate, timely and analysed data is directly relevant to the quality of an individual's health and the healthcare system in general, the delivery of individual care, and the understanding and management of overall health systems (Ranck et al, 2011).

Patient tracking using mHealth applications can support the coordination and quality of care, especially in rural and underserved communities including the urban poor, women, the elderly and the

[1] http://projects.developer.nokia.com/ndg/wiki
[2] See also http://irevolution.net/2011/10/13/flowminder-haiti/, http://www.bbc.co.uk/news/technology-14761144
[3] http://www.fic.nih.gov/News/GlobalHealthMatters/Pages/1209_soldiers.aspx

disabled. For example, Kenya's ChildCount+[4] registers pregnant women and children under five and collects basic information about their health to prioritise visits by community health workers.

Better recordkeeping is another widespread outcome of mHealth technologies. Replacing dated processes with electronic systems lowers costs and saves health workers' time. Workers often have to keep several sets of books and medical records to comply with funding requirements. Automating these processes with mobile technology can free many hours for care. For example, the health information system implemented by the President's Emergency Plan for HIV/AIDS Relief (PEPFAR)[5] in Haiti and other developing countries provides cost savings and operational efficiencies through a mobile-based data entry system, replacing costlier computer- and paper-based tracking of patient data.

The Health Information Systems Programme (HISP)[6] is a South African pioneer of health systems in developing countries. One of their products for reporting health data is the District Health Information System (DHIS).[7] This is free and open-source software used in many developing countries for collection and aggregation of routine data that could help health service managers in making decentralised informed decisions. Shao (2012, p. 37-40) describes seven SMS based and electronic form based data collection frameworks: Open Data Kit (ODK), FrontlineSMS, EpiCollect, RapidSMS, Open X Data, Nokia Data Gathering, and JavaRosa. These frameworks offer varying capabilities regarding the type of data they can collect, handset support, network protocol support and data storage capability.

In siloed and fragmented health systems, the adoption of data standards and interoperable platforms can ease the flow of health information. The rapid proliferation of mHealth and eHealth applications and tools require those concerned about public health to work actively to develop methods for various tools to 'plug in' to one another. Where patients are not currently tracked at the national level, the adoption of unique health identifiers monitored by electronic devices can ensure better coordination across health systems and enable improved epidemiological profiles. Where staffing is limited, electronic collection can speed data capture and compensate, to some extent, for lack of training. Yet the lack of sufficient numbers and training for health informatics professionals will retard this growth (Ranck, 2011).

Other mHealth applications designed to capture real time health information are being used to monitor diseases and public health problems in large populations, especially in remote and non-traditional settings. For instance, EpiSurveyor[8] is an open-source surveying application that helps public health workers in many countries collect valuable health data. More than 2,800 users have registered to use EpiSurveyor, with more than 101,000 health records uploaded to the server.[9] Tools such as this improve the skills of community health workers, increasing the availability and quality of care. EpiSurveyor was used in Senegal to collect information for multiple health departments. An evaluation found surveying this way enabled faster data-gathering and improved decision making (Ranck, 2011)

Ranck (2011) recommends developing a culture of data and information, developing tools for capacity building of health professionals and the use of designers for creative systems. The importance of building systems from the ground up is also emphasised. A sound design approach begins with the end users and then structures incentives and rewards for collecting and transmitting accurate data – and the right data – for making good decisions at all levels.

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[4] http://www.childcount.org/
[5] http://www.pepfar.gov/documents/organization/197834.pdf
[6] http://www.hisp.org/
[7] http://dhis2.org/
[8] http://www.episurveyor.org/user/index
[9] http://www.datadyne.org/blog/100kuploads

On MobileActive.org, Mellissa Loudon provides a useful guide[10] for choosing a mobile data collection solution from defining the information requirements to choosing the most appropriate technology strategy for a specific organisational context and communication environment. K4 Health provides a needs assessment guide[11] for determining factors and logistics of a mobile data collection project. It determines the scope, skills, infrastructure, time frame, devices and wireless services required for mobile data collection. [12]

Other examples of mobile health information systems include the Uganda Health Information Network (UHIN),[13] Phones for Health in Rwanda,[14] and SURE - Securing Ugandans' Rights to Essential Medicines.[15]

4. Drug distribution

mHealth applications can be used for supply chain management, reducing delays in medicine shipments and providing point-of-use technologies for consumers to verify the authenticity of products they buy. The Stop Stock-Outs campaign[16] encouraged consumers and pharmacists in six sub-Saharan countries to report shortages of medicines and other products using SMS, resulting in hundreds of reports in a six month period. A system developed by mPedigree[17] and Hewlett Packard assigns codes to consumer drugs that are scratched off by consumers and authenticated by SMS; the system is being launched in Kenya (Qiang et al., 2011).

Moving from paper-based records to electronic systems will make data more transparent and planners will be able to address gaps in supply and demand. The lack of transparency at the most local level means that intermediaries are unable to make decisions based on real supply and demand. Once systems move to electronic formats it will be necessary to instill a 'culture of data' that encourages making decisions on real inventories. Mobiles can help data flow blockages beginning at the local level so that national level warehouses can make decisions based on actual inventories and actual demand (Ranck, 2011).

mTRAC is being used in Uganda to track medical supplies across Uganda's health clinics.[18] mTRAC is an innovation using SMS to track the health facility stock of essential medicines like the anti-malarial Artemisinin-based combination therapies (ACT). Launched by the Ministry of Health with support from UNICEF and partners FIND Diagnostics, mTRAC allows health facility workers to send government reports by SMS, including real time data to map facility stocks. The aim is to avoid unnecessary stock-outs and to ensure transparency and accountability for the drugs. Using mTRAC, the Ministry of Health will receive real time information on medicine stocks, and district health offices will be able to successfully lobby the National Medical Stores for resupply based on their ability to present reliable and timely data[19].

The SMS for Life project in Tanzania has helped reduce stock-outs of Malaria treatments (Barrington, 2010). Health workers in Tanzania used their personal cell phone to send a weekly SMS stock-count

[10] http://mobileactive.org/howtos/mobile-phones-data-collection
[11] http://www.k4health.org/sites/default/files/AEDSatellife%20GATHER%20Pre-Assessment%20Questions%2012-3-09.pdf
[12] See also K4 Health Toolkit: Planning Mobile Data Collection: Evidence and Lessons Learned http://www.k4health.org/toolkits/mhealth/planning-mobile-data-collection-evidence-and-lessons-learned
[13] http://www.mhealthinfo.org/project/uganda-health-information-network-uhin
[14] http://www.mhealthinfo.org/project/phones-health
[15] http://www.mhealthinfo.org/project/sure-securing-ungandans-rights-essential-medicines
[16] http://stopstockouts.org/
[17] http://mpedigree.net/mpedigree/index.php
[18] http://blog.psiimpact.com/2012/08/how-mhealth-is-supporting-ugandas-health-clinics/
[19] http://www.unicef.org/uganda/9903.html

message. The district management and National Malaria Control Program management used any internet browser on any PC, or alternatively a Blackberry device, to access the data system information. Training materials were provided to both management staff and health care workers, with follow-up training and resources provided as needed. The SMS for Life pilot provided, for the first time ever, reliable weekly stock information on anti-malarials at the health facility level. This visibility has supported better stock management and the elimination of stock-outs. It has also shown that accurate stock level information can be collected from rural health facilities on a weekly basis using simple SMS technology and that the information can and will be accessed by the relevant parties. The project also created a unique public-private partnership model that enabled the problem to be precisely identified, a technical solution to be designed, built and implemented in three rural districts in Tanzania all in under one year[20]. K4 Health note some challenges and recommendations for using Cell Phones to Monitor Availability of Malaria Medicines using EpiSurveyor[21]. Challenges included a phone model that was chosen for its large screen and better keyboard feature, which had occasional difficulty obtaining GPS coordinates. Other challenges included limited internet connectivity for transferring data while still at the facility. It was recommended to upload later with internet connectivity.

5. Human resources

Another major category of mHealth services focuses on making human resources more efficient in the health sector, both at the point of care and in administration. Many applications exist for clinical decision support, enabling consumers and health workers to receive medical advice using technology rather than relying on face-to-face interactions. India's Health Management and Research Institute (HMRI) delivers 104 Advice, an integrated medical centre in the state of Andhra Pradesh that has served more than ten million callers. In rural areas, where seeking treatment at a medical facility tends to be costly and more than half of unmet requests for outpatient care could be treated by phone, 104 Advice provides a hotline for medical consultations.

Mobile phones are particularly useful for connecting community-based health workers. They can report to a central base which helps to coordinate activities and allows them access to health records (Iluyemi, 2009). Jaroka Tele-Healthcare Services for Lady Health Workers (LHWs) in Pakistan is an example.[22] The project launched in 2008, aimed to utilise mobile platforms to extend tele-healthcare based services in rural Mardan, including SMS, MMS, GPRS/Edge and VSAT, to extend medical advice to LHWs in the field by connecting them to a network of specialists. LHWs could also download short audio and video files with latest medical advances and quick training sessions.

D-Tree International has developed a programme for health workers to help eliminate acute malnutrition as a public health problem in Zanzibar. The software is an interactive application taking the health worker step by step through the severe acute malnutrition guidelines using data from past and current visits to determine the child's progress and treatment.[23] A project in Kenya has used SMS to reach remote health workers. A bulk text messaging system has been piloted, helping to streamline and speed up communication. Improvements include regular, more cost effective communication with staff via SMS, resulting in higher compliance rates in timesheet submission and improved response

[20] More on SMS for life http://www.mhealthinfo.org/project/sms-life, http://www.mhealthinfo.org/project/sms-life-0, http://www.k4health.org/toolkits/mhealth/sms-life-rbm-initiative and SMS for Health the Gambia (http://www.mhealthinfo.org/project/sms-health-monitoring-key-drug-stock-levels).

[21] http://www.k4health.org/toolkits/mhealth/september-15-2010

[22] http://www.mhealthinfo.org/project/jaroka-tele-healthcare-services-lady-health-workers

[23] http://www.gsma.com/developmentfund/treating-malnutrition-in-zanzibar-empowering-health-workers-with-an-mhealth-solution/

rates from staff.[24] USAID and the mHealth Alliance have created a public-private partnership, mPowering Frontline Health Workers. It is designed to improve child health by accelerating the use of mobile technology by millions of health workers around the world.[25]

Mobile technology can also address many of the challenges of training health care providers. For providers who are far removed from urban facilities, mobile devices can deliver information to the point of care. Many providers are also quite mobile themselves, covering a large territory, so mobile devices travel with them and can give immediate access to information at time of need. Content can be adapted for providers to stay up to date with the latest advancements or protocols. These training can be delivered on a variety of devices to a variety of types of health care providers.[26]

6. Examples of technologies used for mHealth

Some noted technologies from Bruno Rakotozafy[27] and the Fogarty International Center[28]:

Episurveyor[29]
Created by DataDyne[30] in 2009, EpiSurveyor is a hands-on software that makes it really simple to collect data on any kind of mobile phone. EpiSurveyor lets anyone create an account, design forms, download them to phones, and start collecting data in minutes. More than 9,000 users in more than 170 countries worldwide (including the US, Kenya, Guatemala, the UK, Tanzania, India, Pakistan, Mali, the Philippines, Zambia, Malawi, Nigeria, Peru, Brazil, Indonesia, and Liberia) are making it the most widely used mHealth software.

It has been used for the collection of information regarding clinic supervision, vaccination coverage, outbreak response, and it helps to identify and manage important public health issues including HIV/AIDS, malaria and measles. For example, in 2008, Kenyan health workers used EpiSurveyor to track an emergency vaccination campaign against polio and managed to stop a potential epidemic in its tracks. In 2010, the application was successfully trialled for feasibility and scalability in a pilot in Malawi to monitor the availability of malaria medicines with mobile phones.[31]

FrontlineSMS[32]
FrontlineSMS is a free open-source software used by a variety of organisations to distribute and collect information via text messages (SMS). It enables users to connect a range of mobile devices to a computer to send and receive SMS text messages. The software works without an internet connection by connecting a device such as a mobile phone. If internet access is available, FrontlineSMS can be connected to online SMS services and set up to feed incoming messages to other web or email services. Frontline SMS developed MedicMobile,[33] the award-winning, free, open-source software is specifically adapted for use in healthcare. When MedicMobile was first introduced in an area of Malawi, the local hospital doubled the number of tuberculosis patients treated over six

[24] http://www.mhealthinfo.org/project/sms-reach-remote-health-workers
[25] http://www.usaid.gov/news-information/press-releases/mpowering-frontline-health-workers
[26] http://www.k4health.org/toolkits/mhealth/training-health-care-providers-8
[27] http://healthworkscollective.com/bruno-rakotozafy/45766/10-best-tools-boost-mhealth-initiatives-africa-part-12 and http://healthworkscollective.com/bruno-rakotozafy/45761/10-best-tools-boost-mhealth-initiatives-africa-part-22?ref=node_other_posts_by
[28] http://www.fic.nih.gov/RESEARCHTOPICS/Pages/MobileHealth.aspx
[29] http://www.episurveyor.org/user/index
[30] http://www.datadyne.org/episurveyor/
[31] http://www.mhealthinfo.org/project/episurveyor-mobile-health-data-collection
[32] http://www.frontlinesms.com/
[33] http://medicmobile.org/

months, while saving 2,100 hours in travel and work time and US$3,500 in costs.[34] The tool is now being used in 11 countries, mostly in sub-Saharan Africa.

OpenMRS[35]
OpenMRS is a collaborative open-source software to support the delivery of health care in developing countries. It grew out of the critical need to scale up the treatment of HIV in Africa, but from the start was conceived as a general purpose electronic medical record system that could support the full range of medical treatments. OpenMRS is founded on the principles of openness and sharing of ideas, software and strategies for deployment and use. The system is designed to be usable in very resource poor environments and can be modified with the addition of new data items, forms and reports without programming. It is intended as a platform that many organisations can adopt and modify avoiding the need to develop a system from scratch. More than 124 research and clinical centres are involved in the Open MRS project all around the world.

RapidSMS[36]
RapidSMS is an SMS-based framework that manages data collection, complex workflows, and group coordination using basic mobile phones — and can present information on the internet as soon as it is received. So far, RapidSMS has been customised and deployed with diverse functionality: remote health diagnostics, nutrition surveillance, supply chain tracking, registering children in public health campaigns, and community discussion. Rapid SMS initial development was funded by UNICEF and designed to be customised for the challenges of governments, multilateral, international- and non-government organisations in difficult environment. Famous projects like Millennium Villages or Child-Count are based on the mHealth RapidSMS platform.

eMocha[37]
The **e**lectronic **M**obile **O**pen-source **C**omprehensive **H**ealth **A**pplication is a free open-source application, developed by the Johns Hopkins Center for Clinical Global Health Education. eMOCHA is designed to assist health programmes in developing countries improve provider communication and education, as well as patient care, by coordinating wireless devices with local server-based clinical training and patient care support services. It easily collects patient data, and transforms it into high quality interactive forms such as video, audio files and maps.

Sana[38]
Sana is a standard-focused open-source system that supports audio, images, location-based data, text, and in the future, video. Sana's front-end for data and media capture is accessible through a fully programmable workflow interface. The back-end provides an intuitive user interface for management of medical media. Sana was built to be integrated with OpenMRS and other commonly used medical record systems for portability. The system infrastructure and design allows for modularity and interoperation. Packetisation, a synchronisation model, and multimodal data transport allow Sana to operate even in poor cellular coverage areas. While the system is mobile-centric, it is designed to provide alternatives such as WiFi and tethered uploads for bandwidth-constrained situations. Sana's mission is to revolutionise healthcare access and delivery for remote populations.

PatientView[39]
PatientView is a simple and easy to use electronic medical record system (EMR) targeting small clinics or single departments that have little support from professional IT staff. Many of these clinics

[34] http://www.guardian.co.uk/activate/mobile-messaging-boosts-healthcare
[35] http://openmrs.org/
[36] http://www.rapidsms.org/
[37] http://main.ccghe.net/content/emocha
[38] http://sana.mit.edu/
[39] http://medic.frontlinesms.com/2010/06/22/patientview-beta-is-here/

are currently using paper medical records and would benefit from the improved efficiency and reliability of an EMR, but do not have the technical staff to maintain a large, complex EMR. To address this problem, PatientView was designed to be easy to set up, easy to maintain, and easy to use. Beyond simplicity and usability, PatientView has many mobile features that are useful when working with health workers in the field, like the ability to coordinate SMS to and from the workers, accept forms submitted on mobile phones, and more.

7. Some useful organisations

InSTEDD
http://instedd.org/
InSTEDD design and use open-source technology tools to help partners enhance collaboration and improve information flow and knowledge sharing to better deliver critical services to vulnerable populations. With long-term sustainability in mind, an interdisciplinary team of public health experts, scientists, and software engineers helps build local capacity to solve critical health, safety and development problems. InSTEDD are committed to evaluating the impact of programmes, documenting best practices and sharing the results of their work.

BIOPHICS
http://www.biophics.org/
BIOPHICS emphasises sharing, dissemination and uses of basic and applied aspects of informatics in health sciences field.

National Library of Medicine (NLM) Mobile Resources
http://www.nlm.nih.gov/mobile-app/
A centralised collection of mobile friendly websites and apps from NLM, including resources by device and category.

mHiMSS
http://www.mhimss.org/
Healthcare Information and Management Systems (HIMSS) offer a globally-focused mobile initiative to drive positive, transformational change in health and healthcare through the best use of IT.

GSMA
http://www.gsma.com/developmentfund/programmes/mhealth/
The Mobile for Development's mHealth programme is part of a broader mHealth initiative within the GSMA that aims to promote the development of a sustainable and scalable mHealth market. The aim is to make the most of mobile phones being widely available to help increase health access to underserved people in emerging markets who currently have limited or non-existent access to healthcare services. It is an innovation lab for tools designed to strengthen networks, build community resilience and improve early detection and response to major health-related events and natural or human caused disasters. Its mission is to harness the power of technology to improve collaboration for global health and humanitarian action.

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