Mobile Health Technology

KEY PRACTICES
for DRR Implementers

Humanitarian Aid
and Civil Protection

COOPI
COOPERAZIONE
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Mobile Health Technology: Key Practices for DRR Implementers

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Mobile Health Technology

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- Information and Knowledge Management (COOPI)
- Mobile Health Technology (COOPI)
- Safe Hospitals (COOPI)
- Disaster Risk Reduction for Food and Nutrition Security (FAO)
- Appropriate Seed Varieties for Small-scale Farmers (FAO)
- Appropriate Seed and Grain Storage Systems for Small-scale Farmers (FAO)
- Farmer Field Schools (FAO)
- Irrigation Techniques for Small-scale Farmers (FAO)
- Management of Crop Diversity (FAO)
- Community-based Early Warning Systems (OCHA and FAO)
- Disaster Risk Reduction Architecture (UN-Habitat)

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Foreword by ECHO

The southern Africa and Indian Ocean region is extremely vulnerable to cyclones, floods, droughts and tropical storms. These recurrent climate-related shocks negatively affect the highly sensitive livelihoods and economies in the region, and erode communities' ability to fully recover, leading to increased fragility and vulnerability to subsequent disasters. The nature and pattern of weather-related disasters is shifting, becoming unpredictable, and increasing in frequency, intensity and magnitude as a result of climate change. Vulnerability in the region is further compounded by prevailing negative socio-economic factors, such as high HIV rates, extreme poverty, growing insecurity and demographic growth and trends (including intra-regional migration and increasing urbanization).

The European Commission's Office for Humanitarian Affairs (ECHO) has actively engaged in the region through the Disaster Preparedness ECHO (DIPECHO) programme since 2009, supporting multi-sectorial disaster risk reduction interventions in food security and agriculture, infrastructure and adapted architecture, information and knowledge management, water, sanitation and hygiene, and health. This programme operates with two objectives, notably:

- Emergency preparedness by building local capacities for sustainable weather-hazard preparedness and management, including seasonal preparedness plans, training, emergency stocks and rescue equipment, as well as Early Warning Systems.
- Empowering communities through multi-sectorial and multi-level approaches with DRR mainstreamed as a central component and improved food and nutrition security as an outcome.

This is done in alignment with national and regional strategies and frameworks.

For DIPECHO, one of the main measures of success is replicability. To this end, technical support through guidelines established for DRR implementers is a welcome output of the DIPECHO interventions in the region. ECHO has supported regional partners, namely COOPI, FAO, UN-Habitat and UN-OCHA, to enhance the resilience of vulnerable populations in southern Africa by providing the funding to field-test and establish good practices, and to develop a toolkit for their replication in southern Africa. It is the aim of the European Commission Office for Humanitarian Affairs and its partners to fulfil the two objectives sustainably and efficiently through the practices contained in this toolkit to ensure the increased resilience of the most vulnerable populations in the region.

Cees Wittebrood
Head of Unit, East, West and Southern Africa
Directorate-General for ECHO
European Commission

Foreword by COOPI

In 2013, Cooperazione Internazionale (COOPI) adopted a specific policy a specific environment and disaster risk reduction policy.[1] The main goal of the organization is to increase communities' and institutions' resilience by promoting environmental sustainability, fostering participation, and integrating prevention, mitigation and preparedness actions. COOPI aligns itself with international legal frameworks such as the Kyoto Protocol (1997), the United Nations Millennium Declaration (2000) and the Hyogo Framework for Action 2005–2015. COOPI enacts these frameworks using experience and knowledge in three key concepts: environmental sustainability, participation, and the integration of prevention, mitigation and preparedness. COOPI uses six well established approaches to implementation:

- Land analysis and information system: an essential tool for crisis and risk management, which allows the optimization of resources. COOPI has developed a series of good practices in these areas of intervention, promoting the use and development of research.
- Natural resources conservation and DRR-oriented land management: orienting land management interventions' focus towards protection and appropriate resource management through interventions on protection, value, efficient use and optimization of land.
- Capacity building and knowledge transfer enhancing communities' and institutions'' capacities is essential. COOPI stresses the importance of empowering emergency management structures both at the institutional and at community level through decentralization strategies.
- Education, communication and information combining education, communication and information to create a culture of risk management.
- Risk mitigation and supporting infrastructures: strengthening responses, mitigation and early recovery by identifying vulnerable and useful resources.
- Scientific research and know-how transfer: establishing relationships with DRR academics, scientific institutions and bodies

1 Policy available on: http://www.coopi.org/repository/pagine/coopi_ambiente_2013.pdf

for: alternative energies innovations, monitoring methodologies and vulnerability analysis, natural hazard sassessment, sharing good practices etc.

The *Mobile Health Technology: Key Practices for DRR Implementers* resource toolkit presented here provides support to DRR practitioners in the development and management of mobile-health projects in the context of DRR. Particularly, the tool is based on the lesson-learnt from COOPI's five years of experience in the use of mobile technology applied to the health sector in rural context in the southern Africa region. The toolkit also includes references to practical experiences in Malawi and Madagascar. The toolkit and additional resources and linkages to mobile-health web-applications developed by COOPI are also available at www.seadrr.org

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Acronyms and Abbreviations

COOPI	Cooperazione Internazionale
CSB	centres de santé de base
DRR	disaster risk reduction
FAO	Food and Agriculture Organization of the United Nations
GSM	global system for mobile communications
GPRS	general packet radio service
HSA	health surveillance assistant
IMCI	integrated management of childhood illnesses
MdM	Médecins du Monde
mHealth	mobile health
NGO	non-governmental organization
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
ODK	open data kit
SMS	short message service
UN	United Nations
UN-Habitat	United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund

Preface

Mobile phones are used in international development and disaster risk reduction (DRR) programmes by non-governmental organizations (NGOs), the United Nations (UN) and international agencies to collect data about many different subjects, such as agriculture, micro-credit and finance. Likewise in the health sector, the potential for mobile technology to make an impact is immense. In the health sector, mobile phones, tablets and other devices are not only data-collection tools; they can support health staff in the diagnosis of patients' illnesses, by using specific algorithms that can be embedded into the devices, and they can spread awareness messages or health alerts to health practitioners and to patients. In recent years, sophisticated software has been developed to allow mobile phones to operate almost like medical devices, changing the way health care is delivered to patients.

In the context of disaster risk reduction, it is extremely important to have access to real-time health-related information to monitor disease outbreaks (such as cholera) or when health centres run out of medicines. In this regard, the use of mobile phone communication helps to collect and transfer information from rural health facilities to central hospitals much faster and more efficiently.

Although the potential for mobile health (commonly known as mHealth) projects is huge, it is also easy for such projects to fail and the risk of creating elaborate but unsustainable tools or systems is very high. To prevent this from happening, it is necessary to implement an accurate risk analysis; to have a clear vision of the context of intervention; to know the stakeholders involved, including government bodies and, when information starts to flow, to ensure that the capacities for an organized response are in place, if needed. In addition, some 'technical' issues need to be taken into account, such as network coverage, familiarity with technology and staff turnover. If all of these considerations are clear to the implementing organization then, in the long term, the value of the benefits will exceed that of initial efforts and investments.

Italian NGO Cooperazione Internazionale (COOPI) is at the forefront of testing and implementing these technologies, particularly in flood-affected communities in Malawi and cyclone-affected communities in Madagascar. This technical brief presents the steps followed in using mHealth in these two examples and presents some of the lessons learned in the field.

1. Introduction

Mobile phones are no longer devices limited to voice calls and SMSs. They have evolved into affordable, sophisticated, 'smart' tools that are now also used to connect users to the Internet, to send e-mails and to engage in social networking – i.e. to transfer data. According to the Cisco Visual Networking Index, global mobile data traffic has doubled for the fourth year in a row since 2009. The report estimates an 18-fold increase in global mobile data traffic between 2011 and 2018 (Cisco, n.d.). This has been achieved thanks to improvements in the telecommunication sector: the global system for mobile communications (GSM) network was surpassed by the more advanced general packet radio service (GPRS) (2G) connectivity, followed by 3G and we have now entered the 4G era. National telecommunication companies all

Figure 1: Drugs being distributed at village clinics in Malawi

around the world have been constantly working to provide faster, more affordable solutions with extended network coverage in both urban and remote areas, including low-income and under-developed areas.

The devices themselves are also becoming progressively more affordable, which makes mobile phones and smartphones, as well as tablets, more accessible to different segments of the population. Increased affordability has also led NGOs and other partners, worldwide, to invest in mobile technology and systems as field tools that provide them with real-time, cost-efficient data on which to base actions within a project or programme.

Although the objectives, content and user bases vary depending on the needs assessed at the beginning of a project by its various stakeholders, certain common characteristics and processes can be noted, as illustrated in the sections that follow.

Objectives of mobile health technology

The objectives of mHealth are to:

- expedite the transmission of information between stakeholders in the health sector;
- help health operators to minimize computational errors, copying errors and missing data;
- provide health care staff with additional tools that can assist in diagnosing patients' illnesses;
- act as a supporting tool for emergency situations;
- facilitate data analysis and elaboration, including for research purposes; and
- save lives, above all.

Figure 2: mHealth projects around the world (source: GSMA)

These objectives become clearer if we realize that mHealth systems deal solely with digital information and aim to replace paper forms normally used at health facilities in developing countries. Therefore in mHhealth projects, computations are also automatically calculated, reducing the chances of calculation errors. Copying errors are minimized, as data is sent to central hospitals in a digital format, facilitating its integration into existing databases without any further data entry processes. Data analysis or elaboration of results is made easier, and collaboration between various partners who use data differently and at different times can be encouraged. For example, collaboration between NGOs and other field-based organizations, which collect data to monitor real-time situations in order to respond efficiently, and universities or other research institutions, which analyse and interpret the same information for policy recommendations or other future-based activities, can generate interesting results to plan future actions. In addition, in mHealth poor archiving, due to inadequate space and shelves, damaged registers and archives, is no longer an issue. However, the importance of frequent data backups and of storing data in different locations (e.g. servers, cloud technology, web-based storage services) to prevent data loss cannot be understated.

Intended applications

In this section, a list of possible applications for mHealth projects is presented. While not exhaustive, it provides some ideas and suggestions to organizations interested in engaging in mHealth technology.

- Stock management: Patients rely on the availability of drugs at health facilities for common but potentially life-threatening diseases, such as malaria, diarrhoea and respiratory tract infections. When a health centre runs out of drugs, information should be transmitted quickly to central hospitals or pharmacies

Figure 3: Paper reports are the most common way to collect and transmit health information

where drug stock managers are in charge of organizing the response. To do so, they need to have access to stock level information at all times. In many parts of the world, drug quantity information is still collected using paper forms, which increases the risk of delayed transmission of information to central hospitals, of lost information (forms are often physically transported from one health centre to another, sometimes arriving at the incorrect facility) and of typing and computational errors. It is not unheard of that lives have been lost because information was not transmitted timeously.

- Disease surveillance: Diseases can be tracked more effectively and efficiently with new technology. In developing countries or in remote areas, information is most often collected on paper forms, which may or may not be entered into a centralized system (at clinic level or at 'headquarters' level) that would raise the alarm if a certain disease was becoming prevalent in the catchment area. With mHealth technology, the same information is recorded in digital format and immediately transmitted. Ad hoc mHealth applications may be developed to trigger alert messages to personnel in charge of response, as well as to disseminate prevention messages to targeted populations. This can contribute to containing disease outbreaks and ultimately to saving lives. Furthermore, it could be interesting to link disease outbreak information to geographic software that would allow the data to be mapped and geographical statistics to be elaborated.
- Identify and track patients: Once patients are diagnosed with a specific health problem or disease, it is important to monitor them and to record the evolution of their status. The mHealth projects can help with this monitoring, because they make it easier to track returning patients and view their health history. A message system may be developed to remind both health staff and patients automatically about follow-up visits.

Figure 4: Drug distribution at Chankhwa Village Clinic in Salima, Malawi

- Awareness campaigns or reminders: Mobile phones are often used by organizations or health institutions in developing countries to spread health-related messages (e.g. HIV and maternal health care messages) within a community. In fact, despite the precarious living conditions of the majority of the population, at least one person (often more) in the village has a mobile phone. Bulk SMS systems may be used for health campaigns and alerts or personalized SMSs may be used to remind patients about specific issues. If patients do not own a mobile phone themselves, messages can be sent to health promoters in the village who are then in charge of delivering the message to the specific person or to the community. This happens often in relation to maternal health or nutritional issues.
- Diagnostic tool: Evolution in computer and mobile technology has increased the potential of mobile phones, transforming them from simple data collection tools into proper medical devices. Smartphone applications can include algorithms that assist health operators during patient visits by providing guidelines for diagnosis and treatment. At the top of the technology wave, a team of eye specialists in Kenya uses specially designed mobile phone applications to conduct diagnoses and treatment of people living with eye problems (Okutoyi, 2013).

Figure 5: Health awareness campaign in Kasache Village, Malawi

2. Field-Based Implementation of mHealth Projects

While well worth the investment, it should be noted that it is not easy to implement mHealth systems. This section provides some input for the identification of an appropriate mHealth option and how to approach mHealth project implementation.

Key principles for mHealth

These are the key principles that ensure the development of a good mHealth project:

1. 'Simplicity is the highest sophistication'. Do not look for complex solutions; most often simple options produce the best results. Simple SMS may suit the purpose of your mHealth system. If the amount of information to be collected and sent is a determining factor, then a smartphone may be the most appropriate solution. In any case, whether the mHealth project is based on SMS or smartphone applications, make sure that the device is easy to use, data collection forms are easily understood by compilers and data entry is made as easy as possible.

2. Do not re-invent the wheel. Many mHealth software options exist; check these before investing in developing something new and specific for a single intervention. For example, open source software solutions (open data kit (ODK), OpenMRS, Kobo and CommCare, etc.) are freely available and are already being used by many organizations. Instead of trying to develop something from scratch, investing time in researching various options can help to find the best solution for a project, perhaps needing only minimal customization.

3. Use step-by-step implementation. Many mHealth projects start off as pilot projects and then, after a short period of time, they are rapidly scaled up to a much bigger region or even nationally. It is very important to proceed on a small-scale and expand incrementally, step by step, instead of beginning with something unmanageable. Start with a few villages and, little by little, expand to a larger scale. This will give the project manager time to address critical matters that may arise during pilot implementations before facing bigger issues related to the increasing number of users.

4. Involve all stakeholders in the system from the beginning. Objectives and results to be achieved through an mHealth system

Figure 6 (opposite and current pages): Community health workers record medical information using mobile phones

need to be clear for all the parties involved from the onset of such a project. On the one hand, data collectors need to understand the reasons behind the introduction of the new system; on the other hand, health staff who are monitoring the information need to understand their roles and to be put in position to organize a response, if needed. With proper consultation, stakeholders are much more likely to 'buy-into' the system, which prevents it from being a once-off or a trial project, and encourages its inclusion as part of a clear strategy planned by all the involved stakeholders.

5. Include a feedback component. When implementing an mHealth system, users will often wonder about the effective transmission of information and whether it is well received. From the design phase of the mHealth system, remember to include a feedback component that confirms receipt of information sent by data collectors. It is common for new users to make mistakes relating to touch screen functions when using smartphones, because they may not yet be used to the new technology, so ensuring that they know if their inputs have been received is important. An additional function that allows users to check data before sending is also a useful tool to be integrated in the mHealth system to help encourage data accuracy.

6. Ensure you have capacity. Do not launch an mHealth service unless you have the ability/capacity and resources to act on incoming information. An mHealth system is not just about using mobile phones to collect data for the sake of having information stored at a central level; rather, it is about improving the overall health care information management system. In particular, the main objective of mHealth should be to ensure the delivery of a relevant and efficient response to the issues being monitored. Therefore, if a situation arises that requires an alert, the appropriate stakeholders should be on board to facilitate its approval and delivery or, if someone asks for information gathered in your mHealth system, you need to be able to respond accurately and quickly.

7. Motivate users by involving them in the bigger picture. Try to organize meetings between the different players in the system and to keep them updated on its progress. Health staff members involved in such a project usually feel very motivated, especially in the initial phase. It is important to maintain their motivation throughout the project to achieve the best results from the system.

Activities and key steps required in the field

Nine steps can be identified when implementing a mobile health project:

Step 1. Identify the objective

First, identify what the mHealth system is meant to achieve and what its longer-term impact should be. This helps to define the

elements (mobile device, web interface, etc.) needed for the implementation of the project. This phase will also include a cost analysis of the system to be able to have a clear picture of the system as a whole both in objective and economic terms.

Step 2. Look for the best solution: it may be out there already

Search on the Internet, do a literature review, ask colleagues or other organizations that may have already implemented similar projects. There are also websites that can help you to navigate the sea of mHealth applications and that can guide you in the selection of the best application according to some common criteria. After having identified the right solution for your system, you will also have a clear picture of the type of telecommunication service you will need (e.g. SMS, data transfer, etc.). Then it is time to look for the best network service provider for the context. It may be quite difficult for a single NGO to approach national telecommunication companies directly, but if an mHealth national group exists (as in Malawi), especially if it is coordinated by the Ministry of Health, then

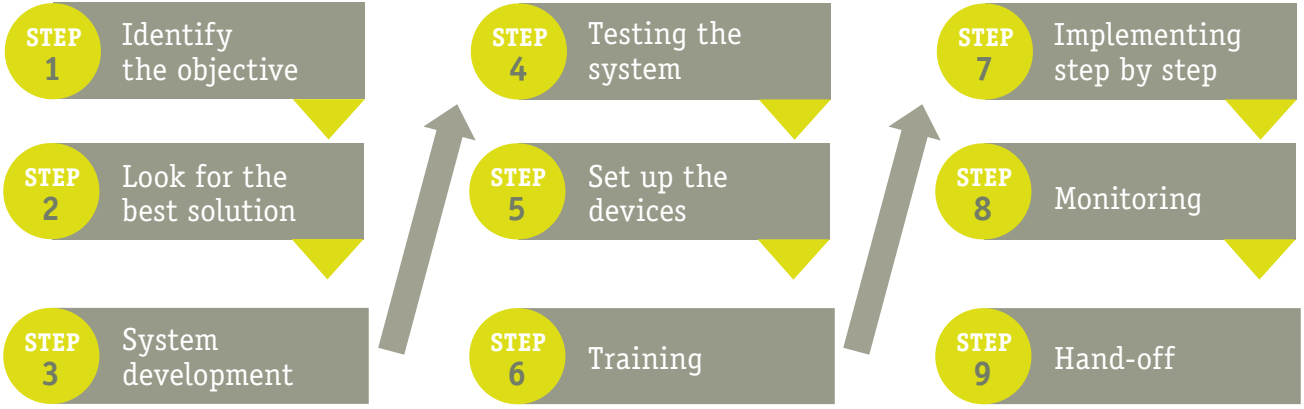

Figure 7: Village Clinic Monitoring System workflow

the chance of success is high. However, to make telecommunication companies interested in the project, a strategy that ensures the visibility of their brand (e.g. on devices or at the end of SMSs) should be central to the use of the system and should be promoted during project implementation.

Step 3. System development

At this stage you need to customize the solution that you have chosen in Step 2. This may require some programming work that can be done internally within the organization, if it has the capacity to do so, or by outsourcing the service from specialized companies. The development phase may include two components: development of the web-application (webpage for data visualization and analysis) and development of the mobile application (data collection through mobile technology). Sometimes it is possible to find solutions where mobile and web application components are already integrated (e.g. Kobo).

Step 4. Testing the system

Once the development of both the mobile and the web application is completed, it is time to test if the system works properly. Test the system at the office first and on the field afterwards in order to verify if there are no network issues that may need to be addressed before moving on into the implementation phase.

Step 5. Set up the devices

Once the testing has been completed, you can start to set up the devices by installing the software, if required. Do some additional data collection and transmission test before distributing the phones to users.

Step 6. Training

At this point, health staff can be trained to use the devices and software. The duration of the training depends on the type of mHealth system you are implementing; however, usually a few days of hands on training should suffice. Little time should be spent on the theoretical parts of the system, and most of it should be dedicated to practical exercises. Make sure that every student has fully understood how to collect, review and send data. Collaboration between students is also a great way to learn and discuss common issues or challenges, both during the training and afterwards during field implementation.

Step 7. Implementation step by step

Now it is time to start the implementation. Remember to start small, both in terms of the number of users and the area to be covered by the system. During the initial phases, field monitoring is critical to be able to assist the data collectors as much as possible. In this phase, some critical issues may arise: try to address them before moving forward or scaling up the project.

Step 8. Monitoring

Although information collected through the mHealth system may be available online and therefore can be monitored from a distance, it is always good practice to frequently visit to the intervention sites for continuous monitoring and get feedback about issues that may arise. Poor network connectivity; mismanagement of the smartphone, such as deleting saved forms or applications, etc. are challenges that have been identified in past project monitoring, and identify the need for refresher trainings to make sure that the methodology for filling the forms has been fully understood.

Step 9. Hand-off

You are now ready to hand over the system to local institutions or partners. When doing so, ensure that they have sufficient training and capacity to take on this responsibility. At this stage it is necessary to discuss data management issues: consider how and where this information is stored, protected and whether and how it might be used in the future.

Figure 8: Basic smartphone used at village clinics

Technical considerations and specifications

Apart from the key principles previously discussed, there are also some technical issues to be taken into account when implementing an mHealth project:

- Choose the right device. For example, when the quantity of information to be collected is limited (not exceeding 160 characters), SMS systems, requiring simple basic GSM phones, can be used. Many mobile health systems (i.e. Rapid SMS, (UNICEF)) are based on the use of coded SMS, with each character or group of characters representing a specific piece of information (the name of a drug, its quantity, etc.) that is then transferred to a server and stored in a database. If more significant or detailed data is required, it is advisable to use other types of devices such as smartphones or tablets. Java enabled phones are also used as they have an user interface similar to the traditional phones but enable forms to be filled and sent through GSM network (FrontlineSMS). However, considering that the price of smartphones is continuously reducing and it is now comparable to Java enabled phones, it is advisable to choose smartphones.
- Limit chances for mistakes. One of the key challenges of digital information is that typing errors can make information invalid, as the database or software cannot recognise it. It is therefore extremely important to limit the room for mistakes as much as possible. This can be done by coding anticipated/known responses numerically, or by using drop-down menus or multiple-choice questions, so that users do not have to type full words.
- Network availability. In remote areas, network coverage may be an issue; however, this need not be an inhibiting factor as solutions exist to overcome this problem. Embedded systems can collect data in forms, store it and send it when connection is available, or it is possible to use small antennas in order to amplify a communication signal where this is present but it is not strong enough. It is also possible to involve telecommunications companies directly to work towards the improvement of network connectivity in remote areas.
- Smartphones' battery life. mHealth projects are usually implemented in remote areas where access to electricity may also be a challenge. This issue is particularly critical for smartphones that have a very short battery life although advancements are being made to improve battery life. Solar chargers may be an alternative but the cost-benefit ratio of devices currently available on the market should still be improved.
- Costs. Money can be an issue as phones must be topped up in order to send messages or data. Although one may think that SMS would be a cheaper solution compared to using packet data from smartphones, in the long run the former is more expensive. Phone service providers provide many cost effective solutions for data transfer.

3. Practical Examples to Guide Implementation

Specific context in southern Africa

Although mHealth is still quite a new practice, there are several experiences in the southeast Africa and the Indian Ocean Region. In most cases, we are talking about isolated initiatives, developed independently by different organizations, sometimes even in the same areas or villages; this can, at times, create confusion for health staff. There is a need to coordinate efforts in order not to replicate initiatives and to encourage collaboration more impact and more efficient results. A good example of this coordination is happening in Malawi, where an mHealth group exists at national level, supported by the Ministry of Health with the objective of sharing experiences between organizations and coordinating efforts between partners.

Many of the available mHealth projects in the region focus on collecting information from remote health centres and sending it

to district hospitals. For example, many mHealth projects in Malawi are related to Integrated Management of Childhood Illnesses (IMCI) programmes, where under-five health conditions are monitored in remote health facilities (village clinics). Stock monitoring is also another important area of implementation, particularly interesting in the context of DRR.

Experiences in southeast Africa and Indian Ocean Region

COOPI has been implementing two mobile health pilot projects in two countries in the Southern Africa and Indian Ocean Region: Malawi and Madagascar.

mHealth system in Malawi

Since 2009, COOPI has been testing the use of mobile technology in Malawi, particularly in Salima District. Since the programme's inception, technology has improved quickly and to keep up the tools used for this programme have been changed and improved accordingly, moving from Windows to Android mobile phones, from Excel and emails to electronic forms (Open Data Kit (ODK))).

Figure 9: Data collection at a village clinic

The system currently used in Malawi aims to improve monitoring disease outbreaks and stock management at village clinic level. Village clinics are small health posts located in remote villages and referring to health centers, which then report to District Hospitals. In Salima COOPI implemented the mHealth project in three sites (Chankhwa, Mbulu and Pemba) which refer their data to Maganga Health Center, which reports then to Salima District Hospital. These locations were selected as they are affected by floods every year.

Village clinics are run by government staff, Health Surveillance Assistants (HSA), whose task is to carry out basic visits, especially for under five year olds and to supply basic medicines (i.e. co-trimoxazole, zinc, paracetamol, eye ointment, etc.). Once a month, HSAs have to send reports about the stock levels and the number of cases to the responsible health center. The current mHealth project replaces the previously paper-based information forms with electronic ones. The information flow is described in the graphic.

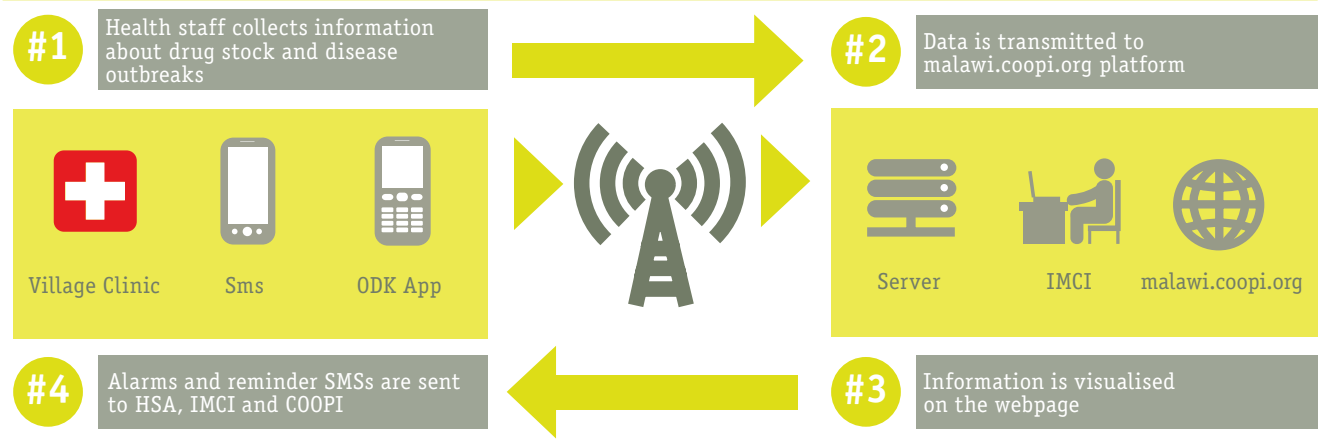

Figure 10: Village clinic monitoring system workflow

The system[2] includes the following steps:

1. Health Surveillance Assistant (HSA) is provided with an Android smartphone including an ODK application. This allows HSAs to fill in specific forms and send the information to a server through mobile data connectivity. HSAs fill two types of form:
   a. Drug stock form, with the same structure as the paper form used by the Ministry of Health.
   b. Child visit form, this is an algorithm that guides HSA in diagnosing child's disease and providing warnings in case of danger signs or suggestions about child treatment. As with the drug stock form, the form has the same structure as the paper one provided by the Ministry of Health.

2. Once collected, information is sent by GPRS local network (or GSM for SMS component), to a dedicated server where it is stored in a database; if network is poor at the village clinic site, information is saved and automatically sent once GPRS network is available.

3. A website is linked to the online database. The web page is accessible at the link: malawi.coopi.org (login required) and includes three main sections: a drug stock page, a disease page and a child visit page; all of them include maps, statistics, warning messages, etc.

4. Finally, an SMS system for alarms and reminders is included. Particularly, there are two types of SMS that are automatically sent from the server to the HSA:
   a. SMS for out of stock alarms: SMS and email are sent to the responsible of the health centre and to COOPI, in the event of drug depletion;
      i.e. *TEXT: 08/2012, Biwi is out of stock of: LA1,LA2,COTRI….*
   b. SMS for reminding HSAs about patient follow up: SMS is sent to the HSA, IMCI coordinator and COOPI staff with the names of the children to be followed up on that specific day;
      i.e. *TEXT: REMEMBER TO follow up on Andrew, Tom….*

Some of the key strengths of the system are:
- improving timeliness of reports, both in terms of sending and receiving;
- allowing real time monitoring of village clinics' information;
- identifying and monitoring important indicators defined in agreement with the Ministry of Health (referral due to out of stocks, follow up percentage, etc.); and
- sending alarms and reminders via SMS to inform directly health operators.

The system has been running in Malawi for the past year. It was designed initially according to the guidelines promoted by UNICEF and the Ministry of Health. Before developing the mobile application and the web interface, several meetings were organized to define

2 Developed in collaboration with gnucoop, www.gnucoop.com

the details of the applications properly. Village clinic staff was trained over one day on the use of smartphones to fill in the forms; the staff assimilated the information, practices and tools quickly and they have been able to send reports monthly. However one of the issues that emerged during the project implementation was the high number of children HSAs are expected to visit each day – sometimes up to 50. HSAs have to fill in both paper forms, as per government guidelines, and electronic forms. This takes time and it may discourage the HSA from filling the electronic forms as mothers with sick children need to be assisted quickly. Therefore, until the electronic tool replaces the paper one, duplication caused by the use of both elements could be a burden rather than a benefit to the process, especially if operators are not used to the new technology.

Furthermore, one of the main challenges has been the involvement of the District Hospital to constantly monitor the information sent by mobile phones and to take actions if needed. This is not happening regularly and therefore the potential of the system is not yet fully realized. In future actions, the involvement of hospital staff in the use of this technology is required, and it would be interesting to integrate the system into other health monitoring programs.

Figure 11: Distributing medicine for under-five year olds at village clinics

mHealth stock monitoring system in Madagascar

In Madagascar, Centres de Santé de Base (CSB) are at the base of the health system. They are mostly located in remote and rural areas. The transmission of information through paper forms between CSB and central health structures can be difficult, particularly in the event of an emergency or during the cyclone season, when roads may not be passable.

The COOPI mHealth project, run in collaboration with Medicines du Monde (MdM), involves 37 CSBs in the region of Sambava in north east Madagascar, a zone frequently affected by cyclones. It is very difficult to monitor quantities of drugs available at any given time in the CSBs in the region; sometimes, when drugs are depleted at one clinic, they are ordered from Antananarivo (more

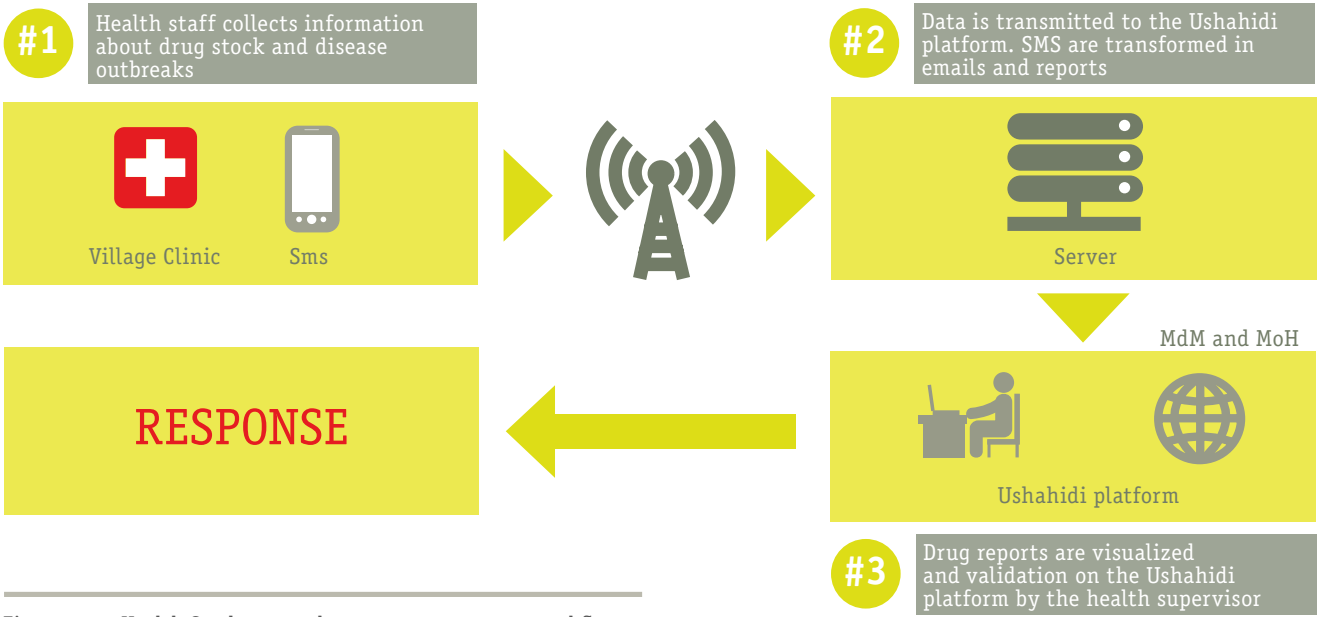

Figure 12: mHealth Sambava stock management system workflow

than 1,200 kilometres away) even though they may be available at a neighboring clinic. This causes delays that could be easily avoided if information was made available through alternative systems.

As such, an mHealth system has been put in place with the objective to monitor the stock of five main medicines (Paracetamol, Amoxiciline, Ibruprofene, Cotrimoxazole, Metreonidazole), as indicated by the Ministry of Health. The information flow is indicated in Figure 3.

The mHealth system is based on three main components:

- SMS: each character represents either the name of the drug, the date of the report or the drug quantity. The structure of the SMS used for Sambava project is shown in Figure 4.
- Ushahidi web interface (Ushaihidi): this is an open source application that can be customized for personalized dissemination of information. It allows reports to be sent through email, SMS or social network and to be visualized on a map after been approved by authorized staff; in this case only the SMS option has been used and reports have been monitored and approved by medical personnel in charge of drug stock for the 37 CSBs.
- Alarms for out of stock events: automatic emails and SMS are sent by the system to concerned staff in case of out of stock events.

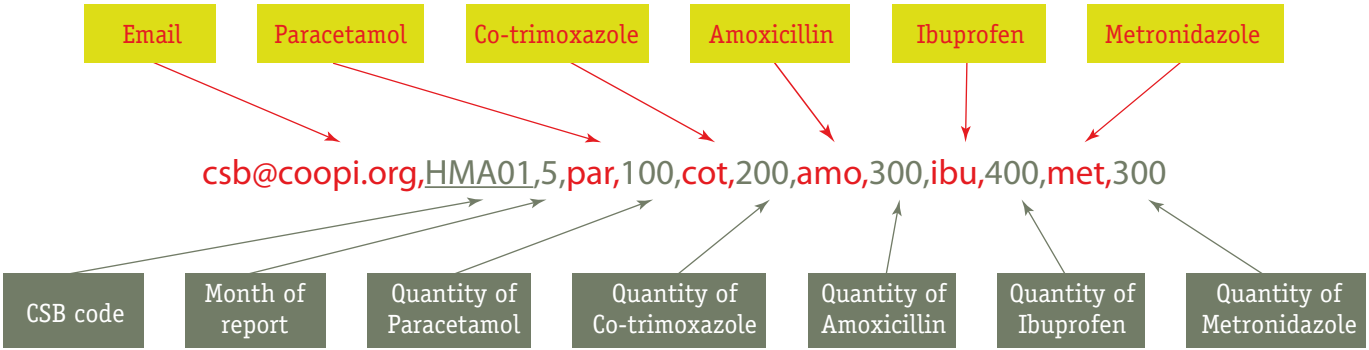

Figure 13: SMS structure - Sambava mHealth project

The system was implemented between July and December 2013. CSB have been using the system every month and the governmental staff in charge of approving the reports had been constantly monitoring the sent information.

The case studies implemented by COOPI, demonstrate that mHealth tools can improve health care services in remote areas. However their full potential has not been fully explored yet. Although some organizations are trying to introduce these tools into their projects, many are still quite sceptical; this is partially explained by the fact that mHealth systems need constant monitoring, at least in the initial phase, requiring time and dedicated resources. Also, it is still quite difficult to integrate the mHealth systems into normal health care operations, increasing the risk that they only remain pilot projects instead of being further tested and then eventually accepted, fully integrated, and scaled up.

However, some experiences combining simple health care needs with smart solutions, have gained the interest of government staff (i.e. Madagascar case study) who felt particularly involved and motivated and therefore fully adopted the system and monitored stock levels monthly, with no need for continuous reminders from the NGO in charge of the project. Therefore possibilities for future steps and developments may be explored.

Figure 14: Sambava mHealth staff training

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