Using Mobile Networks for Low-Cost Data Exchange: The Mozambique Health Information Network (MHIN)

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The MHIN case study was selected for inclusion in this toolkit because it illustrates the fulfilment of a number of critical requirements for moving a project from prototype to pilot and eventual sustainable roll-out:

1) The application of an innovative and affordable technology solution involving mobile networks and the use of PDAs by individuals unfamiliar with the use of ICTs, in this case health workers, who are often of an older age and therefore more resistant to the adoption of new technologies.
2) Government commitment to providing better health services to communities, while benefiting from the better availability and accuracy of health data from the field.
3) Cost savings and increased productivity in terms of data collection from districts, including the monitoring of paper-based versus digital data collection systems.
4) The gradual upscaling of a development project through a collaborative partnership between an NGO (AED-Satellife) and the Ministry of Health, Mozambique.

Background and context

Mozambique is located along the eastern coast of Southern Africa, with a population of over 20 million.[1] Until 1992, the country was plagued by sixteen years of civil war, which literally destroyed all rural health infrastructure, worsening an already poor health network. The existing health system is characterised by insufficient health facilities and low numbers of suitably trained health workers and medical personnel, as can be seen from the 2005 statistical data in Table 1.[2]

Table 1: Selected health statistics 2005

Doctors per population	1/22,000
Nurses per population	1/3,000
Life expectancy M/F	44/46 yrs
Child mortality M/F per 1,000	110.67/104.97
Malaria cases	5,087,865
Malaria deaths	3,569
People living with HIV/AIDS	1,300,000
Adult HIV/AIDS prevalence rate	12.2%
Children living with HIV/AIDS	99,000
AIDS orphans (2003)	470,000

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[1] National Institute of Statistics, 2007.

[2] Ministry of Health Statistics, 2005

Most of the available infrastructure and resources are based in the capital city Maputo, which is located far in the south, a major barrier due to the geographic spread of this long and narrow country, with large travel distances to other provincial capitals. The situation is further exacerbated by the poor transport and telecommunications infrastructure, with a low fixed-line density of sixteen phones per 1000 inhabitants. However, mobile coverage is now available across 45% of the country, creating opportunities for improved communications, although still unaffordable to many.

All of these conditions, combined with the poor and inaccurate health data collection process currently in place, have constrained the ability of Mozambique's Ministry of Health (MISAU) and other decision makers to design adequate policies to provide health services, particularly in rural, underserved communities. This has also prevented the timely allocation of resources where they are most needed.

During 2005, the Mozambican government identified the improvement of community-based health care as one of its most important objectives in reducing the overall burden of disease. The fulfillment of the above objective required MISAU to have a better understanding of the country's disease patterns, based on the analysis of aggregated health data collected at district rural clinics. Thus health data collection was identified as one of the key areas to be developed and as a result, a Department for Health Information was created at MISAU, with the responsibility of managing health data collection processes and analysis.

The ability of MISAU to allocate adequate health resources throughout the country, based on accurate and real-time health data analysis, was and still is one of the major challenges.

The Mozambique Health Information Network (MHIN) is a project which aims to strengthen the capacity of MISAU to collect, transmit and manage health data through the application of low-cost information and communication technologies (ICTs). The MHIN project is jointly implemented by the Academy for Educational Development (AED) SATELLIFE Center for Health Information and Technology, MISAU, and the Mozambique Ministry of Science and Technology (MCT) through funds provided by the Canadian International Development Research Centre (IDRC) and the Canadian International Development Agency (CIDA). Technology support is provided by South African-based industry players – S-Curve Technologies cc and Thalamic Systems cc – under not-for-profit contractual arrangements. Launched in 2007, MHIN is currently operating in 68 health centres located in five districts of Mozambique.

The key objectives guiding the proposed systems design for MHIN were:

1) To replace paper-based health data collection processes with computer-based systems to collect, report and analyse digitised health data
2) To speed up the reporting of health data from rural health centres to MISAU
3) To improve the accuracy of reported public health data
4) To improve clinical and public health information dissemination to rural health clinics
5) To build technical capacity within MISAU to manage and expand MHIN and ensure system sustainability.

To achieve the goal of improving MISAU's health data collection, transmission and management, MHIN has deployed an innovative system for two-way data routing to update and synchronise data between health centres and a central database. A standard, off-the-shelf server is located at MISAU. Accessible via the internet, the MHIN server allows data downloads at national and district levels, as well as facilitating MISAU's

upload of data and information resources onto the server for dissemination to rural clinics.

Each MHIN participant health worker uses a mobile device often referred to as PDA (personal digital assistant). Using standard paper-based MISAU forms converted into PDA format, health workers input and save into PDA memory community health data such as polio and measles vaccination regimes, malaria treatment and birth registrations.

The technology

The African Access Point (AAP)

An AAP (African Access Point) is a computer-based device that communicates with a handheld device (PDA) via an infrared communications link. Other than health data, the AAP has the ability to route other data packets over a cellular GSM (global system for mobile) network to and from the MHIN server.

AAP Software

To ensure platform stability, the AAP is based on an embedded Linux 2.6 operating system with a minimal set of user-changeable parameters. Users may connect to both the server and client units via a web interface, through which they may upload content and email to distribute through the system. The same interface may be used on the server to upload data content for dissemination to the client machines. Data collection forms for the PDAs were designed to prevent health workers from skipping questions.

AAPs are located in specific rural clinics with GSM network coverage and can be shared by different neighbouring health facilities with no GSM access. The AAPs are scheduled to initiate GSM/GPRS (general packet radio service) data calls at low GSM network traffic times to upload and download data to and from the server.

Since each AAP can be shared and makes a single data transfer, telecommunications expenses are reduced. Currently, with the units not used to full capacity, MHIN telecommunication monthly costs are approximately USD 7 per AAP.

Network data flow

PDA health and non-health data from rural clinics are uploaded into AAP via infrared. Based on a GSM/GPRS daily connection schedule, the AAP uploads data into the server located at MISAU. At MISAU a PC client has full FTP (file transfer protocol) data access from all clinics while each district capital has access only to its respective district health clinics' data (see Figure 1).
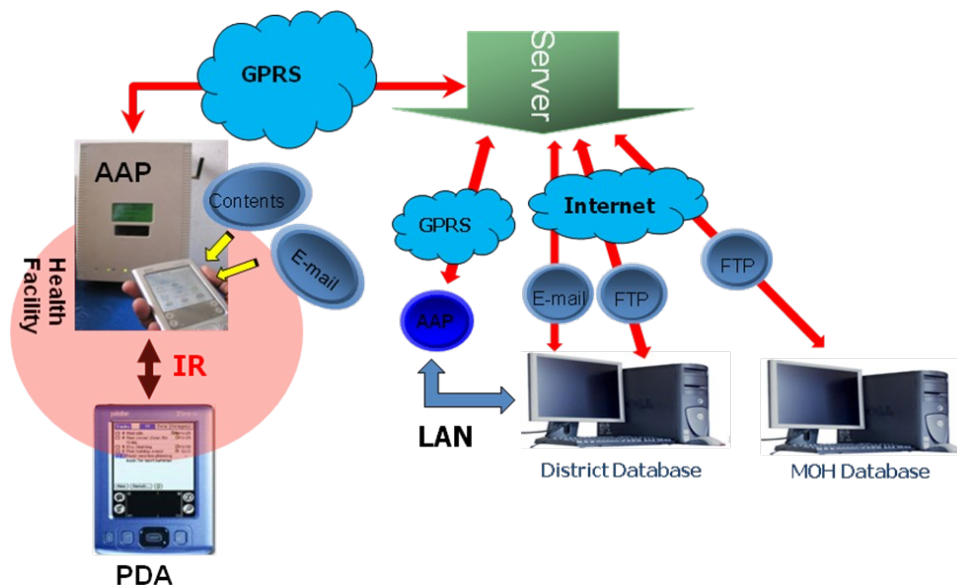
Figure 1: Network data flow

Project impact and beneficiaries

The greatest beneficiaries of the MHIN will be the patients who receive better health care as a result of better policy making and better resource allocation. Preliminary studies indicate that, compared to paper-based systems, MHIN-supported data collection delivers more reliable and accurate data and greatly reduces the time needed in compiling, managing and reporting health data.

A monitoring and evaluation process is being conducted, which will determine the impact and map the outcome changes as well as the project sustainability and cost effectiveness. However, testimonials of MHIN network usage by rural area health workers indicate that, although simultaneous use of both the paper-based and handheld-based collection processes is an added burden, health workers recognise the advantages of the digital system and are aware of the benefits that MHIN provides compared to paper-based systems. The following is an email sent by a rural health worker from her PDA (in Portuguese, with English translation provided below):

> Date: 2008/9/24
> Subject: Vantagem do modulo basico usado pela RMIS
> To: aed.rmis@gmail.com
>
> A grande vantagem do modulo bàsico usado pela RMIS em comparacão com o modulo basico actualmente usado no MISAU eque o da RMIS não precisamos de introduzir dados porque o processo todo è automatico enquanto que o modulo basico usado pelo misau é necessario sentar para introduzir os dados no final do mês e pela quantidade de dados acumulados atè ao fim do mês existe o risco da pessoa que esta digitar cometer falhas que irão alterar os dados, e è um processo muito cansativo,se fizermos uma comparação do tempo no sistema da RMIS usamos um terço do tempo que se usa actualmente no misau.
>
> *[The great advantage of the RMIS (MHIN) database compared to the current database used by MISAU is that on the MHIN database, there is no need to manually enter cumulative data from different health clinics into the database every month-end, which is very tiring and there is always a risk that one can make mistakes when entering data that will affect the*

overall aggregated data. Comparing the time spent on both processes to compile district health data and print reports, the MHIN requires a third of the time we spent using the existing MISAU process.]

Figure 2: Screen shot of an email from an MHIN participant
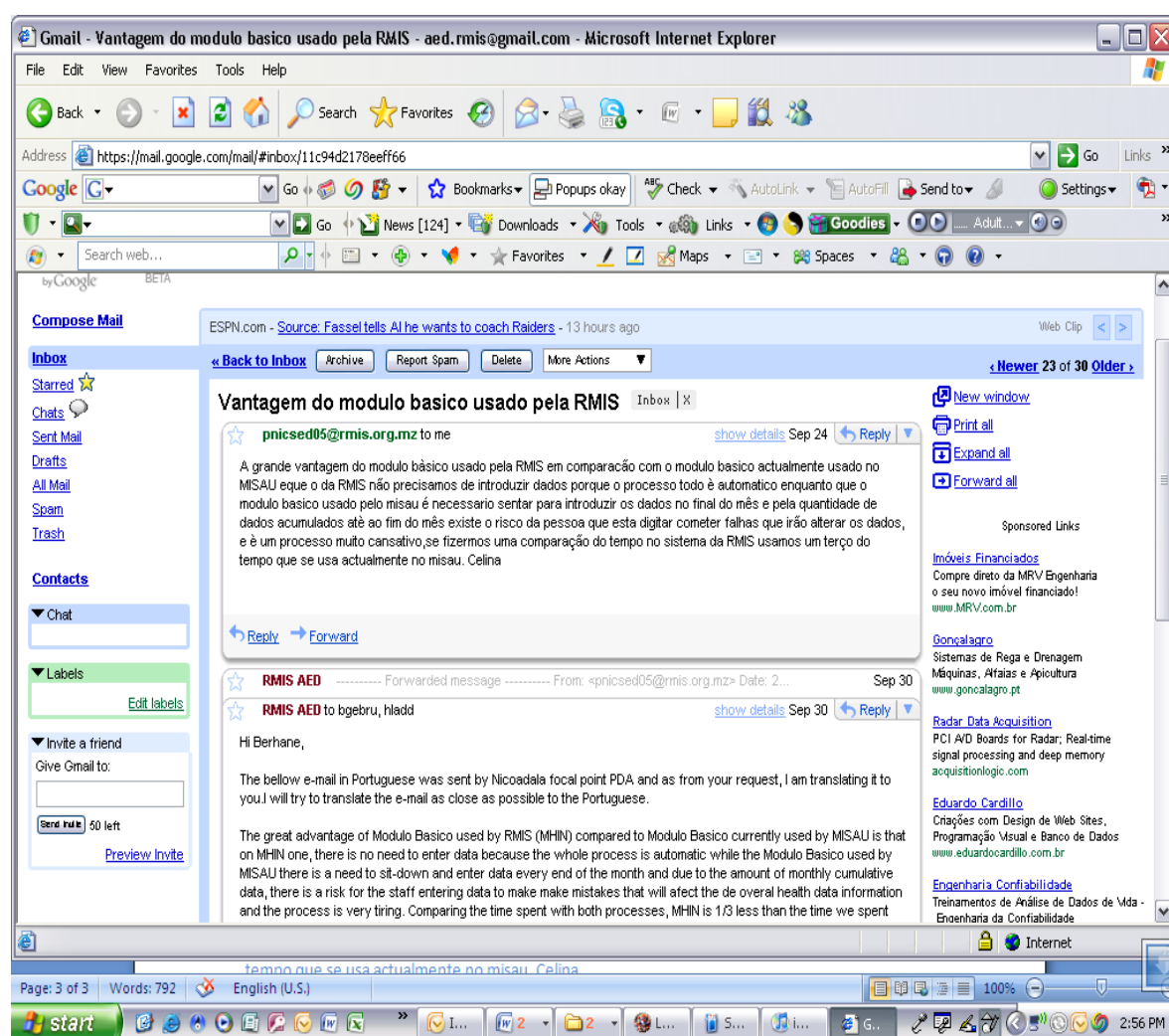
Supporting health workers to deliver more

The MHIN network and the health workers' PDAs are not exclusively used for health data collection and transmission. Rural health workers are also using them to globally exchange emails and to receive and read broadcast content such as MISAU policy and procedures manuals; polio, measles, and dysentery treatment manuals; and malaria vaccination and treatment manuals that support health care.

The information disseminated by the network is improving the knowledge of rural health workers through self-driven learning, in addition to the learning of technical skills. This in turn is resulting in the provision of improved health services to communities at rural health facilities.

Ultimately, projects such as MHIN provide ICT access to health workers in poor, rural areas and contribute to the development of ICT literacy skills in citizens.

Collaboration between government and project staff

The good relationship among AED-SATELLIFE, project staff, and MISAU and MCT managers and staff has had a beneficial effect on the process of selecting and converting paper-based forms into handheld formats, the procurement and clearance of equipment

for deployment, and liaising with provincial and district health directorates to facilitate the training process for health workers. The resulting team spirit has played a major role in the final outcome of the project implementation at rural outposts and health centres in all the districts. Partners are aware, however, that there is still room for improvement in involving all health management information systems (HMIS) authorities at the rural clinic, district and provincial levels.

Successful equipment deployment and the training of health workers were only achieved due to the commitment of all technical staff and teamwork during the process of equipment configuration, the preparation of training manuals and materials, and the mapping of handheld data into the MISAU health database management system.

The future of the project

Impact studies of the project and its beneficiaries are still being conducted and these will ultimately prove (or disprove) the social and financial viability of the project. However, both AED-SATELLIFE and MISAU agreed to increase the number of paper-based forms to be converted into PDA format data in all participating rural clinics before the end of 2008.

MISAU and AED-SATELLIFE also agreed that during 2008, one additional district should be added to the initial five districts and during 2009 a seventh district should also be added into the MHIN project deployment plans.

The outcome of the monitoring evaluation and cost effectiveness study should enable MISAU to make a decision on whether or not they should adopt the project and replicate it throughout the country by using government funds or different funding mechanisms.

The use of innovative technology as applied by the MHIN shows great potential for replication in other poor and developing countries with minimal telecommunications infrastructure.