

Move it:

Report on Monitoring of Vital Events
using Information Technology



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ABBREVIATIONS

AIDS	acquired immunodeficiency syndrome
ALPHA	Analysing Longitudinal Population-based HIV/AIDS data in Africa
ART	antiretroviral therapy
BCRS	Barangay Civil Registration System
CDC	Centers for Disease Control and Prevention
CIDA	Canadian International Development Agency
COD	cause of death
CRVS	civil registration and vital statistics
DFID	Department for International Development
DPHI	Department of Planning and Health Information
GIZ	German Agency for International Cooperation
HDSS	Health Demographic Surveillance System
HIS	health information system
HISP	Health Information Systems Programme
HIV	human immunodeficiency virus
HMN	Health Metrics Network
ICD	International Classification of Diseases
ICT	information and communication technology
IMRSS	Indonesian Mortality Registration System Strengthening
INDEPTH	International Network for the Demographic Evaluation of Populations and Their Health
IT	information technology
JICA	Japan International Cooperation Agency
LGU	Local Government Unit
MDG	Millennium Development Goal
MNCH	maternal, newborn and child health
MOVE	monitoring of vital events
MOVE IT	monitoring of vital events using information technology
MRC	Medical Research Council
NSO	National Statistical Office
SIS-ROH	Sistema de Informacao de Saude – Registo Obitois Hospitalares
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNFPA	United Nations Population Fund
UNICEF	United Nations Children’s Fund
VA	verbal autopsy
WHO	World Health Organization
WOMB	Watching Over Mothers and Babies

EXECUTIVE SUMMARY

In 2008–2009, the Health Metrics Network (HMN) funded a set of projects from different countries, with the common theme of applying the innovative use of information technologies (ITs) to the strengthening of systems for tracking vital events. These projects were called “MOVE IT” (Monitoring of Vital Events using Information Technology). At the end of the project period, this report makes a macro-assessment of the experience, with a view to discerning a synthesis of what has been learned across the projects.

The report is not an account of how and whether the individual MOVE IT project goals were met. Rather, it is an analysis based on a three-dimensional perspective, including *innovation*, *scaling* and *learning* and the role of information and communication technology (ICT) in the facilitation or otherwise of these processes. Such an analysis helps to understand what works and what does not work, and what can be done to make similar initiatives more effective in the future. In this report, *innovation* is understood as the capacity to carry out new tasks using technological interventions, or using new technology to deal with ongoing problems that have previously been difficult to solve using existing means and technologies. A key aspect related to innovation is the local institutional participation in learning and for building capacity to take innovations forward. *Learning* is understood as the new insights developed in relation to the problem and academic discipline under study, or insights developed through the combination of learning from two or more areas, such as public health and informatics. *Scaling* is understood as the capacity of the intervention to be expanded across geographical areas, functional domains, user groups and uses.

The analysis of the MOVE IT projects in this report demonstrate strong interlinkages between the different dimensions, and from these some key principles are inferred: (a) a strong programme logic should drive the system-strengthening efforts, rather than the fact that a new technology is now available; (b) to the extent possible, and to get scaling effects, it is important to build on something that already exists, and which the systems are supporting; and (c) scaling effects need to be maximized in order to strengthen and expand the system of innovation.

SECTION 1. INTRODUCTION AND BACKGROUND

In 2008–2009, the Health Metrics Network (HMN), a Secretariat of the World Health Organization (WHO) funded a set of projects from different countries, with the common theme of applying the innovative use of information technology (IT) to the strengthening of systems for tracking vital events. These projects were called “MOVE IT” (Monitoring of Vital Events using Information Technology). The set of MOVE IT projects, about 20 in number, explicitly focused on the application of information and communication technology (ICT) to strengthen particular facets of systems of civil registration and vital statistics (CRVS) in the countries from which they originated.

In 2007, HMN’s MOVE IT initiative brought together WHO, the World Bank, the United States Centers for Disease Control and Prevention (CDC), academic institutions and others to set out a strategy for strengthening CRVS systems in countries. At the country level, investing in improved civil registration has several benefits. First, visibility leads to accountability – birth and death registration form part of a social contract between governments and citizens, spurring progress towards good governance and mutual accountability. Second, knowledge of regional and local differences in disease burden can lead to more equitable development in settings where premature mortality is most severe and thus the need for robust evidence to back decision-making is most critical. Third, continuity of care: registration of pregnancies and births improves follow-up care for mothers and babies. In the context of monitoring progress towards the Millennium Development Goals (MDGs) adopted by the United Nations, *MOVE IT for the MDGs* was initiated by HMN in 2012 as a new initiative, inspired by committed countries and development partners, to make the monitoring of vital events (MOVE) a priority. MOVE IT aimed at harnessing innovation and advances in IT in a drive to record every birth, death and cause of death (COD), reversing the global and national neglect of this issue.

The MOVE IT priority strategic objectives were to explore the application of mobile platforms and other innovations as a means of gathering birth, death, COD and pregnancy data and show that these can result in vital statistics; and to explore mechanisms for integrating the above data with more traditional vital registration systems. It consisted of three work streams in which it: (a) developed standards and tools to accelerate data collection and transfer, and facilitated data analysis, sharing and dissemination; (b) mobilized high-level advocacy for policy and institutional support at country, regional and global levels; and (c) supported country efforts to improve CRVS systems and generate evidence of what works. The different projects supported under this initiative aimed to focus on one or more of these objectives.

The MOVE IT projects included countries in the African Region of WHO – Botswana, Egypt, Ethiopia, Ghana, Kenya, Mozambique, Rwanda and the United Republic of Tanzania – plus

the ALPHA Network (Analysing Longitudinal Population-based HIV/AIDS data on Africa), which focuses on acquired immunodeficiency syndrome (AIDS) transmitted by the human immunodeficiency virus (HIV), and the INDEPTH Network (International Network for the Demographic Evaluation of Populations and their Health in Developing Countries); and in the Western Pacific Region – Bangladesh, Cambodia, Indonesia and Thailand. The projects are briefly summarized in the Annex, with their titles, objectives and partners. The projects reflected a great deal of diversity in terms of aims, the technologies used, the hosting institutions and the nature of interventions applied. The settings of each project were also unique, and by trying to embed projects within different ongoing activities the project managers made efforts to create mechanisms for sustainability and scalability. As such, there was a wide variety of rich learning opportunities in each of these projects, and also when they were compared with each other.

This report aims, at the end of the project period, to make a broad, macro-assessment of the experience, with a view to discerning a synthesis of what has been learned across the projects, and proposing how to move on from here. The aim is not to develop a specific and micro-level analysis of how and whether individual project goals were met. More specifically, the focus of the analysis in Sections 3, 4 and 5 is on three dimensions – *innovation*, *scaling* and *learning* – and on the role of ICTs in the facilitation or otherwise of these processes as a result of the MOVE IT projects. Such an analysis helps to understand what works and what does not work, and what can be done to make similar initiatives more effective in the future.

Innovation refers broadly to the ability to use ICTs to solve existing problems in new ways, or to conduct new activities. *Scaling* concerns the potential of the projects to expand geographically in scope or in supporting new forms of functions, and plans for continuance once the MOVE IT funding is over. *Learning* refers to the nature and type of new insights that may have been developed about the domains of CRVS or ICTs and their mutual application.

In terms of methodology, the project was carried out by a research team from the Department of Informatics at the University of Oslo, under its Health Information Systems Programme (HISP), and also supported in terms of data collection through some members of the HISP India team. Data collection involved the following methods.

- Visits to four MOVE IT sites in Bangladesh, Kenya, Mozambique and Thailand.
- Face to face meetings and interviews with project members from Ghana, Kenya and Rwanda during the conference “Improving cause of death and AIDS mortality measurement in Africa”, held on 15–16 November 2012 in Cape Town, South Africa.
- Face to face meetings with team members from Cambodia, Indonesia, Mozambique and Thailand during the CRVS meeting in Bangkok, Thailand, on 18–19 April 2013.

- Telephone interviews with project teams from Indonesia, Mozambique and Thailand.
- Study of project proposals, status reports and final reports where available.

The next section highlights key MOVE IT projects (Bangladesh, Cambodia, INDEPTH-ALPHA networks, Indonesia, Kenya, Mozambique, Philippines and Thailand) with information and results provided in greater detail. Country activities of the different projects within the MOVE IT framework are summarized in a set of tables provided in the Annex.

Sections 3, 4 and 5 detail an assessment of the projects that feature in Section 2, with respect to the dimensions of innovation, scaling and learning, respectively. The concluding Section 6 provides a synthesis of the learning across the projects and dimensions, to understand what worked and what did not, and a brief discussion in response to the question “where do we do go from here?”.

SECTION 2. EXAMPLES OF MOVE IT PROJECTS

In this section, some of the MOVE IT projects are introduced and described including the background, aims, brief approach and the results achieved. For a summary of all projects, see the Annex.

2.1 BANGLADESH

MOVE IT Bangladesh was set up as a multi-stakeholder initiative to register all pregnant women and their children in a unified electronic system. The core technological aspect of this is the use of mobile devices for such registration at the community level by household health workers. However, the project aims were larger, including the following:

1. development of unique identification standards;
2. development of minimum data set standards;
3. creating an operational framework for digital design;
4. software and device development;
5. pilot planning and deployment;
6. cross-cutting activities.

The project was housed at the James P. Grant School of Public Health at BRAC University, Bangladesh. The aims of the initiative were extremely ambitious. Development of identification standards, for example, is a large-scale, politically sensitive initiative. The project has tried to coordinate these efforts with various stakeholders such as the Director General of Health Services, the Bangladesh Bureau of Statistics, the Local Government Department, the Prime Minister's Office, and the Ministry of Health. The project leaders ultimately realized they were not in a position to develop their own codes, and would use two existing ones (National ID – NID, and Birth Registration Number – BRN). Should either not be available, a temporary tracking number would be generated, thus imparting a degree of flexibility into the system.

Under the minimum data set project, efforts were concentrated on consultative work with experts to develop minimum data sets for maternal, newborn and child health (MNCH), including in both the clinical and administrative areas. Developing operational definitions would help to collect more accurate data. In addition to consultations with experts and carrying out semi-structured interviews, the project made a search of available MNCH-related instruments, both nationally and globally. There were then further rounds of consultations to discuss the initial draft of the minimum data standards with experts, followed by one to one meetings. Based on these various rounds of discussions, two sets of data were created,

one for pregnant mothers and the other for children. This project then provided part of the foundation for the third and fourth work stream related to creating a framework for digital design and software development activities. The idea was that the MOVE IT project would create a software for collecting and processing data around individual name-based records, which would feed into the DHIS2 (District Health Information Software 2) being used as an aggregate system by the Ministry of Health, Bangladesh. This work was part of the larger stream of cross-cutting activities, where the aim was to link the MOVE IT project activities with the ICT-based strengthening efforts of the Ministry of Health, Bangladesh.

In terms of results, it can be said the project aims were extremely large and ambitious – such as creating a coding system or new software for mother and child tracking, both of which would naturally be difficult to complete in the short time-limited framework of the MOVE IT project. Nevertheless, good results were achieved in defining a minimum data set and creating a business requirements document for the software for mother and child tracking. During a field visit to the site in early 2013, project leaders were told that the design documents were ready and that software development was ongoing and expected to be completed in September–October and followed by a process of pilot testing for which mobile phones were to be procured.

There have also been positive results from the MOVE IT project in creating larger awareness and establishing networks around open source applications for the health sector – OpenMRS and DHIS2. The project has contributed to strengthening the ongoing efforts of the Ministry of Health in Bangladesh towards establishing robust health information systems in the country. In this way, the project has influenced the broader national system, and created broader scale-up opportunities. Arguably, the results may have been magnified if the MOVE IT project had been configured to work with existing open source applications and customize them for its specific requirements, rather than trying to build them from scratch.

2.2 CAMBODIA

The MOVE IT project in Cambodia was implemented through the Department of Planning and Health Information (DPHI), Ministry of Health. The primary emphasis was on strengthening the existing Health Information System (HIS), rather than the CRVS systems. The project focused on four areas:

- assessment of the HIS;
- supporting the development of the national HIS strategic plan 2008–2015;
- strengthening and expansion of the Vital Statistics System;
- building capacity linked to the HIS.

Overall, it can be said that this MOVE IT project was part of a longer-term national HIS strengthening process supported by HMN, including using the HMN Tool and Methodology in 2008 for an assessment of the national HIS with the participation of all stakeholders. There was no explicit technological component in the project, but the HIS strategic plan 2008–2015 was formulated as a result of the process (which was in line with the National Health Strategic Plan 2008–2015) and contributed to the DPHI revising the HIS reporting forms for all levels as well as the design of an Access-based HIS database. In future, the plan is to develop an HIS web-based application. Since 2011, there has also been an increased focus towards the vital statistics systems.

An HIS-strengthening working group was established to oversee the activities, chaired by the Director of DPHI and including members from different health departments and various development partners. There has thus been a large and inclusive process to help in the definition of the HIS design and to review its progress. A number of different activities were carried out under the project, including production of television spots for maternal death surveillance, updating software for the maternal death database, conducting workshops for data collection tools revision, training on filling forms and other documents, and various types of training. Concrete outputs from this process included revised data collection tools, updated software, and training sessions on the use of the tools. There was not a direct impact on strengthening CRVS systems, as the focus was more towards enhancing the national HIS.

As work continues on the HIS Strategic Plan for the country, only a limited number of activities were directed towards CRVS strengthening. Since 2010, the activities have covered three areas: data dissemination and use, vital statistics, and health and disease records. In addition to more general activities such as revision of forms and data quality assessment, the CRVS specific activities included workshops and training. One national Training of Trainers session was used to prepare local training on the routines of birth, marriage and death registration throughout the country, as well as to review these routines. The broad approach of the MOVE IT approach in Cambodia was mainly focused on the national level and was top down in nature. The activities were not directly oriented towards strengthening the country's CRVS systems, but arguably have contributed to strengthening awareness about them and the need to adopt a systems-wide approach.

2.3 INDEPTH–ALPHA COLLABORATION

The International Network for the Demographic Evaluation of Populations and Their Health (INDEPTH) supports scientific research on population-based data in low and middle income countries by bringing together data from multi-site trials and, by pooling, facilitates the extrapolation of data. Through the network, results from this process are shared and new knowledge is generated. While helping to create visibility for centres in rural areas in Africa

and Asia, it uses the power of networked linkages to strengthen the scientific community in Africa and Asia. The methodology of this work is through Health Demographic Surveillance System (HDSS) which seeks to collect data from a whole community over time, thus enabling the monitoring of new health threats, tracking population changes, monitoring health interventions, and assessing policy interventions. The network encompasses 44 HDSS centres covering 20 countries: 32 of the centres are in Africa, 11 in Asia and 1 in Oceania, and together 3 200 000 people are under health surveillance.

Analysing Longitudinal Population-based HIV/AIDS data in Africa (ALPHA), initiated in 2005 and funded primarily by Wellcome and the Joint United Nations Programme on HIV/AIDS (UNAIDS), is another collaborative network for the analysis of population-based HIV/AIDS data in Africa. This network comprises 10 centres that run HDSS and HIV surveillance facilities, so it is smaller and more specialized than the INDEPTH network. ALPHA provides technical support for data management and analysis, and there is no fieldwork involved. While representing a more limited set of activities than INDEPTH, ALPHA too facilitates data sharing, comparison and analysis involving pooled data sets, leading to joint publications. Eight of the 10 ALPHA centres overlap with those of INDEPTH.

The MOVE IT project helped to develop stronger collaboration between these two extensive networks, in order to advance vital registration. Specifically, the aims were to:

- promote use of verbal autopsy (VA) outside the research centres;
- simplify and standardize analysis of VAs;
- resolve controversies about classification of COD, particularly maternal deaths and those attributable to HIV;
- improve confidence in official COD statistics, especially those that contribute to monitoring progress towards MDGs.

Through MOVE IT, support was provided to the respective centres of the networks to update VA data coding, cleaning and preparation. Workshops were organized to train staff from both these networks in the use of interval and analysis of results. There were interesting synergies created through the coming together of these two networks, since the topic was an old one for the INDEPTH network, which has historically been involved in VA questionnaire design and COD analysis, while for ALPHA it was a new one, but they had been previously involved in data related to mortality and survival post-HIV infection.

The HDSS centres in both the networks were already implementing the WHO–INDEPTH VA tool, using physicians to code the VAs with ICD classification. The ALPHA centres can identify the HIV status of a large fraction of the deaths, even when the HIV status is not known to the family member reporting the VA data. INDEPTH centres use probabilistic methods with

InterVA software for reliable identification of HIV deaths, and separating HIV and tuberculosis mortalities.

Through combined workshops, results were generated from both the INDEPTH and ALPHA sites on COD distributions by sex and age and over time, and the impact of the HIV epidemic. The ALPHA centres made available their VA data sets to the developers of the InterVA software, to carry out prior analysis of HIV status. Deaths with classic HIV symptoms were classified by the use of intervals. Further, sites could compare pregnancy and post-partum deaths of those identified by HDSS alone and those identified in intervals, and also the relative risk of such deaths by HIV status of the mother.

During the workshops, scientific training was carried out of the tutors on data preparation and analysis, who would then be able to train more broadly others in their respective networked communities. There was also the aim of developing a standardized and minimum data set from the different INDEPTH centres, which could facilitate widespread data comparisons and sharing. Specific working sessions were held on analysis of fertility, mortality and migration, and the generation of these indicators.

Collaboration between the two networks contributed to the development of the final version of InterVA-4, which should be available soon for general use on tablet computers and smartphones, both for batch analysis and individual diagnosis. Various articles have been written or are planned regarding the association of pregnancy-related mortality with MDGs, which would inform the calculation of MDGs. Given the wide geographical spread of INDEPTH and ALPHA, potentially significant regional impact of the new knowledge gained and its implications on policy networks can be created. Broadly, the project has contributed to the strengthening of CRVS systems through:

- increased contribution of VAs to understanding COD data, especially in rural communities;
- improved identification of HIV using VA tools;
- large-scale implementation of probabilistic modelling of VAs;
- generation of new knowledge of the effects of HIV on maternal mortality.

2.4 INDONESIA

The MOVE IT project in Indonesia was housed at the School of Public Health, University of Queensland, Australia, and involved a contract between the University and the National Institute of Health Research and Development, Ministry of Health, Indonesia. Indonesia is currently in the process of developing its vital registration system based on the recent Population Administration Law issued by the Ministry of Home Affairs. Since 2006, the Ministry of Health together with the Ministry of Home Affairs has implemented the Indonesian

Mortality Registration System Strengthening project (IMRSS), which has been operational in eight provinces since 2010. The Access-based platform of IMRSS was rather simple and had significant limitations. One of the aims of the MOVE IT project in Indonesia was to strengthen the software elements of the system, and then to see how existing systems could be enhanced and integrated with the new developments, as in the tasks detailed below.

- The specific aim was to develop and implement a software application for enabling data capture, processing and analysis of vital registration data in a sample set of field sites. Specifically, it sought to improve COD coding (using the 10th revision of the International Classification of Diseases, ICD-10) of death registries, and automatically try to identify the underlying COD from the different reported codes using software. The software application consisted of a data entry module, two free applications MMDS and IRIS, and a dashboard application that enabled communication between these and the local death registry files. The process of ICD-10 coding and finding the underlying COD is mostly handled through the dashboard application, through the following steps performed on a local death registry file: data entry, creating of a death registry file with a written diagnosis of the deceased.
- Coding of multiple CODs into ICD-10, based on recognition of the written diagnoses.
 - Various optional administrative tasks, including:
 - check reporting completeness;
 - check for variables missing;
 - update data entries;
 - reports;
 - add to list of matches between ICD-10 code and written diagnoses.
- Open file in IRIS software to calculate underlying COD.
- Process this IRIS data into local database file.
- The database file can then be used for analysis, mortality rates, etc.

Though IRIS should be able to find the underlying COD for around 65–70% of correctly coded death registries, the results in Indonesia already reached 50% in the pilot implementation. This is likely to improve as the system has a dynamic list of matches between ICD-10 codes and local ways of writing diagnoses.

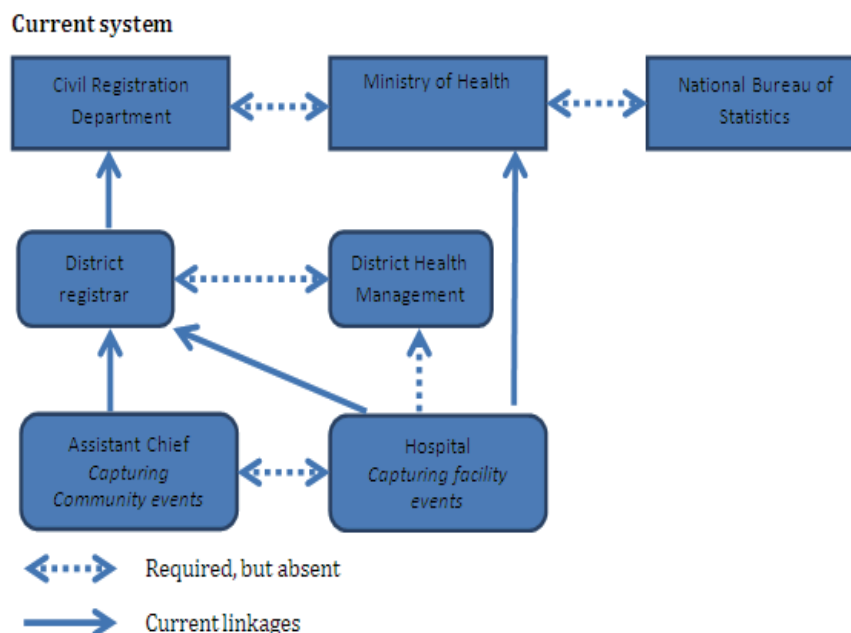
Field site work for this project has been conducted in three provinces of Bali, Central Java and Gorontalo, and data for deaths in 2011 have been compiled at all three sites. Death certificates for 2011 were collected and entered in the New Indonesian Death Certificate Database, and this database was subsequently revised. This also reflects evidence of emerging influence and linkage of the MOVE IT project with the broader national system for death registration. This

included a data entry form with all the required fields in the death certificate. Data entry fields were provided with restrictions using drop-down menus or through validation rules. Location identifiers in the database were based on the Indonesian Census 2010. Freedom was given to the data entry operators to enter COD details according to what had been entered by the physicians. Further, there were query functions provided in Access, for example to query missing or implausible data. Various forms of statistical reports could also be generated. Another interesting development was the mapping of about 6000 medical diagnoses in Bahasa; the common diagnosis is expected to evolve in the future to include more variations. Testing and implementation of the software has been successfully carried out within the framework of the MOVE IT project. Now the project has been successfully moved across multiple local levels, helping to strengthen the quality of local-level data. It has also helped influencing thinking on a national-level system, and will require the software to be web-based and architecturally enabled to allow systems to speak to each other on a server environment.

2.5 KENYA

The Department of Civil Registration of the Ministry of Immigration and Registration of Persons is mandated for the registration of births and deaths in Kenya and those of Kenyan citizens occurring abroad. In Kenya, communities are responsible for notification and registration of births and deaths that occur in their respective areas. The MOVE IT project was conceived to improve the community-based system of civil registration of births and deaths using innovative technology with the involvement of agents from the health sector on a routine basis. The project allowed the use of community health workers to sensitize families and report births and deaths. The vital registration system that existed before the project is shown in Figure 1.

Figure 1. **Pre-existing vital registration process in Kenya**

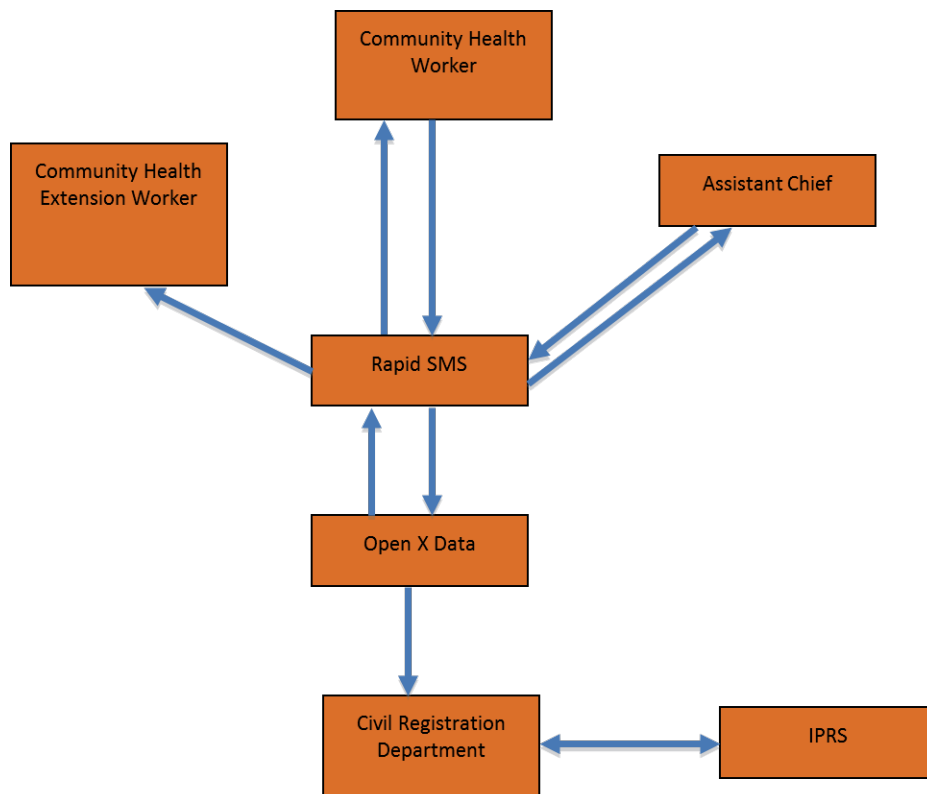


MOVE IT was conceived as a collaborative project between the Civil Registration Department of the Ministry of Immigration and Registration of Persons, the Ministry of Health, WHO and the MDG Centre for East and Southern Africa. The project began in mid-2011. Its main objective was to demonstrate the feasibility of using mobile phone technology to improve the registration of births and deaths, specifically by introducing mobile applications in one or two pilot districts in order to:

- count and register all births and deaths, and thus improve coverage rapidly;
- obtain better COD information using verbal autopsy instead of lay reporting;
- speed up the transmission of information from local collection points to a central database.

Another objective was to ensure that CVRS units improved their coverage, which stood at 60%. Even though the responsibility of implementing the project was left to the Civil Registration Department of the Ministry of Immigration and Registration of Persons, the implementation of MOVE IT activities was led by a technical working group composed of members from various ministries including the Ministry of Health, the Civil Registration Department, WHO and other implementing partners. The group met regularly to advise the Civil Registration Department on registration strategies and innovations. The overview of the proposed system is expressed in Figure 2.

Figure 2. **Overview of the proposed registration system under MOVE IT**



Starting in 2012, the MOVE IT project was implemented in two phases. The first phase focused on the development of mobile phone data collection and a web-based reporting platform for the notification and registration of births and deaths occurring outside of the health facilities. There was also an application for the notification of citizens on the issuance of birth or death certificates. The second phase focused on the use of a short version of the WHO VA questionnaire with integrated algorithms on mobile phones to obtain the most plausible underlying COD information in the case of deaths occurring outside the health facilities.

While the main focus of the MOVE IT project was on events occurring outside the health facilities, it was recognized that there is also a need to improve the quality of information on events occurring at the facilities, where nurses, clinicians or other health practitioners act as registration agents for births and deaths. By law, all deaths are required to be medically certified. To improve the quality of hospital mortality data, another key focus has been on training hospital staff in the use of standards for death certification and COD coding. To date, the project has supported two training workshops for certifiers and coders. The VA tool was improved and is going to be introduced to automate the ICD-10 COD. This will allow registering the causes of deaths that occur in the community. With respect to technology, two electronic systems – both based on mobile phones – were developed under the MOVE IT project to register births and deaths.

- Rapid SMS was an application developed by Millennium Village Project, a nongovernmental organization, is used by the community health workers to report births and deaths in the villages.
- The second application was developed by a private company called Multiple Choice Labs and allows using 2G mobile phones for notifying deaths using OpenXdata. The application customized a reporting form so that the agents (the assistant chiefs) could document the births and deaths using the mobile-based OpenXdata solutions.

To run the first application, already existing equipment was used. For the second application, 42 mobile phones of the model shown in the photograph were purchased: 22 were distributed to the assistant chiefs, who were trained to use the application.

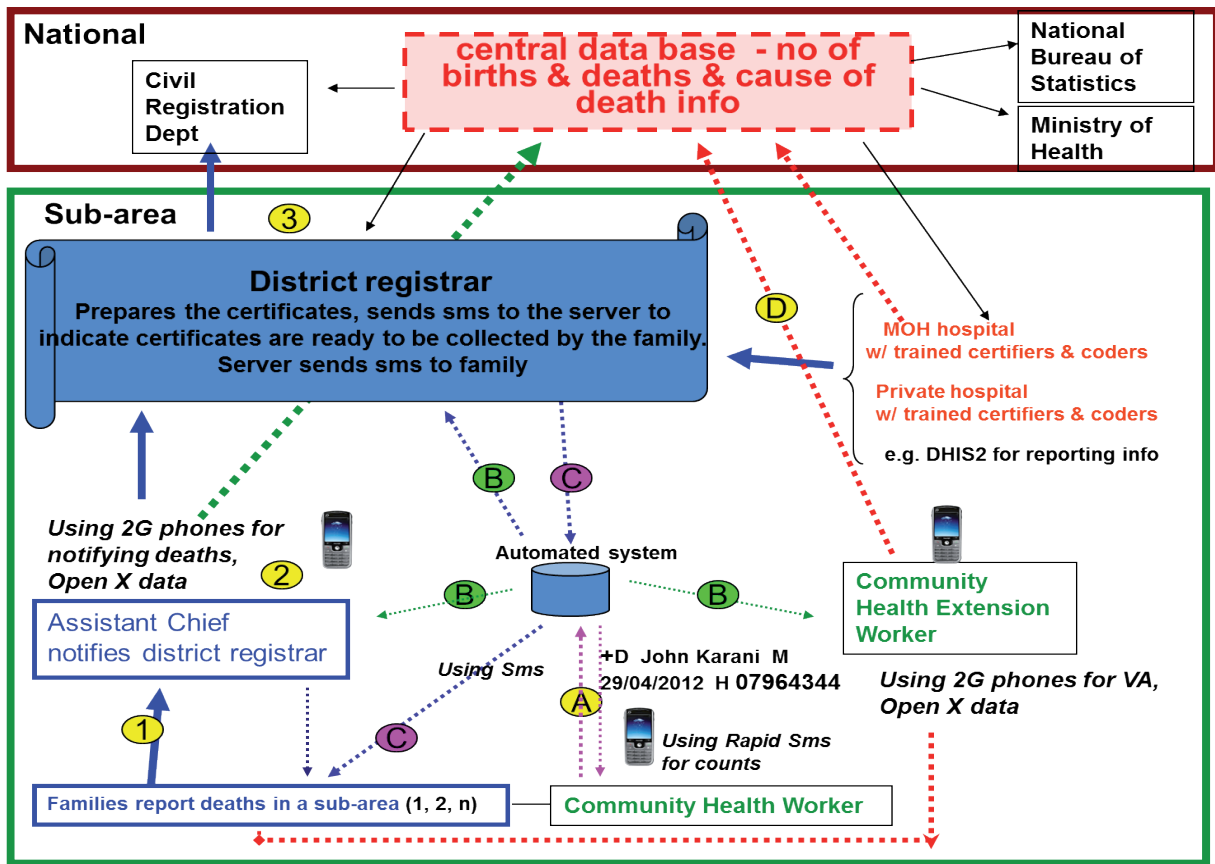
Because Kenya has a community-based strategy that uses community health workers, the project used this already existing infrastructure as a preferred approach. The project was piloted in three districts with 43 community units. In Narvesha district, 35 community health workers were trained to use the mobile application with SMS.



Model of the mobile phone used.

To manage data collected by the two systems, an automated system was developed (see Figure 3). The blue arrows represent the current scenario, which was computerized, thus allowing the quality of data coming into the system to be strengthened. The system can also inform family members when the certificates are ready, avoiding long queues of people coming to wait for their certificates to be prepared. The server is centralized and hosted currently in Geneva. A respondent said: "Once everything is in a central system, people will be able to access the information wherever they are; there is no need to go to the place where the death or birth was registered. People can just go to the next register and ask for a certificate."

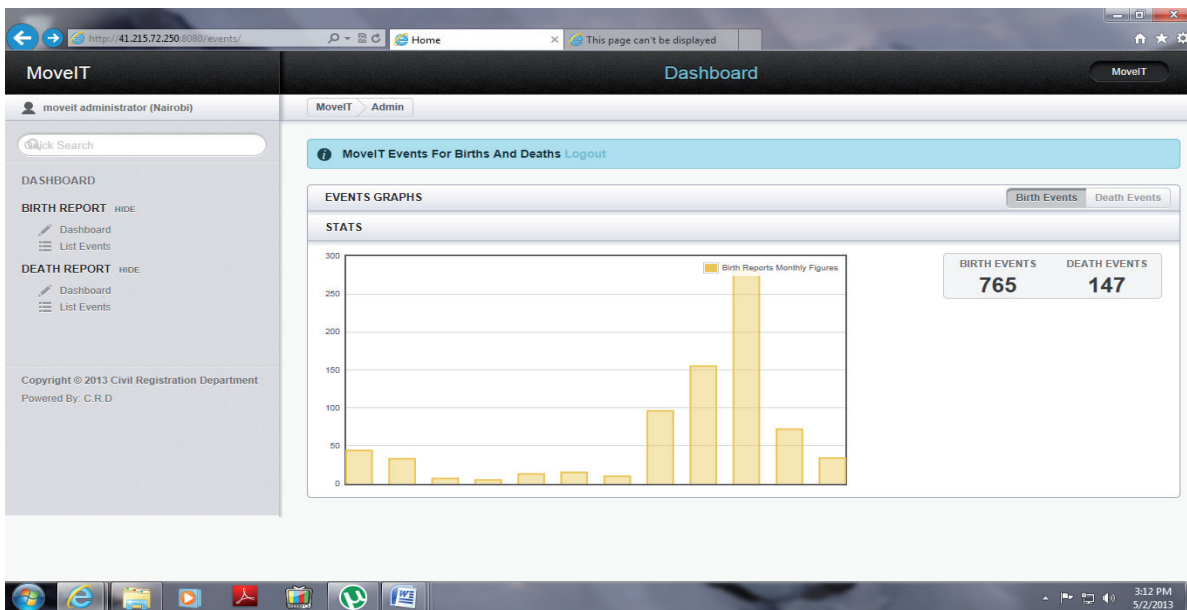
Figure 3. Detailed information flow under MOVE IT



A key challenge in scaling up the mobile application would be the backbone to which data would be sent by SMS. Currently, a database application was developed with the project to which the SMS were being sent and stored. As the project would need to be stored at the national level, the SMS would need to be integrated with the DHIS2 application which is the backbone for the national application. This has not yet been carried out, and data are currently sent to a server in Geneva. This routing would need to be changed in the future to a local server, for the data to be collected and processed locally.



Computers running the MOVE IT program.



Screenshots from the MOVE IT system.

MoveIT Events Logout

DEATH REPORTS EVENTS LIST Death Reports

Displaying rows 1 to 10 out of 147 entries

Date of Death	Reporter ID	Name	Location	Status	Details
2013-02-21 00:00:00.0	254726567941	Monica Musyoka	Munanda	Incomplete	Form Details
2013-02-17 00:00:00.0	254729531168	Eburru David Ikanyi	test	Incomplete	Form Details
2013-02-15 00:00:00.0	254724120823	Mary Njeri Ndungu	dry a	Incomplete	Form Details
2013-01-26 00:00:00.0	254711707206	Ninnah Odimu	Njeru	Incomplete	Form Details
2013-01-08 00:00:00.0	254702543362	Munandaann Walthera	test	Incomplete	Form Details
2012-12-31 00:00:00.0	254725300314	Kanorero Joseph Mwangi	test	Incomplete	Form Details
2012-12-24 00:00:00.0	254724503443	Oi Dunyuburu Silvester Nyaundi	test	Incomplete	Form Details
2012-12-17 00:00:00.0	254729531168	Eburru Pauline Muthoni	test	Incomplete	Form Details
2012-12-14 00:00:00.0	254702543362	Munanda Grace Wanjiku	test	Incomplete	Form Details

2.6 MOZAMBIQUE

In Mozambique, prior to 2006, no routine data were available on COD and morbidity, and there were no representative civil registration data. In 2006, the Ministry of Health adopted formally the decision to use ICD-10 and standard classifications, through the creation of the National Committee for the implementation of standard classifications. This committee had the responsibility to define the short lists of about 25 causes per clinical ward. While progress was made, there was not a national level agreement on these shortlists, which are expected to be introduced in 2014.

A first pilot was conducted in 2007 in one hospital using shortlists based on aggregated data, and in 2008, mortality registers were introduced in some hospitals based on individual records. The mortality register allowed the first national mortality analysis based on routinely collected data, although initially restricted to a hospital setting. Despite low coverage of the system, data reflected a degree of consistency with national indicators, and provided information useful for public health policies and hospital management. A gradual scaling process was initiated, with shortlists being introduced in level II/III hospitals and full ICD-10 in level IV hospitals. The shortlists were defined by the National Committee, and feedback from use was received and taken into account in the revision of the lists.

There were further reforms initiated in the mortality system through the revision of the death certificate, introduced nationwide in 2009, and the introduction of SIS-ROH (Sistema de Informmacao de Saude – Registo Obitois Hospitalares), a software to enable individual-based data management, including demographic data, data on hospitalization and COD. Initially, SIS-ROH was installed in 27 sites: 7 in provinces, 3 at the central level, 4 general, 3 in rural areas, and 10 Provincial Directorates of Health. Between 2009 and 2011, more than 30 000 mortalities were registered through these different systems. Building upon these ongoing processes of reform, in 2011, through the MOVE IT project, Jembi/mOASIS initiated a modernization of the national vital statistics system, which at that time was not implemented nationally and only covered deaths in hospitals. The aspect of building upon existing initiatives was an important aspect of the MOVE IT project's success.

Version 1.0 of SIS-ROH was a stand-alone application developed on .Net framework (using VB.Net) and MySQL database. The application allowed the capturing of hospital deaths. Version 1.1 permitted expansion of the system to allow extra-hospital deaths to be registered too. Extra-hospital deaths included deaths registered by police stations, through auto de obito (death declarations made by particular individuals) and also from declarations recorded by local community authorities. The forthcoming version 2.0 being prepared by Jembi/mOASIS is being developed using PHP and MySQL database, which will allow internationalization and will be web-enabled. This is expected to give a boost to scaling efforts, and also to enable the consolidation of data in a single database.

A number of stakeholders were involved in this project (called mOASIS) including the South African Medical Research Council (MRC), CDC, nongovernmental organizations and the private sector, and the Ministries of Health and Justice; MRC/Jembi/mOSASIS were the implementing entities. The mOASIS objectives were to:

- improve the coverage and quality of the national mortality system of Mozambique;
- strengthen the National Mortality System designed by an expert group drawn from stakeholders;
- strengthen processes of advocacy and understanding among the different stakeholders on the importance of CRVS systems and COD information.

The project was thus aimed towards strengthening the coverage and quality of the national mortality data. A key aim of the project was to strengthen the locally developed SIS-ROH software used for mortality reporting based on ICD-10 coding in 27 hospital project sites. Installation of SIS-ROH included training on ICD-10 coding and classification of COD for the clinical staff and users of the system. A total of 46 health technicians and clinicians have been trained on these issues.

By enhancing the software in terms of functionalities over time, the aim is for SIS-ROH to be extended gradually until it becomes the national mortality system. The mOASIS project has helped the Ministry of Health to improve data collection tools, enabling the registering of 30 512 deaths (including 280 hospital deaths) since 2007 in SIS-ROH at the Maputo Central Hospital. This was one of the key elements in the success of the MOVE IT project in Mozambique, as otherwise the deaths were most often unregistered. There remain some limitations with the software. Even with introduction of extra-hospital death registration in SIS-ROH, there are certain deaths, for example when autopsy is not carried out, which are not captured by the system. The flow of information when activities are done at the morgue does not allow for intercepting the documents used to register these deaths by the statistics office of the Maputo Central Hospital. Most of those deaths, if there is no autopsy, are not registered in the health system. As it is for now, SIS-ROH will solve only part of this problem, but there are significant other influences to the problem of non-registration of deaths.

The SIS-ROH software has improved with regular use and feedback from the users in selected hospitals. Simultaneously, there have been ongoing efforts to develop capacity of nodal provincial staff, in both IT and the use of SIS-ROH, so that they are able to provide technical support on the software to end users.

Another key result of the project has been to generate a broader interest, including a political and institutional awareness, in the strengthening of CRVS systems in the country; mOASIS has helped to establish coordination mechanisms to enable CRVS system strengthening by involving different stakeholders, including the Ministries of Health and Justice, the Director of

the National Institute of Statistics and the Rector of University Eduardo Mondlane. The South African Government and the MRC have also been involved. Regular meetings are taking place among these stakeholders on how to take the agenda forward. It is hoped that this will lead to a national level initiative for CRVS systems computerization in two years. All these different efforts have helped to raise the efforts being taken in Mozambique towards CRVS strengthening internationally.

2.7 PHILIPPINES

The Philippines MOVE IT project was a collaboration between the National Statistical Office (NSO) and the Department of Health. This project involved the use of two existing monitoring tools: the Barangay Civil Registration System (BCRS) and Watching Over Mothers and Babies (WOMB). The WOMB system is an ongoing project of the department to enable registration and processing of maternal and child vital events, and for the generation and utilization of vital statistics at the local levels. The BCRS was developed by the NSO for use at the Local Government Units (LGUs) to support the process of civil registration, which under Philippines law is a responsibility of the municipality supported by the barangay secretary. The BCRS supports the civil registration process by bringing it closer to the communities, and trying thus to transcend physical, economic and geographical barriers experienced by the population. By empowering the barangay to function as a unit for civil registration assistance, citizens do not have to travel far to the municipal headquarters. In addition to supporting timely and complete civil registration at the barangay level, the BCRS also seeks to establish a database of social and demographic profiles of barangay residents.

In terms of information systems, the BCRS complements the LGU data with data collected directly from the barangay. The MOVE IT project supported the gathering of data on demographic profiles for all residents, including vital registration status. Specifically, the aims of the MOVE IT project were to:

- support technical advances on BCRS;
- redesign of the data gathering tools to facilitate data processing;
- create an online database at the national level for hosting authorized BCRS implementers.

The scope included the following targets:

- Increase awareness among the barangay constituents of the importance of civil registration, as a part of their basic human rights.
- Ensure interoperability between WOMB and BCRS.
- Improve quality and completeness of BCRS through the use of more effective tools and technologies.

- Monitor and evaluate causes of death for delayed and non-registration of causes of births and deaths, and develop solutions to respond to these challenges.
- Improve utilization of vital statistics for public health action.

Empirically, the project was implemented in six pilot municipalities of Oriental Mindoro. The sample selection for the project was made very carefully and systematically; the province was selected as it had one of the highest maternal mortality rates in the country, then the barangays were selected by a random sampling method. The projects involved creating different BCRS forms including a listing form, a household questionnaire, a user manual and supervisor manuals. All materials were pretested before implementation, and field operation included training. The data processing was carried out at the provincial office. It can be argued that both the structure of the project in terms of the selection of the province and the barangays in it, and the process of strengthening the data collection tools, can be scaled nationally.

In terms of results, more than 20 000 households were interviewed and data were collected. Birth registration was carried out in the system. An interesting aspect of the results was an analysis across the barangays of why births were not being registered: reasons varied from negligence to lack of awareness, with registration not being seen as part of the culture. Similar analyses were carried out of the status of marriage and death registrations and reasons for their non-registration.

Some key recommendations emerged.

- The system designed through MOVE IT can be replicated in other LGUs and potentially scaled up to national level.
- New fields were identified that could be introduced into other forms, including cause of death, date and sex of person who died, and questions related to maternal mortality.

2.8 THAILAND

The Thailand MOVE IT project was hosted at Mahidol University in Thailand. Broadly, the project was concerned with the use of vital statistics data to estimate COD patterns related to HIV/AIDS. It builds upon an earlier project of the Global Fund to Fight AIDS, Tuberculosis and Malaria, which initiated an analysis of vital statistics in the context of scaling up antiretroviral therapy (ART), an activity that highlighted the potential of using vital registration data at both the regional and national levels. Specifically, the MOVE IT project aimed to develop methods for innovative use of vital statistics to assess the impact of the HIV epidemic and the response to the epidemic. The review included:

- analysis to ascertain trends of age-specific mortality and AIDS-related mortality in response to ART scale-up at the national level;

- analysis to ascertain trends of age-specific mortality and AIDS-related mortality in response to ART scale-up at the regional level, with different levels of HIV prevalence and ART roll-out;
- investigation of the use of vital statistics to estimate HIV prevention and treatment impact on mortality and cost-effectiveness of the HIV response.

Specific results from the project included the following.

- Analytical report on mortality trends according to different levels of HIV prevalence and ART roll-out by region.
- Analytical report on the use of vital statistics in estimating HIV prevention and treatment effects seen in mortality statistics in vital statistics.
- Analytical report on estimating cost-effectiveness of HIV prevention and treatment responses, using the estimates on their impact.

In this way, the project demonstrated both the strengths and weaknesses of vital registration data. These findings can potentially inform the national authority for further improvement and additional use of the data in Thailand, with implications for other countries as well. While these results are indeed striking, a limitation is the fact that the project is based in the university and may thus not have adequate resources or the mandate to support practical implementation of the methodology in strengthening HIV programme management. Since Thailand already has a very strong CRVS system, this project did not directly contribute to strengthening the CRVS. However, the implication from this study is its specific learning for cause of death from HIV/AIDS. In principle, the results from this study, including the methodology and analysis techniques, can be taken up for implementation at a national level for HIV/AIDS management, and also potentially for other diseases. However, high levels of specialization and skills are required to apply the techniques in everyday disease management. These skills concern both the epidemiology of HIV/AIDS and the statistical techniques required to carry out the analysis. The skills may typically be housed within universities and research institutions, making their routine use by the Ministry of Health uncertain. There will also be implications for scaling.

* * *

After the above overview of some of the MOVE IT projects, the following three sections focus on their analysis based on their contributions towards innovation, scaling and learning, and the role of ICTs in facilitating these contributions.

SECTION 3. ANALYSIS OF THE INNOVATION DIMENSION

In broad terms, innovation is understood as the capacity to carry out new tasks using technological interventions, or using them to solve ongoing problems that have previously been difficult to deal with using existing means and technologies. Another important feature of innovation comes from the institutional aspect, reflecting the degree to which the state or the country was involved with the project. This potentially strengthens the level to which the higher administration would have learnt about the local innovation and its capacity to take it forward.

In the case of the Thailand project, the MOVE IT project was able to demonstrate how the existing problem of COD analysis could be strengthened using vital registration data. This has helped to add value to an already good vital registration system in Thailand, through finding innovative ways of using the data. This analysis demonstrated further potential use of vital data even when the cause classification is imperfect, and at the same time helping to motivate stakeholders to improve data quality. This project also helped to focus on a broader public health issue in terms of value of HIV prevention and treatment efforts.

The Thailand project is innovative as it demonstrates new techniques for combining different kinds of data, and improved techniques to analyse and use existing data. For example, the researchers demonstrated a very simple technique to cope with errors or missing data of adult deaths obtained from the civil registration system. Further, they also demonstrated how to adjust incomplete death data obtained from vital statistics data related to HIV/AIDS epidemics, especially for 15–19-year-olds. These techniques could potentially be applied to other countries that are facing adverse HIV/AIDS impacts and also have a poor civil registration system. Similar analytical work can be undertaken by other countries to strengthen motivation to collect better vital data.

The project in Bangladesh can be seen to demonstrate innovation in the process followed for getting experts involved in processes of consultation for the development of the minimum data set standards. They have also been innovative in emphasizing the use of free and open source applications (such as DHIS2 and OpenMRS) in the health sector in the country. Even in the development of the software, for the mother and child system, the project followed a systematic process for gathering requirements and creating a specification document. The technical innovation related to the mobile data collection has yet to be formulated, as this is still in the design and development phase at the time of writing this report. However, on the organizational side, MOVE IT Bangladesh differs from other projects in that a local university

plays a strong role, and will be responsible for the training of household health workers once the system is deployed. The innovation of the Bangladesh project is thus the approach of involving several actors, each with different strengths and responsibilities, working towards a common goal.

The project from the Philippines exhibits various innovative dimensions. First, it probed the content of civil registration challenges, for example in trying to understand the reasons why births, deaths, marriages were not being registered. In a lot of technology interventions relating to CRVS and even HIS strengthening more generally, the content of the system often takes a back seat to technology. This bias has been reversed in this project. The project emphasized the importance of vital statistics in understanding how to improve the coverage of registration and also the quality of data. Another important dimension of innovation has been the manner it has built on two existing systems of BCRS and WOMB, creating synergies through their linking, and extending and strengthening them within logic firmly grounded in civil registration and public health. The Cambodia project, on the other hand, focused more on the HIS strengthening processes, and the potential innovations with respect to CRVS strengthening were limited to primarily building awareness.

The Mozambique project represents a first in the country to have mortality statistics from routinely collected data. The system allowed performing the first analysis of mortality-based statistics on routinely collected data at the national level. Initially, only mortality data from Maputo Central Hospital were available (about 15 000 registers in three years); during the course of the project more than 30 000 deaths were registered. This led to the realization that this mortality information can be used to improve hospital management, organization of services in the territory and public health interventions. Innovations have thus come in the form of using the mortality data for multiple purposes.

The project was innovative in strengthening improvements in data collection instruments. With the introduction of SIS-ROH it was possible to review the collection tools, and include ICD-10 codes, which was not possible with older versions. The introduction of extra-hospital deaths allowed also the revision of the tools, contributing to the automation of death registration, and associated scaling of the processes.

Another component of innovation has been around training on ICD-10 coding and classification of COD for the clinical staff and users of the system. A total of 46 health technicians and clinicians have been trained in mortality registration and ICD-10 coding. Training has also been carried out for local private informatics service providers for every province, including maintenance and support of the mortality software and hardware.

In the Mozambique project, the aim of strengthening statistics was met, along with the larger aim of strengthening awareness and orientation of vital events nationally. It provides for a good practice to raise awareness on the importance of vital statistics, and a model that is not just restricted to the country. The model provides for better action for health, as well as having started the process to strengthen the overall achievement. Through the project, a strong and locally owned consultative process has been initiated that has helped to provide strong seeds to grow the CRVS systems in the country.

A further innovative component of the project was the use of mobile phones. As a consequence of SIS-ROH, mOASIS developed mICD, a mobile phone application that allows medical doctors to search for ICD-10 codes via the name of the disease or to certify the disease of a certain ICD-10 code. This enables a significant reduction in the amount of time needed to search manually across three volumes, in getting the death causes into ICD-10 format. This application was tested in the mobile phones of 20 medical doctors at the Maputo Central Hospital, and has been made available for free download.

The project in Indonesia focused on two problems of COD classification. The first was the amount of time needed to manually code diagnoses into ICD-10, and then find the underlying COD from these. The second was to do this in a standardized way, so that all deaths were coded and classified according to the same rules and logic of interpretation. Applying ICT to these tasks ensured not only massive saving of time, but improved the consistency and data quality of COD classification.

Figure 4 shows the report of processing one batch of death registries, with a success rate of 45%. While this means a lot of extra work has to be done if the COD should also be found for the remaining records, it has still classified almost 2000 records in a few minutes, an impressive improvement compared with the manual process.

Figure 4. **Report of automatic COD classification in Indonesia**

End of Batch processing		
15-Apr-13 8:11:15 AM		
	Number	Coding success
Certificates	4,189	
Processed	3,830	100.0%
Rejected	2,105	55.0%
Syntax	3	0.1%
Code	841	22.0%
Interval	0	0.0%
Ern	1,209	31.6%
Micar	4	0.1%
Acme	1	0.0%
AcmeMayBe	47	1.2%
Coder	0	0.0%
MainInjury	0	0.0%
Final	1,725	45.0%
Not processed	359	
Empty	359	
Closed	0	
Manual	0	
Non initial	0	
'Do not recoded' certificate	0	
Terms processed	0	-
Icd codes selected	0	-
Non-recognized	0	-

The key innovation dimension in Kenya was the adoption of a community-based system of civil registration. Registration of births and deaths as provided for in Cap 149 of the laws of Kenya became compulsory in the whole country in 1971. However, after 40 years only 57% of all births and 49% of all deaths were being registered. This low coverage could be attributed to the fact that events outside health facilities were not being registered. Furthermore, registrations done by nurses, clinicians and health practitioners were mostly not medically certified, and thus not treated as legally registered. The community-based system strengthened registration of events occurring outside the health facilities, including the use of VA. Training of the staff was carried out in the use of standards for death certification and COD coding.

Another dimension of innovation in the Kenya project related to the use of mobile phones. These applications were introduced to support the above infrastructure and mainly because the Provincial Administration (Assistant Chiefs) for home events were sitting in their offices waiting for people to come for registration. The use of mobile phones provides them with information about households where either death or birth occurred, and they are then supposed to act with this information. To run the Rapid SMS application, the already existing mobile phones were used; for the application on OpenXdata, new ones were purchased.

A significant innovation of the INDEPTH-ALPHA network gets enabled through the power of linking, and bringing strong and historically existing networks together. With different kinds of knowledge, there was tremendous synergy created when MOVE IT could enable the linking of these two networks. New knowledge was created on COD analysis in rural areas, and use of the VA tools showed how improved identification of HIV could be carried out. The networks then provide the medium to propagate these innovations further both across and within countries.

SECTION 4. ANALYSIS OF THE SCALING DIMENSION

Scaling is understood as the capacity of the intervention to be expanded across geographical areas, functional domains, user groups and uses. The various MOVE IT projects helped to demonstrate different kinds of scaling effects.

The Thailand project built upon existing learning, including a prior Global Fund project, thus leveraging existing capabilities. While the project can potentially be scaled to the national level covering the entire HIV/AIDS programme, it can potentially also be scaled to other health programmes.

The Thailand civil registration system is well developed, and so there will be no direct impacts of this study on the same. The need for the analysis of using vital events data for COD analysis comes to attention from HIV modelling experts, within the country and also internationally. The problem formulation was on how to use civil registration data and to calibrate model outputs, to make better estimates on HIV/AIDS deaths particularly. Results were presented at the XIX International Conference on AIDS, held in Washington, USA, on 22–27 July 2012. Further presentations are planned to other international conferences and journal submissions. However, a challenge to scaling comes from the fact that the personnel and expertise to carry out such analysis are housed in a university department, and will typically not be available in the Ministry of Health.

The Bangladesh MOVE IT project may have demonstrated the potential for scaling, but not the actual scaling itself, as systems development was under way. By positioning itself within the framework of government use of OpenMRS and DHIS2, the potential for scaling was established, as it can develop on existing capabilities. While this project has benefited from the broader initiatives taking place in the country, the planners did not take full advantage of it – by not using the available software – and instead opted to build from scratch. However, by making the minimum data sets acceptable by the government, they can actually be scaled, something which currently is in the stage of potential and has not yet been done. Similarly, the software has to be developed, tested, piloted and then scaled. That has not yet happened, but potentially can be done. At the time of the 2013 field visit, the development of the software application had been outsourced to a private company. Scalability of the application depends on ownership of the code and licences. For instance, while licensing fees may be small for a pilot implementation, a national roll-out might prove very expensive if the government does not assume full ownership of the finished product, thus adversely influencing scale.

The Philippine project was tried out in six barangays within a particular LGU. As it builds upon two government systems related to civil registration (BCRS and WOMB), it has the created the potential to scale easily within the framework of existing government mechanisms. Furthermore, it has tried to develop interoperability between the two systems, which enhances also the functional scaling of systems. Through the MOVE IT project, the technology was simplified and improved, various forms and manuals were created, and all of it would contribute to the movement of the systems to other LGUs, with arguably the potential to become a national system. The project does not report on how in future the results from here would underpin the broader range of work nationally, despite the clear potential existing for the same.

The Cambodia project primarily linked MOVE IT activities with the strengthening of the national HIS. While this indeed was a limitation in terms of providing primary attention to vital events strengthening, it was an important scaling strategy to link activities to the national HIS strengthening efforts. However, in this project, these linkages have not been explicitly demonstrated. Impacts on CRVS systems were primarily in terms of building awareness.

The project in Mozambique demonstrated scaling along different dimensions. The first dimension was a functional scaling, where the software SIS-ROH version 1 was developed and will be scaled up to version 2.0 in June 2013. This will include functionality to concentrate on the need to expand the coverage of the mortality register in terms of registration of extra-hospital deaths and registration of deaths occurring in health centres. The 2.0 version would include all the death certificate variables, security and confidentiality tools. As of now, the SIS-ROH software is only available in Portuguese, and does not lend itself to immediate scaling to countries using another language. The project has also demonstrated a geographical scaling with the application being installed in a total of 24 sites spread over the city of Maputo, and also in the provinces of Niassa, Tete and Zambezia.

There has been a functional scaling of SIS-ROH, which initially was only intra-hospital, and now has expanded to capture extra-hospital deaths as well. While the Net versions did not have import/export features and data were shared as database backup using external devices, the forthcoming version will allow import/export features. The application will also be provided in English. The mICD application and the testing results will be presented to the Ministry of Health and discussion of its expansion is to be held. SIS-ROH development team is collaborating with the team developing other Ministry of Health systems in order to provide mechanisms of interfacing their systems. Now, in the 24 hospitals, the use of SIS-ROH has been institutionalized, and regular support and training are being given. In view of regular attrition of staff, there is a need to keep training and support ongoing and continuous.

National scaling of the COD software dashboard in Indonesia should not run into major problems on the technical side. The two applications MMDS and IRIS are free, and the mapping

of the local dashboard to interact with them has been done. This bundle of applications can easily be distributed. However, there are two potential challenges. Firstly, in the pilot area, a file containing approximately 10 000 records would take 10 minutes to process with ICD-10 codes and the underlying COD. Clearly, with potentially millions of records, this process is likely to run into serious memory problems in the near future. This can be accommodated by splitting the records into several files, for instance based on geographical areas. This, however, leads to a second potential challenge because different files would have different mapping of written diagnoses to ICD-10 codes. Since this mapping is cumulative over time, as new variations of doctors' written diagnoses appear, some way of keeping a synchronized "master list" will also need to be developed. Through real time implementation, the scaling challenges could be understood, leading to the development of improved interventions. Resource constraints are the serious challenges to national scaling, but it does appear the technical systems and methodologies are ready for it.

Regarding potential for taking the Indonesian system to other countries, there will be a need for some significant initial programming. The MMDR and IRIS software are free, but the linkages of these applications to a mortality registry were described as complex. The locally developed dashboard application was available in English, but it was not clear if it is also going to be free and if it will be possible to link it to other formats of mortality registers.

The Kenya project has technical feasibility, and is in the process of finding institutional mechanisms for taking the solutions to scale. Stakeholders are part of this discussion on scaling strategies. There are strategies that are being tried out to develop an integrated architecture at the county level that would link through interoperability a suite of facility-level tools including OpenMRS, DHIS2, Logistics, Human Resources and others. The plan would then also be to make MOVE IT a central component of this architecture, thus being scaled with the architecture. A current challenge to scaling is that the server is centralized and hosted in Geneva for both the mobile solutions made. As this will restrict local ownership of the data and infrastructure, it would adversely influence scalability and sustainability.

Both the INDEPTH and ALPHA networks on their own represent significant scale in terms of countries and HDSS centres covered. By linking these networks, indeed the scale is magnified exponentially in terms of coverage, and also in terms of new kinds of knowledge that was created and circulated. The INDEPTH workshops specifically focused on training tutors on data cleaning and processing, who potentially would train others in the network, expanding scale. And potentially, this new knowledge can be spread at the African and Asian regional levels through the participating countries, and the new ones that may join.

SECTION 5. ANALYSIS OF THE LEARNING DIMENSION

The learning dimension refers to new insights developed in relation to the problem and academic discipline under study, or insights developed through the combination of learning from two or more dimensions, such as public health and informatics.

A key learning experience from the Thailand study relates to the development of new techniques around how to adjust incomplete death data. New techniques were developed in order to integrate data from different sources including the civil registration system, HIV sero-surveillance system, the AIDS case reporting system, HIV modelling (AIDS Epidemic Model), National AIDS Program, and also other sources such as the census population, survey of population change, and also other relevant information from literature reviews. Combining data from these multiple sources helps to create new learning insights regarding the quality and coverage of CRVS data, but also more broadly about HIV/AIDS and its epidemiology.

The review of the underlying causes of death derived from the system in Indonesia revealed different opinions about this subject. The algorithms in the IRIS software are based on different premises than those used in Indonesia, and as such there will be cases where different underlying causes will appear. There is a parallel scientific debate around this at the international level. This project demonstrated learning on how to link national databases on death registration with IRIS for death coding. This could provide interesting learning for other countries on how to carry out such integration to strengthen both the coverage and quality of death registration.

Further, a second learning from Indonesia is that users without strong skills in databases can still be included in the process of keeping such databases up to date. Since the automatic generation of ICD-10 codes is based on recognizing text, there will be instances where differences in spelling and use of abbreviations originating from multiple users will challenge the mapping between text and code. To counter this, the software has developed functionality for easily mapping pairs of text/code, so that multiple ways of writing a diagnosis can be linked to the same ICD-10 code. For instance, common misspellings of a diagnosis may be added, all pointing to the same ICD-10 code. That this can be done through the software user interface, rather than only in a background database table, allows ordinary users to keep the database dynamic and increases the percentage of successful coding. The key learning to be taken away from this relates to a design principle of user empowerment, where the medical proficiency needed to correctly map written text to ICD-10 codes can be tapped into to improve the cumulative success rate of automatic COD coding.

There are various forms of learning to be obtained from the Philippine project. The first relates to a methodology to understand why people do not conduct the registration of different types of vital events such as births, deaths and marriages. Often, the technology is believed to cope with these issues, forgetting the content of the system and how that needs to be understood within programme logic. The other important learning is for the need to build upon and try to strengthen existing systems rather than trying to build something from scratch. The effort in Indonesia explicitly tried to build upon existing systems.

In Mozambique, to avoid problems with viruses, the team developed what is called sys-compact-station at the José Macamo Hospital. The users claimed that the system benefited only the top level of administrators: the users enter data into the database but they cannot extract the reports they need for local decisions.

The information produced by the system is fundamental for local planning as well for national public health purposes. The integration with other sectors of vital statistics is ongoing and produced the need of a national reform of this sector that should be strongly supported. The project demonstrates the strong learning capacity of the system to adapt the new technological interventions and apply it to strengthen their work processes. With this background, it would not be difficult for health facilities to be adopting newer versions of SIS-ROH including the future web-based system. This can thus help stronger integration with civil registration and vital statistics reform.

The project demonstrates learning on how to carry out local data use, and in real time. This both supports routine hospital management and informs national health policy through annual use of data. For example, through the use of data, the ministry can see trends such as 60% of deaths are male, or the key causes of death of over 1-year-olds are from HIV and malaria, and there is an increasing incidence of deaths from cancer and cardiovascular diseases, and fewer deaths from infectious diseases. Statistics also show a reduction of deaths from 4457 in 2008 to 3901 in 2010. Such analysis was just not possible before. The ability to analyse such data and identify these trends helps to support hospital management and national policy interventions. Another important learning is the effectiveness of adopting a bottom-up driven ICD-10 implementation process rather than a top-down directive.

The Bangladesh project provides learning insights in to how to carry out participatory consultation processes in the development of minimum data sets. By engaging experts in a series of consultations, a technically sound data set could be created, spanning both clinical and administrative functions. The plan is to tie birth registration to incentives such as birth certificates becoming compulsory for government services, to buy property, etc. Successive CRVS systems around the world show that such incentives are vital to make the systems work. Also, while a national user identifier has not been agreed upon, there are several candidates for such. Making the MOVE IT information system independent of one particular, the Bangladesh

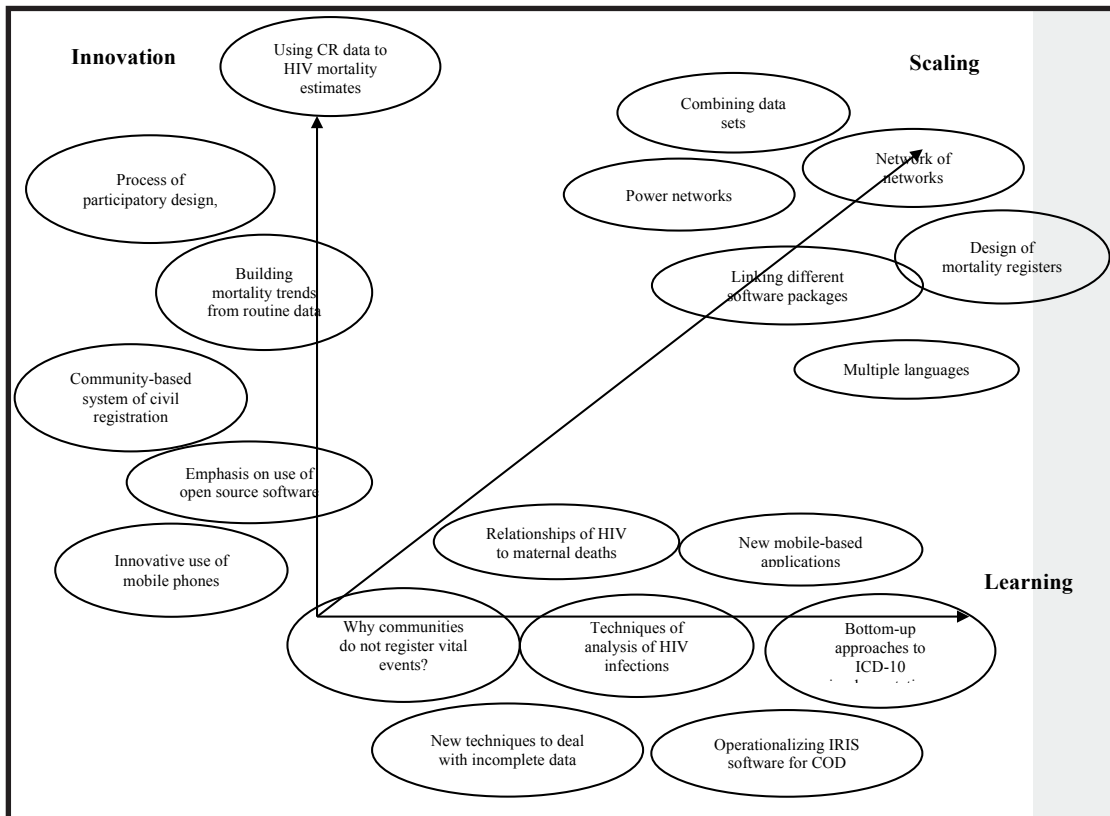
project opted for a strategy to include two established and one emerging user identification systems. This “hedging” might be a fruitful strategy to ensure future compatibility with whatever emerges as the one national system.

Kenya has faced problems in dealing with the developers of the application, mainly when it related to the inclusion of features. Currently, the project does not have the source code, but it is expected to be delivered to the technical team. Does it work, why or why not? How was the public–private collaboration? These were questions asked. The interviewees felt that the main reason for problems was because the developers were contracted by WHO, and the Ministry was not aware of this before the fact. As a result, Ministry felt they did not have control over the developers, and sometimes when changes were asked for they were unable to reach them. The need for stronger control over the development process was an important learning from the project, especially to evolve the technology based on user needs.

Significant new learning has taken place through this project linking the INDEPTH and ALPHA networks. New knowledge related to probabilistic modelling of HIV deaths and the effects of HIV on maternal mortality could be generated. Knowledge about dealing with large data sets, building standardized minimum data sets to create analysis, and training of tutors to carry out such data cleaning and analysis were direct outputs from the networked alliance. These different experimentations and learning have contributed to a new version of InterVA-4 which would be available for general use. Joint workshops, publications and conferences are specific mechanisms promoted by the project to enable development and sharing of learning.

SECTION 6. CONCLUSIONS: WHERE DO WE GO FROM HERE?

Figure 5. Contributions to innovation, scaling and learning from the MOVE IT projects



The MOVE IT projects have contributed to different forms of insights over the three dimensions of scaling, innovation, and learning. These are depicted in Figure 5. While for analytical purposes the dimensions are shown independently, they are in practice intimately interconnected. The insights obtained on each of the dimensions are summarized below, followed by an explanation of their interlinkages.

Scaling. Scaling broadly refers to the expansion of something, be it a technological artifact, a process or some form of knowledge. On the scaling dimension, the various projects contribute over different aspects of geography, functionality and data sets, and the bringing together of these factors leads to the expansion of different knowledge systems. With respect to geography, the MOVE IT projects have showed scaling of systems both within and across countries. Examples of within-country scaling include Indonesia, Mozambique and the Philippines, and in the respective countries there has been demonstration of expansion of data collection tools, software, registers, training and other processes across different districts and provinces.

An example of intercountry scaling clearly comes from the INDEPTH–ALPHA alliance of networks, which takes the results to more than 55 HDSS sites spanning about 25 countries. By the linking of the networks, the combined knowledge that is created can potentially be expanded to the HDSS centres in all these countries. Further, the systems developed through the projects in Indonesia and Mozambique can potentially be taken to other countries. This potential has not yet been realized.

In addition to the geographical scaling, there is expansion when two different and previously not connected data sets are combined and the combination leads to new insights. For example, in the Thailand project the civil registration and HIV prevalence data sets were combined in order to yield insights on how incomplete data sets can be used for HIV prevention and treatment effects. Similarly, in the INDEPTH–ALPHA network, data sets relating to population-based surveillance were combined with those for HIV treatment to develop new insights, for example related to maternal deaths and HIV infections.

Other scaling strategies were carried out by the Philippines project, which consciously built upon existing systems of vital registration including the BRCS and WOMB systems. Without trying to create new systems – which creates scaling challenges – the project built upon and refined the existing systems and built linkages across them to create significant scaling effects. Similarly, the Indonesian project also linked its system development tasks to the existing Indonesian ministry database, and with other IRIS software helped to strengthen the systems relating to coverage and quality of COD reporting. Similarly, the Mozambique project put its efforts in building upon, strengthening and expanding the functionalities and use of the SIS-ROH system to good effect. Also, by strengthening training and support to this system the project enabled its institutionalization, implying an expansion in the depth and coverage of use.

While some of the projects have been applauded for creating significant scaling by building upon existing systems and strengthening them, others can be criticized for focusing too much of their project effort on building software and databases from scratch. Part of the Indonesian project, the activities in Bangladesh and some other mobile application development efforts could arguably have had more time devoted to strengthening the content of the CRVS systems, had they not put primary focus on building new software. Arguably, for example in Bangladesh, the software currently being used for mother and child tracking could have been used by the project and customized appropriately given that it was built on free and open source platform. In this way, the systems could have been scaled more effectively.

Innovation. The operational definition of innovation was the ability to use the technology to solve existing problems in new ways, or to be able to use the technology for new purposes. Through the set of the MOVE IT projects, various examples of innovations appeared. For example, the Thailand project dealt with an existing problem of weak coverage and quality of

COD data by combining data sets relating to civil registration and HIV prevalence, especially for 15–19-year-olds, and gaining innovative insights into prevention and treatment effects and how to deal with incomplete data sets. This innovative technique developed through the project could potentially be scaled to the national-level HIV/AIDS programme in Thailand, or to other disease programmes and also to other countries.

The Mozambique project demonstrated the innovation of being able to discern mortality trends based on routine data. This was not possible earlier because, firstly, the tools and registers were not in place; also, routine data had not been used for this purpose. By building upon ongoing efforts of the ministry to strengthen the civil registration systems, the SIS-ROH software provided the tools that allowed these innovative insights. These were further enabled by training and support efforts in each of the sites, and also the steady expansion in the software functionalities, such as including facilities for processing inter-hospital deaths. Scaling was, however, limited by the fact that the software was not web-based, which meant improvements in a new version of the software needed to be reflected in every installation. The project staff acknowledged this limitation and are proceeding to make the software web-enabled in the second version, and also to link the system with the DHIS2, an open source web-based application that is currently in the process of being implemented nationally for the health management information systems.

The Bangladesh project can also be applauded for its emphasis on supporting the national ministry's use of open source software for aggregate and patient-based systems. This potentially allows them more possibility for creating innovative uses. Further, by consciously trying to design with linkages between these different systems in mind, potentially more innovative uses can be enabled.

The Kenya project showed the innovation in applying a community-based approach to strengthen civil registration systems. Within the existing framework of how civil registration is carried out, mobile phone applications were used to strengthen systems of notification of a vital event. On receiving the notification, the authorities were supposed to act to carry out the act of civil registration. In the past, they would say they had not received the information of the vital event from the community. Today, with this new system of notification, there is less chance of their saying that.

An interesting observation across these different examples of innovation was that the driving impetus for the innovation came not from the technology, but the fact that the effort was grounded in a strong programme-based logic. To take the example of Thailand, the guiding logic was of a strong public health understanding of how civil registration data could be combined and modelled with HIV data to develop new insights. Similarly, the example from Philippines was the logic of trying to understand from the programme perspective why people did not register vital events of births, deaths and marriages. This understanding gave rise to

clear recommendations on how systems such as the BRCS form must be modified to gather more relevant data. Also, in the case of Kenya the starting point was the programme-based understanding of how to strengthen the community component of the vital registration system. Based on this, an appropriate mobile application was developed that complemented the existing community registration systems.

Learning. An important aspect and mechanism of learning demonstrated by the different projects was the combination of different types of knowledge systems contributing to new knowledge insights. For example, in combining the data sets from INDEPTH and ALPHA, learning was created about the relation between HIV prevalence and maternal mortality. In the Mozambique project, combining routine data with mortality statistics helped to discern trends in mortality, which had implications for both hospital management and national policy. The informatics research discipline has emphasized the futility of trying to implement standards in a top-down and hierarchical manner. This premise, coupled with the medical and public health knowledge related to the complexity of ICD coding, contributed to creating an approach to ICD coding that was driven from the bottom up. This learning was useful in making this approach of bottom-up implementation successful, and also to generate new insights that could be taken into other hospitals. Similarly, the Indonesian project demonstrated learning coming through the combination of different databases. The existing database for recording deaths with the IRIS software helped to develop new techniques so that more than 50% accuracy could be achieved in coding COD.

New techniques for data cleaning, standardization and analysis were developed through INDEPTH by the bringing together of data sets from the different HDSS centres that were part of the network. Furthermore, combining data sets from the ALPHA and INDEPTH networks led to creating new techniques for data analysis that provides learning on the relationships between HIV prevalence and maternal mortality. Similarly, learning about the design of appropriate mobile applications comes from the knowledge of informatics and civil registration, together with an awareness of the strengths and weaknesses and an understanding of the importance of the role of communities in civil registration.

Linkages between the three dimensions of innovation, scaling and learning. The importance of creating scale can be one of the key drivers for innovation. For example, the importance of scaling experienced in the Mozambique project provided the impetus to be innovative and build new functionalities into the software. Conversely, if the learning is incomplete and not guided by strong programme logic – and instead is being mandated by technological needs – the systems developed are typically not appropriate and not conducive to appropriate scaling.

The MOVE IT projects taken together demonstrate these interlinkages. Some of the principles that can be inferred from this combined perspective can be listed as under:

- A strong programme logic should drive the system strengthening efforts, rather than the fact that a new technology is now available.
- To the extent possible, and to get scaling effects, try to build on something that exists and is supported by the systems.
- Maximize scaling effects for strengthening and expanding the system of innovation.

The different projects have their respective plans to scale and continue the projects after the MOVE IT phase is over. For example, there are plans within the Mozambique project to link the scaling of their systems with the new efforts in the government to introduce DHIS2 for national HIS strengthening. In Kenya, there are plans to develop architecture at the county level based on interoperable systems in which MOVE IT is seen as an integral component. Also, in the Philippines, since the MOVE IT project by design was integrated with the national civil registration efforts, the learning from MOVE IT would be integrated into the ongoing national efforts. Similarly, other projects in Bangladesh and Kenya have designs for integrating efforts with national initiatives. Some of the other projects, such as those from Thailand and the INDEPTH–ALPHA networks, have a primary agenda of strengthening research, and there are ongoing efforts for developing combined publications and other forms of research output.

In conclusion, the MOVE IT project could be said to have provided for diverse and unique contributions, which are magnified when seen in totality of the set of projects rather than in isolation. It is important to see that the learning which has taken place across these projects is not lost and is shared among all partners. Small mechanisms such as placing the learning in a common repository, making all reports, software and other resources available to all, constitute important efforts in this direction.

ANNEX. MOVE IT PROJECTS: OBJECTIVES AND PARTNERS

Bangladesh	
<i>Project title</i>	Collaborative development of a unified electronic information system to register pregnant mothers and their children
<i>Objectives</i>	Develop unique identification and minimum data-et standards; create an operational framework for digital design for mother and child tracking system; carry out software development and pilot implementation
<i>Partners</i>	James P. Grant School of Public Health, BRAC University; Bangladesh Bureau of Statistics; Bangladesh Ministry of Health and Family Welfare; UNICEF; UNFPA; WHO; GIZ; USAID; DFID; CIDA; Click Diagnostics; Devnet; International Centre for Diarrhoeal Disease Research, Bangladesh

Botswana	
<i>Project title</i>	Analysis of vital statistics trends in Botswana related to impact on MDG 6 (Combat HIV/AIDS, malaria and other diseases)
<i>Objectives</i>	Analyse mortality statistics from vital registration and HIV programmatic data on ART and services to prevent mother-to-child transmission of HIV during the period mid-1990 to 2010
<i>Partners</i>	UNAIDS; Global Fund to Fight AIDS, Tuberculosis and Malaria; Botswana Ministry of Health; Botswana Ministry of Labour and Home Affairs; Department of Civil and National Registration; WHO

Cambodia	
<i>Project title</i>	Establishment of a community-based system for vital events recording, maternal death surveillance and maternal death audit system for remedial interventions and prevention of avoidable maternal deaths
<i>Objectives</i>	Train community-based volunteers and agents to track and report the occurrence of vital events especially maternal death to the nearest interface of the health system and commune council for confirmation, official recording, notification and certification; train health facility workers (doctors and other appropriate clinical staff) on COD determination and ascertainment from home deaths through VA tools use; institutionalize regular mortality audit on deaths especially every maternal death occurring in health facilities and reported home deaths
<i>Partners</i>	WHO Country Office, Cambodia; University Research Corporation, USAID; Ministry of Interior; National Statistics Office of the Ministry of Planning; Commune Councils; World Bank; DFID; JICA

Egypt	
<i>Project title</i>	Generation of evidence and lessons learnt from country activities
<i>Objectives</i>	To develop and implement a series of interventions to improve the quality of COD data, building on the existing, nearly complete system of registration of deaths; an initial systematic review of the current civil registration system, particularly focusing on COD certification and coding, and identification of remedial interventions
<i>Partners</i>	Egypt Ministry of Health; Civil Registration Office; National Statistics Office; University of Alexandria; WHO Regional Office for the Eastern Mediterranean; WHO Department of Health Statistics and Information Systems; WHO Department of Road Safety; WHO regional offices; WHO Family of International Classifications Collaborating Centre, Kuwait; Kuwait National Centre for Health Statistics, CDC; and University of Queensland, Australia

Ethiopia	
<i>Project title</i>	Establishment of a community system for monitoring and recording of vital events by community health extension workers with the support of mobile devices (tablets/computers, mobile phones)
<i>Objectives</i>	Systematic review and a write-up of ongoing monitoring and recording of vital events in communities by community health extension workers in pilot districts and provinces using mobile devices (tablets/computers, mobile phones); convene a national stakeholders meeting to present and discuss lessons learnt from the project; secure the support of national government and policy-makers, stakeholders and development partners for adoption of the project findings and lessons learnt for implementation on a national scale
<i>Partners</i>	Ministry of Health; Tulane University; WHO; local councils/government; Ministry of Justice; Global Fund to Fight AIDS, Tuberculosis and Malaria; community elders/leaders

Ghana	
<i>Project title</i>	Establishment of a community-based monitoring and recording of births and deaths (especially under-five deaths), pregnancy tracking and data management system supported by IT
<i>Objectives</i>	Establish a reinforced vital registration system through IT-enhanced community-based reporting of births and deaths, and pregnancy tracking and pregnancy outcome recording in rural communities; produce more accurate and real time vital statistics on births, and neonatal and under-five deaths at district-level; generate local, national and global learning about the feasibility, cost and effectiveness of community-based tracking and recording of vital events as an approach to improve information which informs the design of more effective and efficient public health (and other social) programmes, and evidence-based decision-making
<i>Partners</i>	Institute for International Programs, Johns Hopkins University, Baltimore, MD, USA; Noguchi Memorial Medical Research Institute at the University of Ghana-Legon; Ghana Health Service; National Statistical Service; Births and Deaths Registry; District Assembly and Ministry of Local Government and Rural Development; UNICEF; CIDA; WHO; Ministry of Finance; INDEPTH Network; and Native Traditional Governance Authorities

INDEPTH Network and ALPHA Network

<i>Project title</i>	Improved analysis of COD information in low and middle income countries: a joint proposal from INDEPTH and ALPHA health and demographic surveillance networks
<i>Objectives</i>	Promote the use of VA outside the research centres by simplifying and standardizing analysis of VA; resolve controversies about classification of COD, particularly maternal deaths and HIV; improve confidence in official COD statistics, especially those that contribute to MDGs

Indonesia	
<i>Project title</i>	Use of IT to improve the management and processing of vital registration data
<i>Objectives</i>	Develop and implement software for data capture, processing, and analysis of vital registration data in a sample set of field sites; improve COD coding (using ICD-10) of death registries, and automatically try to identify the underlying COD from the different reported codes using software; strengthen the Ministry of Health and Home Affairs software as part of the Indonesian Mortality Registration System Strengthening project
<i>Partners</i>	University of Queensland, Australia; Ministry of Health (National Institute of Health Research and Development); Ministry of Home Affairs; WHO Country Office, Indonesia

Kenya	
<i>Project title</i>	Introduction of mobile phone technology to speed up and improve the registration of births and deaths in three districts.
<i>Objectives</i>	Counting and registering all births and deaths thus improving coverage rapidly; obtaining better COD information using VA instead of lay-reporting; speeding up the transmission of such information from local to a central database; expanding the coverage of the CRVS units
<i>Partners</i>	Department of Civil Registration of the Ministry of Immigration and Registration of Persons; WHO Department of Health Statistics and Information Systems; WHO Department of Violence and Injury Prevention and Disability; WHO Country Office, Kenya; the MDG Centre East and Southern Africa

Mozambique	
<i>Project title</i>	Improvement of hospital mortality data management system and its extension throughout the country
<i>Objectives</i>	Establish IT-supported and enhanced hospital mortality data capture as well as data management and information practices in Maputo Hospital. Roll out the knowledge and practices to other hospitals in Mozambique for complete national coverage of timely and quality hospital mortality data availability, management and information use; review the current hospital mortality data management system and set up a new IT-enhanced system for improved hospital mortality data management and data use practices; institutionalize use of timely and good quality mortality data and information derived from these for continuous improvement in the quality of patient management for better care outcomes, improved efficiency in hospital interventions and practices
<i>Partners</i>	Jembi Health Systems South Africa; Jembi-mOasis (nongovernmental organization in Cape Town); University of Eduardo Mondlane in Maputo; Ministry of Health, Mozambique; South African MRC; WHO Family of International Classifications Collaborating Centre, Cape Town; mOASIS (Jembi Health Systems branch in Mozambique)

Philippines	
<i>Project title</i>	n/a
<i>Objectives</i>	Support technical advancements on the BCRS, including the redesign of the data gathering tools to facilitate data processing and the online database; increasing awareness among the barangay constituents about the importance of civil registration, as a part of their basic human rights; ensure interoperability between WOMB and BCRS; improve quality and completeness of BCRS through the use of more effective tools and technologies
<i>Partners</i>	NSO and the Department of Health

Rwanda	
<i>Project title</i>	Use of community health workers in two districts in Rwanda for the monitoring of vital events
<i>Objectives</i>	Use existing national technologies, processes and systems to develop and support a reliable community-based reporting system for vital events (all births, and under-five deaths including maternal and neonatal deaths) using trained community health workers in two rural districts; conduct a CRVS rapid assessment (and eventual comprehensive assessment, if indicated)
<i>Partners</i>	Partners in Health; Rwanda School of Public Health; Ministry of Health Maternal and Child Health Directorate; Ministry of Local Government; Community Health Department of the Ministry of Health

South Africa	
<i>Project title</i>	Analysis of vital statistics trends in Botswana and South Africa as related to impact on MDG 6 (Combat HIV/AIDS, malaria and other diseases)
<i>Objectives</i>	Analyse vital (mortality) statistics independently at the holding or operational sources of the data in order to generate appropriate statistical descriptions and ascertain the quality of the statistics (data); identify opportunities for integrated and or interoperable provincial and national vital registration systems; determine vital registration system data management and data analysis capacity needs and make appropriate recommendations for improvements (such as information technology tools introduction and human resources and skills development)
<i>Partners</i>	South African MRC; UNAIDS; Ministry of Home Affairs; NSO; WHO

Thailand	
<i>Project title</i>	Innovative use of vital statistics to assess public health programme impact
<i>Objectives</i>	Analyse available statistics to ascertain age-specific trends of AIDS-related mortality in an environment of ART scale-up; use available vital statistics to estimate HIV prevention and treatment impact on mortality and the cost-effectiveness of HIV response interventions.
<i>Partners</i>	Institute of Population Studies, Mahidol University; National Health Security (Health Insurance) Organization; National Statistics Office; UNAIDS; Global Fund to Fight AIDS, Malaria and Tuberculosis

United Republic of Tanzania	
<i>Project title</i>	Preparation of a comparative analytical study on the quality and use of cause-specific mortality data from the Sample Vital Registration and Verbal Autopsy study and National Population Census, and the statistics (quality, completeness and use) generated from the United Republic of Tanzania CRVS system
<i>Objectives</i>	To evaluate past and present community-based registration of births and deaths in the United Republic of Tanzania for good practice, limitations, data comprehensiveness, reliability and validity, using existing information, as well as new data that will be released from the first four communities enrolled in the sample study
<i>Partners</i>	National Bureau of Statistics; National Institute for Medical Research; Ministry of Health and Social Welfare; Ifakara Research Institute; RITA (the national Vital Registration Institute); London School of Hygiene and Tropical Medicine