

Civil Registration and Vital Statistics 2013:

challenges, best practice and
design principles for modern systems



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ABBREVIATIONS

AIDS	acquired immunodeficiency syndrome
BCRS	Barangay Civil Registration System
BRIS	Birth Registration Information System
COD	cause of death
CoIA	United Nations Commission on Information Accountability
CPR	Central Population Register
CSB	Citizen Service Bureau
CR	civil registration
CRVS	civil registration and vital statistics
HIS	health information system(s)
HIV	human immunodeficiency virus
HMN	Health Metrics Network
HRS	Household Registration System
ICT	information and communication technology
INDEPTH	International Network for the Demographic Evaluation of Populations and Their Health
IS	information system(s)
MOVE IT	monitoring of vital events using information technology
MCD	Municipal Corporation of Delhi
NSO	National Statistics Office
PIN	personal identification number
SMS	short message system
UNICEF	United Nations Children's Fund
VA	verbal autopsy
VS	vital statistics
WHO	World Health Organization
WOMB	Watching over Mothers and Babies

EXECUTIVE SUMMARY

Within the domain of public health, information obtained from civil registration and vital statistics (CRVS) is critical, allowing tracking of individual births and building profiles of mortality and causes of death. These data play a fundamental role in planning and monitoring public health outcomes, as well as a broad range of outcomes in other policy domains.

CRVS information systems (IS) may be paper based or increasingly technology-driven, and incorporate multiple business processes including: recording of all details related to the vital event, for example a birth or a death; notification of the event to the authorities; registration of the event; and generation of VS. A variety of actors are involved in the recording, notification and registering of these vital events, as well as in the use of the system's outputs. The involvement of multiple institutions and actors in CRVS makes coordination and governance a key challenge in building effective CRVS IS.

In recent times, there have been various efforts in countries to harness the potential of technologies, computer and mobile based, to strengthen CRVS IS and the CRVS as a whole. This report seeks to study experiences and best practices of such systems from different countries. This analysis helps to identify best practices associated with well-functioning systems, and also the various design and implementation challenges that exist and potential approaches. A key effort is made to identify how existing best practices from well-functioning systems in both developed countries and low and middle income countries can be adapted and applied to others engaged in currently strengthening their CRVS IS. Considering the experiences of countries across the development spectrum, the challenges and opportunities for CRVS IS are identified as scaling up, innovation, integration of systems, business process streamlining and automation of CRVS processes.

Five design principles are proposed in this report to support improvement of CRVS IS: (a) establish CRVS as a public good; (b) establish institutional incentives to keep the CRVS updated and of good quality; (c) establish a holistic approach to CRVS design; (d) establish the business relationships of identified information flows; and (e) develop the technical approach for operationalization of these relationships.

SECTION 1. CIVIL REGISTRATION AND VITAL STATISTICS INFORMATION SYSTEMS

1.1 WHAT IS CRVS?

Civil registration and vital statistics (CRVS) systems are concerned with the legal registration and analysis of vital events in the population. Vital events include births, deaths, marriages, divorces, foetal deaths, annulments, judicial separations and adoptions, and through the registration process these events are made legal and legitimate. Civil registration (CR) is defined by the United Nations as the universal, continuous, permanent and compulsory recording of vital events provided through decree or regulation in accordance with the legal requirements of each country (1). Vital Statistics (VS) represents the statistical output of a well-functioning CR system (2). CR and VS systems are intrinsically interconnected, and their combined information systems (IS) are termed Civil Registration Vital Statistics Information Systems (CRVS IS). A well-functioning CRVS IS has in recent times been recognized as a key ingredient in strengthening CRVS systems in general, and the United Nations Commission on Information Accountability (CoIA) for Women's and Children's Health has especially mandated that countries would need to strengthen their CRVS IS. Specifically, Recommendation 1 of CoIA points to the key issue of systematic registration of vital events, stating: *"By 2015, all countries have taken significant steps to establish a system for registration of births, deaths and causes of death, and have well-functioning health information systems that combine data from facilities, administrative sources and surveys."* (3).

Within the domain of public health, data from the CRVS IS are critical, allowing tracking of individual births and building profiles of mortality and causes of death. These data play a fundamental role in planning and monitoring of public health outcomes, for example relating to immunization planning, and monitoring of broader developmental process indicators such as for maternal and infant deaths, sex ratios and fertility rates. An effective CRVS can help ensure enrolment of every child into immunization programmes, and VS indicators can be tracked to better support the prevention of avoidable diseases. If drawn from a well-functioning CRVS system, these data also provide rigorous mortality data which are of significant public health concern, including those concerning the human immunodeficiency virus and acquired immunodeficiency syndrome (HIV/AIDS), tuberculosis and malaria. CR is crucial for individuals to establish legal identity and to access public health services, while VS provides essential information about the demographics and health of the population, making policies more effective and responsive to the needs of society.

CRVS systems are also fundamental to various development processes other than health, such as relating to social security, literacy and education, law and order, identity and different forms

of citizen services. Since CRVS by definition is multisectoral, a variety of actors are involved in the recording, notification and registering of vital events (citizens, health-care workers, doctors, police officers, clerics, and ministries of health, justice and home affairs, for example) and the use of its outputs (such as health authorities, tax authorities and policy-makers). The involvement of multiple institutions and actors in CRVS makes coordination and governance a key challenge in building effective CRVS IS. In practice, CRVS systems tend to be fragmented and compartmentalized: different sectors, for example health, population statistics and social security, are typically not able to access the same database and to generate VS directly from the CR system. Arguably, providing such access requires CRVS IS to be treated as a public good, being able to support decision-making for a multiplicity of sectors (4). VS on births and deaths is crucial information for policy-making and planning and for the guidance of health programmes at the global level as well as across national health systems. Where CRVS systems are weak and different sectors are not linked, planning – including for health – must rely on census data, which are typically inadequate as they are of decadal frequency and lack the right level of granularity.

Contributing to this situation of poor integration of systems and inter-institutional data sharing is the fact that CRVS in low and middle income countries have been largely paper based and manual. In recent times, there have been various efforts in countries to harness the potential of technologies, computer and mobile based, to strengthen CRVS IS and the CRVS as a whole. For example, in Sri Lanka, there has been use of scanning and digitizing technologies to automate their paper records. These efforts are reflected in a significant increase in the volume of global and regional activities to strengthen systems, including of the United Nations in Africa, the Arab states, Asia and the Pacific, and the global attention of international partners as a result of the Bangkok Call to Action in 2013. There thus now exists a large base of experiences from both developed countries and low and middle income countries from which we can learn what works and what does not, and draw guidelines to support future efforts. This report contributes to that aim.

Countries such as Australia, Denmark and Norway have strong and integrated CRVS IS supported by institutionalized governance structures, and various low and middle income countries such as Albania and Egypt have made impressive progress in strengthening their respective CRVS systems, including the supporting IS. However, despite these exceptions, by and large the situation in many low and middle income countries suggests that CRVS IS are not up to satisfactory levels in terms of coverage and quality of registration data, and in the manner in which this data is aggregated, used and shared across the institutions involved. Weak IS have adverse influences on multiple connected systems of identification, health services, issuing of passports, and various others. Building a well-functioning CRVS IS remains a non-trivial challenge, given its multisectoral nature. The CRVS IS needs thus to span *systems of systems*, involving design approaches that are different from what is used for individual systems (5). These are by definition technically and institutionally complex to build and use.

A key challenge in making CRVS IS multisectoral in practice (including sectors such as health, population registries, justice and others) is to develop strategies for the different systems to communicate and share data (5). But enabling communication and sharing data is not enough – the different components must be interdependent in an ‘ecological’ framework that mutually incentivizes the production, sharing and consumption of quality data. However, such thinking, unfortunately we may add, has escaped the CRVS and Health Information Systems (HIS) reform efforts, leading to piecemeal and fragmented systems. For example, the Health Metrics Network (HMN) report (6) has described as a ‘lost opportunity’ the way that data on births and deaths being captured in the routine HIS of a country do not necessarily integrate with CRVS registration records. Creating such multisectoral linkages would be mutually beneficial for the participating sectors, but practical and research-related knowledge is limited on how this can be effectively done in practice.

In order to strengthen our knowledge of the nature of this multisectoral CRVIS IS, with its inherent technical and institutional challenges (6), and how they can be designed, developed and implemented, this report studies experiences of such systems from different countries. This analysis helps to identify best practices associated with well-functioning systems, and also the various design and implementation challenges that exist and approaches to meet them. A key effort here is to see how existing best practices, from both developed and low and middle income countries, can be adapted and applied to other countries, especially the latter group that is currently engaged in strengthening their CRVS IS. A key objective of this report is to provide an overview of the status of some country CRVS IS, with a view to answering the following specific questions.

1. What are relevant design guidelines for the building of integrated CRVS IS?
2. What guidance can be provided to global development partners, donors and national policy-makers on how to invest in information and communication technology (ICT) initiatives to strengthen CRVS systems?

The report analyses five key themes and the associated opportunities, challenges and approaches. These are scaling up, innovation, integration of systems, business process streamlining, and opportunities for automation. Scaling up relates to the process of taking interventions from pilot projects into working solutions across administrative levels, interagency and expansion in terms of geographical areas, functionality and time; innovation is the capacity to carry out new tasks with technological interventions, or using new technology to address hard-to-handle problems; *integration of systems* relates to the technical and institutional issues of making different systems communicate and share data; business process streamlining is the capacity to design interventions that support a sustainable flow of high quality information between different entities; and *opportunities for automation* relates to the potential of using digitized and computerized information systems in terms of triggering actions and driving processes, and building interconnections between sub-processes.

1.2 THE IMPORTANCE OF CRVS IS AND THEIR CURRENT NEGLECTED STATE

CRVS represents key institutions of a country as well as providing a basis for assessing a country's status and development in general. Most low and middle income countries have inadequate CRVS IS, contributing to the unfortunate situation where many births and deaths are not being registered, described as the “scandal of invisibility” (1). A well-functioning CRVS IS has in recent times been recognized as a key ingredient in strengthening CRVS activity in general, exemplified by the CoIA recommendations. There is emerging evidence that technology can play a critical role in ensuring that births, deaths and causes of deaths are registered and that quality information is available to inform country and global development priorities. Both the United Nations Children's Fund (UNICEF) and HMN have sponsored activities in countries to strengthen CRVS systems through innovative use of ICT initiatives. However, there is yet no guidance for countries, international development partners or donors regarding appropriate technologies and architecture designs and principles to be promoted or invested in a CRVS system. So, despite increasing emphasis on CRVS IS, and growing investments in technology, it can broadly be inferred that the state of these systems in most low and middle income countries tends to be below desired satisfaction levels, and that ICT interventions have not yielded desired benefits – as yet.

Most low and middle income countries have CRVS IS that are primarily paper based, and many of them are in the process of applying ICTs for their modernization. The Health Metrics Network, a secretariat of the World Health Organization (WHO), initiated in 2007 a set of projects called Monitoring of Vital Events using Information Technology (MOVE IT) which explicitly sought to understand how ICTs can be innovatively applied to strengthen CRVS systems. Various countries, such as Albania, Bangladesh and Liberia, have also undertaken ICT-based CRVS reform initiatives either on their own or with support from donor agencies. But the success of these initiatives does not mirror the invested efforts. A recent survey of eCRVS and mCRVS initiatives in low and middle income countries (6) has indicated that many of these initiatives remain on a small scale and at a pilot level; as such, they have not delivered to their promised potential and the impact on actually reforming the CRVS systems has remained marginal.

In the public health domain, while HIS have gained in importance over the years as an object of research (7), CRVS IS, arguably due to their multisectoral nature, have slipped between the cracks and not been systematically studied within one domain – be it public health, demography or (health) information systems. As a result, there has until recently not been the urgency now being expressed by the research community to strengthen CRVS IS. For example, the IFIP 9.4 Working Group on Social Implications of Computers in Developing Countries, in its last three decades of conferences, does not show even one paper on CRVS despite its centrality to development processes. As a result of this research neglect, findings

in the IS domain pertaining to multisectoral, large-scale and complex systems such as those emphasizing the architecture approach (5), sociotechnical networks (8) and flexible standards (9), despite their direct relevance to CRVS, have not been applied to the understanding of the domain of CRVS systems. This report thus seeks to enable learning also between research communities involving design and implementation studies of information systems more broadly and CRVS IS in particular.

1.3 TRENDS EMPHASIZING THE IMPORTANCE OF CRVS IS

While computerization of CRVS IS has been around for several years, even in the context of low and middle income countries, what is new today is how systems are becoming increasingly interlinked with databases that are able to exchange information. Such interlinking was not technically possible in the earlier time of stand-alone, and often paper-based, systems. Interlinking of databases together with server-based solutions opens up a range of new opportunities. For example, it allows national databases to connect with registration offices in districts and sub-districts, creating the technical ability for the sub-national offices to register and issue certificates. Furthermore, health institutions recording births can now potentially transmit the name-based records pertaining to an event of a birth or a death electronically to the civil registry offices to register the event. Mobile phone technology further extends the geographical and temporal access to databases, enabling reporters of events taking place in remote areas to communicate directly with databases located elsewhere. The possibilities that are being created through these technologies and their interlinking represents not merely a simple automation of a paper-based birth or death registration system, but potentially ushers in a radical transformation of how the business processes around births and deaths registration takes place. Harnessing the potential of these technologies will also require the legal processes to be redefined, for example to enable the acceptance of mobile phone-based notifications of a birth or a death related event, for example by using the short message system (SMS).

SECTION 2. CURRENT STATUS AND CHALLENGES RELATING TO CRVS IS

The CRVS IS comprises multiple facets including: **recording** of data – where all details related to the vital event, for example a birth or a death, are noted down typically at the point of event (for example, the health facility or the home) on paper; **notification** of the event – informing the details of the recorded event, which in case of death would also involve details of the cause of death (COD), to the authorities responsible for the issue of legal documents, for example the Registrar General's Office; **registration** of the event – which involves the issue of the certificate of registration; and **generation** of VS – which involves the generation of aggregate indicators on key health and development indicators by the national authorities.

An integrated and holistic CRVS system should entail data linkages across these various facets in a seamless manner, even if they have their own respective systems. The different components that comprise the overall CRVS system represent a multiplicity of information flows from different sources and agencies, each of which has unique relations (unilateral or multilateral) with the CRVS system. For example, birth records from health registers may provide the source of registration in CRVS, while surveys of births and deaths can provide a framework for triangulation and strengthening of data quality and coverage. These relations will be shaped very much by the legal and political framework in the country. To deal with multiplicity within this and other areas necessarily requires taking an integrated architectural approach – one that involves the relationship of the different components with each other and the whole.

Surrounding these multiple flows are several stakeholders with their own IS and institutional arrangements. Getting institutional agreements for sharing data has often been found to be more complex than building the technical bridges (5). Donors often confound this problem by providing support to building individual systems, such as for strengthening COD reporting, without looking into the issue of how these data will interface with processes of registration and generation of VS. Such individual support leads to typically fragmented systems because the different components are designed as silos, within a short-term project framework with strong donor dependencies that encourage a limited focus. As such, these systems are not institutionalized as a part of a larger ecology of systems: they remain one-dimensional, are neither scalable geographically or functionally, and consequently are not sustainable.

Another key challenge in this regard is how to deal with legacy data that historically represent CR data. Most low and middle income countries would have primarily paper-based records of individual birth and death records, and these are not easily amenable to computerization and thus retrieval and sharing. Some countries, such as Sri Lanka, have initiated projects involving the digitization of all such records, but progress has been slow and also there is still not a clear

strategy on how they become part of an integrated CRVS. Many others, for example Albania and Egypt, have recognized the potential value of ICT and have usefully leveraged HMN support to develop innovative prototypes of such integrated systems. These efforts still need to consider the larger challenge of moving from prototypes and pilots to systems of provincial and national scale with sustainable models to continue their evolution.

Little is known about IS (based on computers and mobiles) supporting CRVS systems from a systemic and architecture perspective, which spans the entire CRVS process from recording the event, its notification and registering, and the issuing of the legal document surrounding the event, to its consolidation into VS. The literature presents various examples of descriptions of particular ICT interventions relating to limited parts of the overall whole, such as on birth notification (10), death registration (11), COD recording (12) and the compilation of VS (13). While these specific examples provide stories of both successes and failures for the particular intervention they practise, they do not and cannot by design help to illuminate issues relating to the transformation and scalability of the overall CRVS system, as they do not take account of issues of relations with other flows and with the broader context. For example, Toivanen et al. (14) describe a mobile birth registration system using GPRS technology and smartphones in Liberia which, while appearing technologically sleek and cost effective for birth registration, does not deal with scaling issues and engaging with the additional complexities that scale inherently involves.

For the government to make every citizen count, or every mother and child count, as CoIA mandates, the need is for the technology to help the CRVS systems to achieve full coverage based on good quality data. This requires systems to be scalable both geographically and functionally. Geographical scaling implies full coverage of the whole population in which every vital event – be it a birth, death, marriage or other – is registered. Functional scaling should enable the capacity to be able to register and process every type of vital event and its components in its completeness, and will also involve the ability of the CRVS system to exchange information with associated systems. For example, verbal autopsy (VA) systems collecting COD information should be able to speak to the CR system dealing with death registration. Similar is the case with surveillance systems and population registries, as they need to be linked to systems of births and deaths registration.

In a majority of the cases studied, technology-based interventions in the CRVS domain have been applied in pilot or small scale settings, and focused towards one aspect of the system, such as birth notification or COD studies, without considering how that speaks to other components like the registration system and further to the generation of the VS. Typically, interventions tend to be focused on one or more of these three areas: (a) at the point of occurrence of the event (of birth or death); (b) at the point of creation of the legal document (birth or death certificate); and (c) at the point of consolidation of the VS. Two broad kinds of challenges can be seen to characterize these interventions. First, these interventions focus

on a limited component of the overall CRVS system, and are thus arguably limited to bring in systemic improvements. Second, these interventions by design are focused towards pilot efforts and not to the larger scale of national systems. The scaling challenge gets further magnified, because the pilot initiatives are donor funded and not state owned, and tend to wither away once external donor attention and funds are withdrawn. These design and implementation limitations are reflective of challenges faced in IS and HIS more broadly, leading to a crisis of sustainability and scalability of systems (8).

Another key challenge relates to the governance of CRVS IS. Governance of integrated systems, or architecture, is based on a focus of how individual systems – both technical and institutional – are interdependent, how they communicate and distribute different tasks, who makes decisions, and what incentives exist to participate in the architecture. The original metaphor of architecture comes from city planning, where it is important that systems of utility, water, power, sanitation, sewage and others are synchronized with each other for the city to work effectively. Despite city planning efforts, cities, especially megacities in low and middle income countries, are often in a state of chaos because they have not been able to anticipate migrations, purchase of cars, terrorism attacks, natural shocks such as earthquakes, and various other eventualities. However, most people will agree that without city planning efforts, the conditions of cities would be worse than they currently are.

Effective governance mechanisms can help to better understand, plan and implement new architectures or to change existing systems. In doing so, the governing authorities need to acknowledge that the future is not determinate and can never be fully anticipated, so decisions made today should not block or make irreversible certain paths in the future. This requires an approach to building CRVS IS as one of architecting, as a verb, signifying the architecture is not a finished product but is something that is always in the making. Governance should involve a holistic perspective to manage current and expected future sociotechnical heterogeneous components that need to constitute, together, purposeful work systems. For example, there is little point in introducing mobile phones to notify births and deaths events if the legal system that only accepts fingerprinted or signed notifications does not also change. An effective governance system should ensure these heterogeneous components act together with each other, contributing to the overall strengthening of the system.

In the business world, governance has been addressed through concepts of 'enterprise' or 'business architecture' to manage sociotechnical arrangements of software, hardware, organizational structures, human competences and incentive schemes (15, 16). In such environments, governance seeks to deal with efficiency and effectiveness concerns based on levels of standardization and integration within large-scale work systems, supporting the overall operations of the organization. This enterprise architecture approach is now also being adopted in other domains such as the development of health information architectures (5). While many of the meta-principles of enterprise architecture, for example that an architecture

is comprised of three layers of the users, business logic and data exchange, will remain the same in the case of the CRVS, the details of the different systems and the stakeholders involved and the specific flows of information will need to be worked out. These particularities will have implications on the governance of the architecture.

Some of the learnings from IS research relevant for CRVS IS governance include:

- the adoption of a social systems approach, which emphasizes the historical and institutional context, including people, data and institutional practices;
- an emphasis on a holistic approach, which takes into account the wide range of systems involved, the relations between them and the strategies for data exchange;
- the identification of best practice standards, as the glue to enable data exchange across the various sub-systems involves the adoption of a modular structure, enabling components to be plugged in or out, based on evolving needs of stakeholders.

Systems in countries such as Australia and Norway provide models on how these meta-principles have been put into practice, and can serve to guide efforts in low and middle income countries with appropriate and considered customization.

In describing the state of art of the existing CRVS IS, we do it with respect to three broad functional areas on which the systems broadly focus. The first concerns systems for the recording and notification of a vital event; the second concerns the legal act of registration; and the third system concerns those related to the generation of VS. The very fact that these systems are described separately for these three functional areas reflects the fragmented nature of the systems that exist. This point is revisited at the end of the following sections describing the three sets of systems.

2.1 STATUS OF INFORMATION SYSTEMS FOR RECORDING AND NOTIFICATION

A significant proportion of technology-based initiatives related to CRVS takes place at the point of the event of the birth or death, especially related to births. We can see the technological interventions to support three different kinds of activities around the vital event relating to **recording, notification** and **registering** of the event. Recording refers to the noting down of all details relating to the event, for example with respect to a birth it would include details relating to the name of the mother, place, type of birth and address. Notification would take place after recording and represents the act of official communication of the details of the event to the authorities responsible for the issuance of the legal document relating to the event. Registration then represents the higher-level function in which the event is legally registered within the CRVS IS. This can be in the provincial or national-level database,

electronic or paper-based, and made ready for the compilation of the VS. The registration then also includes the important act of issuing the certificate of birth, death, marriage, etc.

Commonly these three functions are often not clearly demarcated, and everything is said to involve a “registration”. Despite it being difficult to separate the interventions described in these three categories, we believe it is important to do so as a certain technology may have features that lend it better to certain functionalities than others. For example, mobile phones intuitively seem more suited to functions of notification than for registration, which could be better carried out in an electronic data warehouse. Also, technical changes will necessarily need to happen in conjunction with other systems, such as legal and governance. For example, even though the notification of the birth may take place through the mobile phone, the issuing of the registration certificate legally requires the physical presence of the individual who is the subject of the vital event. As legal systems change much more slowly than technical ones, the use value of technological interventions needs to be assessed accordingly.

Table 1 briefly summarizes some examples of systems related to each of these activities, and some corresponding examples.

Table 1. Summary of activities and systems relating to civil registration systems

Nature of CR activities	Status of the information system	Examples
Recording	<p>There exist examples of real-time recording of births, but death recording systems are far more limited</p> <p>There exist systems for VA, but they are rarely linked to death registration</p> <p>It is often unclear if systems are only recording the event or also carrying out notification and actual registration</p> <p>Typically, systems are stand-alone</p> <p>Various efforts are made by countries to use ICD-10-based classification systems for mortality information, but they suffer from weak linkages with CR systems</p>	<p>Agincourt Health and Demographic Surveillance System in South Africa (13)</p> <p>Birth recording in Ghana based on an OpenMRS based system called MGV-net is used to record real-time birth information in a pilot project (11)</p> <p>Burkina Faso, Ethiopia, the Gambia, Mozambique, Senegal and the United Republic of Tanzania are all reported to have introduced stand-alone CR systems, often based on the Household Registration System (HRS) to register births, deaths and migrations (17)</p>
Notification	<p>Mobile phones may be especially suited for low and middle income countries, where a significant proportion of the birth and death events typically takes place outside the jurisdiction of the health facility</p> <p>Since notification would involve legal mechanisms to be created, in their absence SMS can be used to trigger the process of notification rather than carry out registration</p> <p>Linkages of SMS with CR are relatively unclear, other than possibly triggering information about the event</p> <p>Legal processes need to be established whereby an SMS can be treated as a formal notification, something typically not currently in place</p>	<p>In Ghana, the CR database can be accessed, or in our terms “notified” and updated by mobile phone, which can then allow the generation of the birth certificate at the community level</p> <p>Monitoring of vital events using information technology (MOVE IT) projects in Kenya and Rwanda, based on low end phones and Rapid-SMS, support that the details of the event are appropriately coded and entered in a paper form, taken then into a form on the mobile phone and sent by SMS to the district level which is expected to register the event.</p>
Registration	<p>There are few examples of fully automated registration systems</p> <p>Computerized registration initiatives are typically not integrated with other systems</p> <p>Typically, registration initiatives are based on an electronic data warehouse approach where information is stored in one place</p>	<p>In Albania, for each citizen an individual record was created in the CRVS database, also treated as a population registry, and issued a Unique ID (18)</p> <p>The Government of Fiji has introduced a web-based system that integrates information from Health, Registrar General and Statistical departments, eliminating duplication of data entry and coding</p> <p>Bangladesh has introduced the Birth Registration Information System (BRIS) on a pilot basis with the aim to record individual birth information, automatically issue birth certificates, and retrieve and report birth data when required by storing them centrally in an electronic database (19)</p>

2.2 STATUS OF INFORMATION SYSTEMS FOR REGISTRATION

Registration of a vital event by definition is a legal act, and involves typically the issuance of a certification of registration of the event. Mostly, countries have manual systems that are historical and may have been running for more than a hundred years. As a part of reform efforts, many of these countries are in the process of automating their manual systems, and different technologies such as scanning and computerization have been involved in the process of digitization and archiving. Among low and middle income countries, there are arguably only a few that have fully automated systems with capabilities of generating also the legal documentation required for the completion of the act of CR. Some examples are offered in Table 2.

Table 2. **Examples of automated civil registration systems**

Country	Examples
Albania	Every citizen has a separate record in the population database containing his or her birth information, residential and civil status information (18). This is based on a web-based system facilitating the generation of documents. This system uses as the primary key a unique personal ID number. CR information is shared with other government departments, and citizens may obtain birth, death and marriage certificates and register marriages online
Mauritius	Under the e-Business plan, the country has put in place a system that, in addition to registering vital events and generating VS information, produces legal documents locally by accessing the central database
Ghana	CR systems do not appear to be equipped with the facility for generation of the legal documents (11). Possibly, because these are mostly pilot systems, they may not be entrusted with this responsibility
Namibia	A birth certificate is provided to all babies before they leave the health facility (20), which then enables integration with other government information systems. The same situation is reported in Uganda
Philippines	The National Statistics Office (NSO) provides the facility to obtain birth certificates online, since all CR documents are digitized and available in a database.

It can be seen that there are many different models being used by countries to carry out the registration of the event, and the technologies are varied. Further, a large majority of the events being registered relate to births rather than deaths, and COD details are most often difficult to find.

2.3 STATUS OF INFORMATION SYSTEMS FOR VITAL STATISTICS

While some countries are reported to have integrated CR and VS systems, for example Albania, Egypt, Mauritius, Moldova, Mongolia, South Africa and Thailand, most countries by and large seem to have separate systems. Integration of systems enhances the capability of generating vital information statistics reports and also permits the analysis of data, such as profiling of deaths by causes and geography. Some of these systems store individual records for life events, from which statistical reports can technically be generated to help formulate demographic and other indicators. In Fiji, the CR system is integrated with the Health and Statistics department, making full use of birth information which is entered at the time of birth at the health facility. This robust integration facilitates the extraction of VS data and each citizen is identified by the birth registration number issued by the Registrar General's department at the time of birth. From the Sample Registration System (SRS) in India, statistical reports can be also generated. Also, basic demographic indicators are being generated from some of the demographic surveillance systems (17). The Chinese disease surveillance point system collects COD data based on ICD-10 codes and generates statistics from these records (21).

In the Municipal Corporation of Delhi, there is an integrated system capable of producing statistical reports related to births as well as deaths. The BRIS from Bangladesh is only reported to have the capacity to aggregate birth information. Some surveillance systems, for example the Agincourt Health and Demographic Surveillance System (HDSS) in rural South Africa, are updated annually with resident and vital events, from which they are capable of generating statistical reports. The Ghana system is described to be capable of generating VS reports for the cluster of villages where the system is operational (11).

Various systems have been described as being capable of generating statistics from individual data such as those in Iraq (22), Malawi and the United Republic of Tanzania (10), but it is unclear whether these represent the formal VS systems of the area. Similarly, the Electronic Inpatient Morbidity and Mortality Reporting system (eIMMR) of Sri Lanka reports COD information for deaths occurring in hospitals. Though it does not contribute to the formal death registration statistics, this system is capable of generating statistical reports at facility, regional and national levels regarding hospital deaths, COD and age-specific mortality rates (12), which do not necessarily relate to the formal VS systems of the country.

As can be seen from this brief overview, there are various kinds of systems in countries that deal with VS. Some of the underlying characteristics of these systems are that often such statistics are not generated automatically from the individual records of births and deaths but represent a parallel system. The systems are sometimes technically not capable of carrying out automatic aggregation from the individual records to generate VS. Furthermore there are efficient systems, such as the one in Sri Lanka, which are capable of generating aggregate

statistics from individual death records but, because they are not linked to the CR system, are not treated as the official VS and thus face challenges in being scaled nationally.

2.4 KEY UNDERLYING CHARACTERISTICS OF EXISTING SYSTEMS

The above review of the status of CRVS IS based on their three functional areas, which leads to a broader discussion of some of their underlying characteristics. While some of these characteristics have been discussed earlier, they are further elaborated on and combined below.

CRVS IS are historically manual records

Most low and middle income countries still continue to have primarily paper-based systems, and it indeed is a challenging task to make the existing systems digital and redefine practices to support the new digital environment. Incorporating and integrating legacy data that run into many years – even over a hundred – with new systems, represents both a technical and an institutional challenge. There are of course associated problems in not dealing with a digital database, such as the challenges this creates in sharing data electronically across systems, or in being able to create consolidated statistics by drawing upon data over time and place.

Small-scale systems, typically pilots

CRVS systems represent the classical scaling problem in the health-care sector of “all-or-nothing”. This implies that if all the vital events from a catchment population are not registered, one cannot say the VS are complete and usable by the authorities. To achieve the benefits of a fully fledged CRVS system, all births and deaths must be properly registered, and these data must be shared widely – a need that cannot be resolved through pilots, and thus the merits of the CRVS IS become difficult to show. However, full-scale CRVS systems covering the whole geographical area or all the vital events are different to construct, given that most projects are funded by donors and are pilot and short term in nature. A donor project is usually designed to cover a small pilot area, or a small part of the overall CRVS system, say birth or death registration or a study on COD. This then does not lend itself favourably to full-scale deployment.

Focus on recording

A majority of technical interventions seem to be taking place at the level of where the event occurs, mostly concerned with recording details of the event, and transmitting information either through paper in the traditional model or by SMS where there are experimental efforts using mobile phones. In many cases, this transmission does not serve as a formal notification of the event, because that calls for additional legal requirements to be in place, for example the thumb impression or the signature of the citizen being accepted. If this option is not available, the details transmitted can at least serve as a trigger for actions leading to notification and

registration. The other important characteristic with the recording systems are that they focus primarily on the birth event. Death recording events are more difficult to find, a fact which can be attributed to the challenge in determining COD, and the fact that staff are typically reluctant to report a death, especially of mothers and infants. On the other hand, systems that focus on COD, such as VA, are usually not connected with the CR systems.

Use of stand-alone systems – not a holistic approach

The different systems being used in CRVS tend to be largely fragmented in nature, breaking the CRVS process into smaller bits and not being able to reconstitute it as a whole due to their lack of technical capability to exchange and share information. In many cases, the use of a stand-alone system, rather than a web-based application deployed through server–client architecture, impedes the local setting to link up with central databases; the local level is thus restricted in carrying out all the CRVS functions including the issuing of legal documents. Systems that concentrate on one or two aspects of the overall process, as do many in Africa, make the results of computerization and modernization rather limited and not so promising. Many African countries are experimenting with CRVS systems that can collect relevant details at the point of event and be capable of generating VS reports in their catchment areas, but they most often lack the capacity to generate documents that are legally acceptable. Furthermore, since efforts are confined to a small geographical area and carried out in a research mode with limited capacity and intention to scale up, they are not equipped with the legal authorizations required. This leads to a vicious cycle: because of their pilot status they cannot fully impact on the CRVS system, and without its legal capacity, they are not able to scale up. Again, this impedes being able to develop an overall picture of the CRVS status.

Focus on births, not deaths

As mentioned earlier, processes of death registration and the associated VS generation are seen to be generally poor in low and middle income countries, where much greater emphasis seems to be given to modernizing birth-related systems. This is probably because birth registrations are relatively trouble free, while death records are often not completed and COD information is notoriously difficult to fill. The problem is further magnified when deaths take place outside the health facility, in the community or at home. There are limited examples of national systems that are integrated with death-related data coming from various sources such as hospitals, funeral homes or burial grounds. In addition to the challenge of coverage of data, death data also suffer in terms of quality because of the challenges in accurately determining COD, which is often left blank or completed as “other”.

Proprietary technical platforms

Most of the examples of CRVS systems reported in the literature are built on proprietary or non-open source platforms, for example in Albania. A consequence of this is that data sharing across such platforms is a non-trivial challenge because of constraints in accessing the code or the database structure by the agencies involved. The use of proprietary platforms

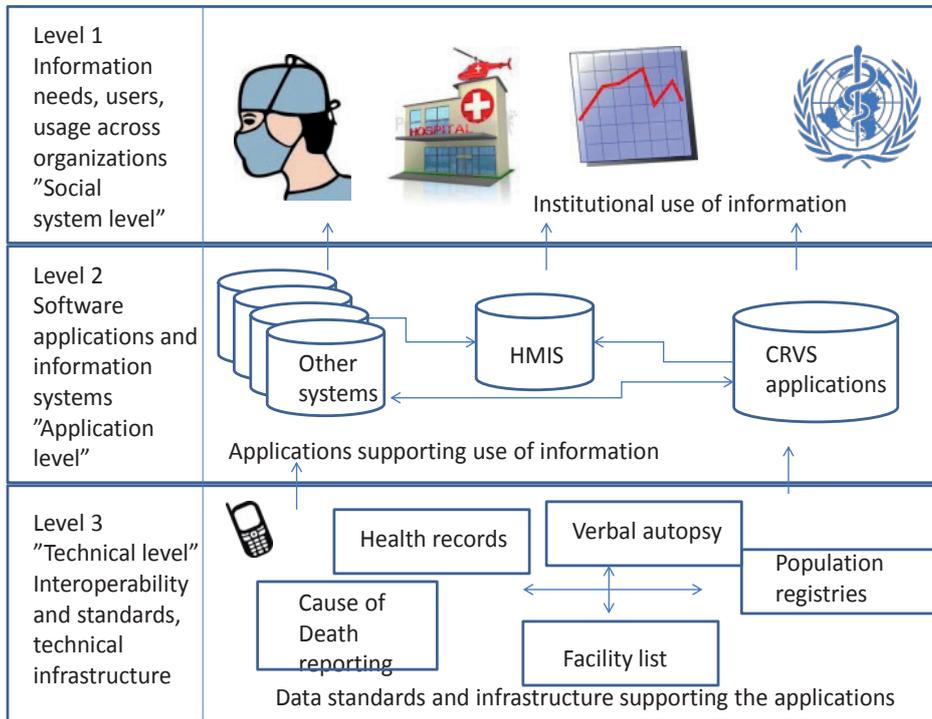
tends to create vendor lock-ins, where it becomes difficult to create any changes to the code without contract-based interventions from the vendor. The problem of data sharing is further magnified in the absence of the use of open standards in the CRVS domains. Or even worse, in the absence of standards themselves, sharing of data is problematic. Given the multisectoral nature of CRVS systems, the absence of easy and free mechanisms of data sharing across systems makes it extremely difficult to have effective and well-functioning systems.

Lack of architecture focus

Overall, there is an absence of an architecture approach in which, by design, the various systems that constitute parts of the overall CRVS are seen to exchange information. These limitations arise from both technical and institutional conditions. Technical challenges arise from reasons of the use of proprietary platforms or systems not designed for interoperability, and the use of stand-alone rather than web-based platforms, which makes it complex for multiple systems to speak to each other. The lack of data-sharing standards also provides other technical constraints. Institutionally, there are various challenges for the systems to communicate, the biggest ones being that systems are owned by different ministries and are thus guided by different norms and sets of practices. For example, while the HIS come under the purview of the Ministry of Health, the CRVS IS is the responsibility of the Ministry of Justice. As a consequence of different institutional ownerships, problems arise because of the absence of shared vocabularies by which the respective systems are able to recognize each other's data, and even more challenging is the absence of a political will to share.

In summary, the challenges to CRVS can conceptually be understood at three interconnected layers. The first is at the *political* or institutional level reflecting the weak understanding and agreements between the different stakeholders (for example, the Ministry of Health and the Ministry of Justice) to share data and to have common standards. Furthermore, these different entities act only on their respective functions, and often do not value integrated information coming from different functions. The second is at the level of the business logic or the semantic level concerning the alignment of the purposes of why the systems should share data. For example, if both the health and justice departments are collecting data on events of deaths, they should share also the common business goal that the recording of these events should lead to the events being registered with the CRVS system according to the legal requirements of the country, resulting in the issuance of a death certificate from a common database of vital events. For this to take place, at the third, *technical* level, there must exist interoperability or to have syntactic interoperability by which data could be shared with each other. An important point to note is that these three levels are interconnected, and without agreements on any of the three levels the system cannot operate in totality. This three level interconnected model is represented in Figure 1, which then becomes also a normative ideal to strive for in the process of reforming CRVS systems.

Figure 1. **Three level inter-connected model of CRVS**



Source: adapted from (5).

There are some best practices, seen in both developed and low and middle income countries, which inscribe the principles of this three level model and which arguably has contributed to their being described as "best practices". It thus becomes important to try and understand how in these examples they have operationalized design representing this three level model. The next section examines examples of five best practices coming from diverse contexts of Australia, Denmark and Norway representing developed countries, and two low and middle income countries – Albania and India. After having introduced these examples, in the following section we inductively draw learnings from them to try and infer design principles that can normatively guide system building efforts to achieve this three levelled interconnected model. Following this, we discuss some of the perceived technical and institutional challenges, from the perspective of a low or middle income country, in achieving this normative framework. Working to meet these challenges can provide a road map for future CRVS IS building efforts.

SECTION 3. BEST PRACTICES OF CRVS INFORMATION SYSTEMS

3.1 EXAMPLES FROM DEVELOPED COUNTRIES

There are experiences in developed countries from which low and middle income countries may usefully gain. This section thus presents CRVS-related experiences from Australia, Denmark and Norway which are seen to be relevant for all countries in how they approach the design and implementation of their respective CRVS systems.

Australia

In Australia, there is strong coordination between the different actors involved in CRVS, based on interagency cooperation between people and agencies to achieve good quality data on births, deaths and COD. These include health facilities (for births, death certificates), the Registries of Births, Deaths and Marriages, Justice Agencies and courts (for coroner deaths), and various private agencies (such as hospitals and funeral directors). The Australian Bureau of Statistics serves as the point of consolidation of data from these different sources, and to ensure completeness and coverage. In Australia, health information is treated as an essential component of the CR process, and birth notifications and medical certification of death must be received before a birth or death can be registered. In particular, this creates a very strong incentive for deaths to be properly certified.

The registration of deaths is the responsibility of the eight states and territory Registrars of Births, Deaths and Marriages, who receive the confirmation of a birth or death from the health system. Information on COD is supplied by the medical practitioner or by a coroner to the registrar, who then forwards it to the Bureau of Statistics for coding, compilation and supplementation with information from the National Coroners Information System. Data quality assurance is provided at every point in the production of statistics, including receipt from registries, editing, coding and publication. The key experiences from Australia can be summarized as follows:

- Health data are treated as an essential component of CR.
- The Bureau of Statistics plays a key role to coordinate information collection, coding and publication and ensure coverage and quality.
- There exists a widespread involvement of various actors of the CRVS systems, and their systems of coordination.
- There are strong processes in place at different stages of the information flow to strengthen data quality.
- The system is especially strong in bringing in COD information, which remains historically weak in most national CRVS systems.

Denmark

The electronic CPR system in Denmark was established in 1968 (25). Registration is based on the notification of birth to the national birth registry, and covers 99% of births in the country. Each birth record is linked to the mother's PIN in the CPR. The CPR system records contain PIN, name, gender, date of birth, place of birth, place of residence, citizenship, vital status, CPR number of parents and spouses, along with an additional 150 variables. The records are updated on a daily basis.

The PIN assigned to each individual is unique and used in all national registers. The PIN has ten digits, where the first six indicate the date of birth (two digits each for day, month and year), the next three indicate a serial number to distinguish between persons born on the same day, and the last one is a control digit introduced to minimize recording errors and it also indicates the sex of the person registered. Once a person has been assigned a PIN, the same will not be assigned to another, and stays with the person forever. The CPR number does not contain any personally attributable data other than the date of birth and the sex (25).

The Danish system reflects a good architecture, where there is a central PIN linked to various other systems such as health and administrative services. While privacy is ensured, it still has a central system of linkage. Security and privacy concerns are important when dealing with CRVS, and computerization increases the vulnerability of the information as sensitive and vital information is available in electronic format (26). The challenge is to secure information from unauthorized access, while maintaining integrity and ensuring authorized access. It has been reported by Pedersen et al. (27) that the information in the CPR is of very high quality, and various factors could contribute to this.

- Information is continuously used by public administration employees, who correct erroneous information as they encounter it.
- When the CPR was established, all citizens received a certificate with their own information, inviting them to correct it.
- The PIN is well designed and serves the needs of the population.
- The system architecture is well designed supporting privacy, integrity and accessibility of the name-based records.

Like the Norwegian system described earlier, the Danish system also shows well-designed technical and institutional measures contributing to a robust and well-functioning CRVS system.

Norway

From as long ago as 1685, Norwegian churches reported aggregated births, deaths and marriages (23, 24). In 1876, a new law required all births, deaths and marriage information on an individual basis to be sent to the Norwegian Central Bureau of Statistics annually. In

1964, a computerized Central Population Register (CPR) was introduced in Norway based on the 1960 census. In the same year, a Personal Identification Number (PIN) was established. In 1994, all local registration offices were fully computerized and had an on-line connection with the CPR database. VS in Norway date back to 1735 with figures on births and deaths, and marriages were included from 1770. From 1968, annual VS have been produced based on the data hosted in the CPR. Statistics Norway was formally established as an entity in 1876, and produces today approximately 90% of all official statistics in Norway.

Since 1991, the Norwegian Tax Administration under the Ministry of Finance has had the responsibility to ensure that the CPR is accurate and up to date. A statistical 'copy-register' rests with Statistics Norway and similarly with a distributor (a private company). While the CPR is updated in real time, the copy-registers are kept up to date with batches every night. The CPR is used for population statistics, but also acts as the foundation for tax administration, elections and public administration in general, as well as being available to the private sector (banks, insurance companies and credit information agencies in particular). At the same time, access to the CPR is strictly regulated. Public entities are granted access if necessary for administrative purposes, while private companies only have access to non-confidential information if it is necessary to ensure their respective legal rights. Access can be granted as direct login to the registry based on a client, or batch transfers of the registry to local databases. Keeping the national registry up to date is based partly on notifications from the authorities, such as birth and death notifications, but also notification from citizens. For example, Norwegians are obliged by law to register if they are changing address, and doctors and midwives are obliged by law to notify the local tax office no later than a week after a child is born. If the child was born without a doctor or midwife present, the mother shall within one month after the birth send a notification to the local tax office. The local tax office forwards this paper-based birth notification to the CPR, which subsequently requests the issuing of a PIN from the Office of the National Registrar and registers the baby in the central database. Finally, the tax authorities are issuing birth certificates. In the case of a death, it is the responsibility of the next of kin to send a notification to the probate court and the local police in the municipality where the person was living. The probate court will forward the notification to the CPR. At the same time, a doctor will issue a death certificate, whether the death occurs in a hospital, an institution or at home.

CR is for Norwegian citizens an obligatory passage point to access a rich and varied set of social services. For example, registering a birth will trigger the payment of family allowances and registering a change of address will grant citizens the right to receive public services in the vicinity of where they are living. Further, many public registries (tax offices, real estate, vehicles, passports, police, etc.) and private corporations are using the CPR for address information. When changing address or name, changes in the CPR will propagate, as name and address is fetched from the national registry by a range of public and private institutions when needed. Thus, citizens will save the efforts of informing all these institutions independently

by informing the CPR, and the different public entities can keep track of the citizens to assure correct collection of taxes and payment of pensions. The CPR is further used as the foundation for rights and duties, issuing of passport, birth certificates and other identification documents. Based on these strong incentives, the CPR has achieved the status of being the central register, having high quality data and operating in an independent fashion and thus being trustworthy. According to an assessment in 2006, the quality of data in the Norwegian CPR is very good, both in the sense that the data are according to the notification received as well as legally correct. The success of the Norwegian system can be attributed to the following factors.

- Both CR and VS are historically well-developed institutions dating back more than two centuries.
- The close linkage between CR and VS was established more than a century ago, and has been deeply strengthened through institutional use over time.
- All functional areas of CRVS are supported by regulation and legal acts (recording and notification, registration and VS).
- CPR is used as a master registry for a range of public and private purposes – strong incentives for citizens and private and public institutions to keep it up to date.
- Well-designed technical systems based on an architecture approach support the institutional mandates of data sharing.

In summary, it can be seen that the Norwegian CRVS has achieved success through a series of technical and institutional measures, including a strong governance model.

3.2 EXAMPLES FROM LOW AND MIDDLE INCOME COUNTRIES

In Section 2, while describing the status of CRVS systems generally, the various examples primarily described some of the weaknesses of systems in low and middle income countries. While the general picture of CRVS IS in such countries is a challenging one there are also some exceptions, which can be seen as best practices and serve as inspiration for other countries to emulate. In this section, two such positive examples are drawn from very different contexts in Albania and India.

Albania

Based on the Modernization of the Civil Registration System in Albania project, Albania has improved on periodicity, quality, reliability and comparability of data and indicators, especially on demographics and VS. The aim of the project was to develop a centralized CPR, with a dual focus on strengthening the ability and capacity of the CR system by establishing a central administrative unit, a central national register and the necessary legislation and modernizing the CR offices, including the transition from paper to digital records.

During the initial stages of the project, the focus was on scanning and archiving of paper-based register books and sharing of information with third parties. Statistics Albania utilized this shared information to generate register-based statistics. In 2008 all the registration offices were connected through the Internet with a web-based system and all citizens were registered in the CPR. The CPR was also used for creating the voters list and to issue biometric passports and ID cards. A limitation here is the proprietary nature of software used to develop the web-based system, which firstly made it expensive to develop and secondly in enabling data sharing processes with other systems. This also restricted the linkages between the CRVS and other government data.

For each citizen, an individual record is created in the CRVS database, also treated as a population registry, and issued a unique ID (18). This system is reported to have achieved national scale and is capable of generating national-level VS. The web-based system also facilitates generation of legal documents at the local setting, accessing the information stored in a central location where individuals are identified by their unique ID number. This registered information is shared with other government departments, for example facilitating the issuance of passports and other documents based on the registered birth certificate. The legitimacy of the individual is confirmed through the system when the person accesses other government welfare services. A common government web portal is used for many eGovernment services including vital registration. In this system, each citizen is registered with a birth registration number issued by the Registrar General's department. A citizen can obtain birth, death and marriage certificates and register marriages online. The Norwegian statistical office has been actively supporting the modernization initiative in Albania.

Key experiences from Albania can be summarized as follows:

- Modernization requires a dual focus on the central database and the registration offices that are distributed.
- Overall, a holistic approach has been adopted by examining the linkages between the CRVS system and other supporting systems.
- Using the CR system as the basis for the list of voters helps to strengthen the institutional role of the system.
- Despite the extra costs and barriers for integration induced by the proprietary nature of the software used, the system has facilitated sharing of information between public entities and has ensured accessibility for the citizens.

Municipal Corporation of Delhi, India

The Municipal Corporation of Delhi (MCD) is a big organization covering 14 million citizens living in Delhi. The MCD Health Department has computerized birth and death registrations since 2003 with the aims of reducing errors, improving speed and efficiency, developing better management of human resources, allowing more complete access to information and

permitting real time transparency. The other interesting aspect of the system is the integration between the health and registration functions, and details of births and deaths taking place in the hospitals are electronically transferred to the registrar office. The MCD has a Citizen Service Bureau (CSB), which serves as a single-window port for the citizens to access different services, including the issuance of birth certificates. Any citizen who needs a certificate can in person request a printed copy, or use the online ordering facility, paying by credit card and receiving the certificate at the doorstep upon payment of courier charges. Computerization has also facilitated the process of generating a unique PIN for each child. It has helped to improve data management, speed up the generation of reports and provide enhanced online monitoring. It has also helped in the monitoring of births by sex and zone in the city.

CSB has further launched an online institutional registration system supporting all government and private hospitals/institutions to register births and deaths. Because the scheme primarily covers institutional births, the head of the family or the relative living nearest to the registration centre registers births or deaths that have taken place at home. The online system manages nearly 1200 entries and generates some 3000 birth and death certificates every day. Furthermore, a pilot project was launched in 2006 to link immunization to birth registration. This has covered 32 maternity homes with the aim of integrating basic services for children. This was implemented within the framework of a tripartite partnership involving the MCD, the Office of Registrar General and UNICEF. Immunization and birth registration are two services provided for children by the MCD and handled by two separate sections within its Health Department. At the time the pilot was initiated the birth registration system was already computerized, while the immunization programme involved a manual process, with a fair degree of overlap in data collection and next to no synchronization. There were obvious advantages to be had through integration, as it would help to track a child from birth to the cycle of completing full immunization (or not) in addition to reducing duplication of work and information flows. Data entered once while registering births would also be used for immunization, for the compilation of a database on children by area, and for planning and supervision at the facility level, including the generation of electronic registers. It was envisaged that the system would help to strengthen reporting of events (births/deaths) occurring in the community covered by outreach staff of the immunization programme, including unregistered children born outside the MCD area. This information would be sent to the Office of the Registrar General of India for forwarding to respective states (provinces). UNICEF supported two components of this pilot project, namely staff training and software development, and the project was scaled to cover the entire MCD area from April 2008. This has helped to have a very efficient system for generation and dissemination of birth certificates.

Key experiences from MCD can be summarized as follows:

- Computerization is facilitating data management, reporting and analysis such as the profiling of births.

- Through integration, data entered while registering births are also used for immunization, to compile a database on children by area, and for planning and supervision at the facility level.
- A linkage between the birth recordings in maternity clinics with birth registration in the registrar office has been established, so data do not need to be entered twice.
- The CSB enables citizen-friendly services in the dissemination of the birth and death certificates to citizens.
- This case demonstrates that online systems for recording and registration are feasible also in low and middle income countries.

SECTION 4. CHALLENGES AND OPPORTUNITIES FOR CRVS SYSTEMS

This section describes five key themes emerging from the assessment related to challenges and opportunities for CRVS systems: scaling up, innovation, integration of systems, business process streamlining and automation of CRVS processes. Drawing on experiences from the MOVE IT projects in Bangladesh, Cambodia, Indonesia, Kenya, Mozambique, the Philippines and Thailand (6), the focus is on identifying opportunities and how they were leveraged, challenges experienced and promising approaches that have shown results.

4.1 SCALING UP

CRVS information interventions must provide scale-up opportunities to move beyond pilots. More particular, CRVS IS must work across administrative levels (facility to district up to centre and also back), interagency (e.g. automatically from community workers – registry or health – and into a central database used by registries or health) and expanding in terms of geographical and temporal coverage. Functional scaling also involves expanding the technical capabilities of the system, so that it can cater to more functions, and provides for linkages with other systems.

Opportunities and how they are exploited

The MOVE IT project in Thailand built upon existing learning, including a prior Global Fund project, thus leveraging existing capabilities. While the project focused on a research project containing limited data on HIV/AIDS-related causes of death, it can potentially be scaled to the national level covering the entire HIV/AIDS programme, and also to other health programmes such as those for malaria and tuberculosis. Similarly in Bangladesh, by positioning the project within the framework of government's use of medical record system (OpenMRS) and health information system (DHIS2), the potential for scaling was established, enabling development of existing capabilities and infrastructure. In the Philippines, the project was tried out in six barangays within a particular Local Government Unit. Since it built upon two government systems related to CR – Barangay Civil Registration System (BCRS) and Watching over Mothers and Babies (WOMB) – it created the potential to scale easily within the framework of existing government mechanisms. In Kenya, there were strategies tried out to develop an integrated architecture at the county level that would link through interoperability a suite of facility-level tools including medical record systems, HIS, logistics, human resources and others. The plan is to make the MOVE IT initiative a central component of this architecture, thus being scaled with the architecture. In Mozambique through a real-time implementation, the scaling challenges of CRVS IS could be understood, leading to the development of improved interventions.

Challenges experienced

In Thailand, a key challenge to scaling came from moving from a research environment to the practical field of the Ministry of Health. The personnel and expertise to carry out the necessary analysis (statistical and epidemiological) of CRVS data was housed in the university department, and was typically not available in the ministry. In Bangladesh, the development of the CRVS software was outsourced to a private company. Also, the scalability of the application depends on agreements on ownership of the code and licences. While licensing fees may be small for a pilot implementation, a national roll-out would prove very expensive; if the government were to experience constraints in assuming full ownership of the finished product, scaling would be adversely affected. In Kenya, the key challenge to scaling was that the server was centralized and hosted in Geneva for the mobile solutions made. As this will restrict local ownership of the data and infrastructure, it would adversely influence scalability and sustainability.

Approaches

Dealing with these issues must be based on an understanding that scaling will not happen on its own, but needs to be designed, planned and implemented. These processes must focus on the following considerations.

- Build in the perspective of a “total cost of ownership” in the design of such systems, so that the efforts required for operating, managing and supporting the systems over time, and at full scale, are firmly budgeted in the process. Donor projects should explicitly build in mechanisms of funding and resources to support these scaling processes.
- Geographical and functional scaling must be made an explicit aspect of consideration in the system design and in particular its architecture. Where countries are developing integrated national architectures in the health area (HIS, logistics, patient records, etc.) the CRVS systems must be made a key part.
- To support scaling interventions, the CRVS system should be positioned within existing frameworks and standards and should develop based on existing technological and human capabilities.

4.2 INNOVATION

Broadly, innovation is understood as the capacity to carry out new tasks using technological interventions, or using innovative methods to deal with ongoing problems that have previously been difficult to solve using existing means and technologies. Another important aspect of innovation comes from the institutional factor, reflecting the degree to which the state or country was involved in the design, development and implementation of the project. This potentially strengthens the level at which the host country or institution would have learnt about the local innovation, and their capacity to own and take it forward.

Opportunities and how they are exploited

The Thailand MOVE IT project focused on an existing problem of weak coverage and quality of COD data by combining data sets relating to CR and HIV prevalence, especially for 15–19-year-olds. This helped to gain innovative insights on prevention and treatment effects around HIV/AIDS, and how to deal with incomplete data sets. The innovative technique that was 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 the tools and registers were not in place, and also routine data had not been used for this purpose. By building upon ongoing efforts of the ministry to strengthen the CR systems, the SIS-ROH software provided the required tools to allow innovative insights. These were further enabled by training and support efforts of local staff 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 were proceeding to make the software web-enabled in the second version, and also linking the system with the DHIS2, an open source web-based application currently in the process of being implemented nationally for the Ministry's Health Management Information System. 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, which potentially allowed more possibilities for creating innovative uses. Further, by consciously trying to design for the linkages between these different systems, other potentially more innovative uses can be enabled. The Kenya project showed innovation in applying a community-based approach to strengthen CR systems. Within the existing framework of how CR 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 initiate processes to carry out the act of CR. In the past, they would say they had not received the information of the vital event from the community; today, with the new system of notification, there is less chance of saying that and thus a higher probability that the event is registered.

Challenges experienced

The project in Cambodia was focused on the HIS strengthening processes, and the potential innovations with respect to CRVS strengthening were limited to primarily building awareness. When a project is part of a larger initiative, in this case HIS strengthening, there is the challenge that only limited attention is given to CRVS IS strengthening because the overall focus is on something else. Another key challenge experienced in Kenya was that 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. The Mozambique project points to the technical limitations of working with non-web-based software, while the Kenyan

case shows the institutional challenges of linking the notification process with others such as registration and the generation of VS.

Approaches

An interesting observation across these different examples of innovation was that the driving impetus came not only from the technology but from the fact that the effort was grounded in strong programme-based logic. For example, in Thailand the guiding logic was a strong public health understanding of how CR 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 do not register vital events of births, deaths and marriages. Based on this understanding, clear recommendations could be made how the systems (such as the BCRS form) must be modified to gather more relevant data to help enhance the quality and coverage of data. Also, in the Kenya case, 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. The key learning is the need to situate the system within strong programme logic, and not to introduce technology for its own sake.

4.3 INTEGRATION OF SYSTEMS

CRVS systems in low and middle income countries are disparate, typically not designed to be integrated, and focusing on one aspect of the overall CRVS process. This is a key challenge undermining both the coverage and quality of CRVS data. Integrating the different components is a technical challenge related to standards, protocols and infrastructure data interexchange. At the same time, the multisectoral nature of CRVS implies that integration is also an equally significant institutional challenge requiring institutional agreements achieved at the level of departments and ministries, and the establishment of governance and coordination mechanisms.

Opportunities and how they are exploited

The cases of Australia, Denmark and Norway demonstrate a broader and systemic integration rather than a piecemeal integration involving only certain subsystems. In all these cases, a key ingredient seems to have been twofold: (a) making one central repository of data to ensure quality and integrity, while enabling access to different institutional data owners to ensure data are updated; and (b) establishing strong governance mechanisms to ensure that there is appropriate technical and institutional coordination and the development of shared understanding. In the context of low and middle income countries such as Albania and India, we can see similar principles being adopted. Technical solutions in Delhi provided for birth and death data as they were recorded in the hospital facility to be made available automatically to the Registrar offices for the event to be registered. Integration in Albania was enabled through

fostering interdependencies, where for example the issuing of a passport depended on the use of the registration data. Delhi also showed how registration was integrated with citizen services, making it easier for citizens to receive their registration certificates: for example, they could visit kiosks to collect certificates or even have these couriered to their home address on paying a normal fee. Use of technologies such as mobile phones in Kenya and Rwanda have fundamentally helped to integrate different sub-processes such as the recording of an event to its notification. A key learning here is how to enable integration through both technical and institutional mechanisms, which are best taken in conjunction.

Challenges experienced

In low and middle income countries, integration tends to fail at two levels. First, CR and VS systems are typically separate, hampering the ability to generate VS reports or to carry out data analysis such as profiling of deaths by causes and geography. Second, CRVS systems (separate or not) are typically not integrated with other systems generating relevant data, for example information related to death emanating from hospitals, funeral homes and burial grounds. This is typically a combined result of a prevalence of paper-based registries; lack of standards, protocols and infrastructure for data inter-exchange; and lack of willingness to share and policies supporting information sharing. The use of proprietary systems in many such countries acts as a severe impediment to integration, although as Albania demonstrates they can be overcome with strong institutional efforts to integrate, albeit at higher cost. Another challenge often seen is that the institutions do not have clearly defined cases for deploying integrated data, and by design the systems are not made to share data.

Approaches

There are several trends that may contribute to changing the situation in meeting integration challenges. First, are new technological opportunities such as the Internet and mobile phone networks. Internet backbones and connectivity are continuously improving in low and middle income countries, enabling the use of web-based and client-server architecture which, by design, allows for integration in single repositories. There is rapidly increasing coverage in the extent and quality of coverage of mobile phone networks as a data carrier bears with it the potential to connect remote sites. Second, there is a growing awareness of the need for coordinated sharing at both global and national levels, and with it the elaboration of initiatives to develop frameworks and standards related to, for example, HIS architectures, supporting the use of open source tools and standards to strengthen integration. The HMN promoted the use of a data warehouse approach to enable the integration of data and the creation of a shared repository to support a multiplicity of user needs. Countries such as India have a nationally declared policy to support open standards, which provides an enabling environment to support integration. Third, there are initiatives ongoing in various countries to promote open information by removing data-sharing and knowledge-sharing barriers. Thus a broader environment is being created to strengthen integration efforts, and tools are coming forth to help materialize these opportunities into practical realities to strengthen integrated

systems. A key ingredient is for institutional actors to actively pursue integration efforts right from the design phase.

4.4 BUSINESS PROCESS STREAMLINING

CRVS systems are composed of various business processes such as recording, notification, registration and the generation of VS. These business processes each have their particular information flows, artefacts in use and applications. CRVS IS interventions must be carefully designed to support flows of information both within the process and also between different entities and information systems that comprise the CRVS IS architecture. Taking a business process view of CRVS can help to establish the flows necessary to generate high quality data in a sustainable way and ensure active use of the data by different stakeholders. In low and middle income countries, there tends to be a lack of business process thinking in relation to CRVS systems, also reflected in the integration discussion above. Taking such a perspective can be vital for strengthening the overall system.

Opportunities and how they are exploited

While originally the notion of business process reengineering came from the domain of management consultancy, in recent times this methodology has also been applied to the social sector, such as in the public health reform effort in Ethiopia. As a part of this reform process, each functional unit of the health unit was defined as a business process, with clearly documented process owners, processes of information and workflows, inputs and outputs, and criteria to evaluate the effectiveness of a process. In this way, the systems are able to identify clearly any bottlenecks in the processes and suggest how they can be removed. In CRVS, there are clear opportunities for such a business process approach to be adopted to help align, streamline and reconfigure processes so as to attain stronger synergies. By treating, for example, notification as a business process, the practice of notification can be applied just as easily to birth notification as it can to death notification, and is an opportunity to have both effectiveness and efficiency in implementing the process. A medical notification of a death can be used both to generate COD information and to serve as the basis for death registration. A business process perspective can help to identify how the outputs of a single process can feed into multiple processes, thus improving integrity of data and reducing redundancies. Mapping out and aligning the business relationships between different stakeholders and entities require defining the norms of the interlinkages between these entities, process owners, what are source(s) and destination(s) of different processes, thus emphasizing interlinkages right at the design stage. Such thinking provides guidelines on how should data be shared, what are mutual benefits, how to resolve conflicts and other such processes.

Challenges experienced

A key challenge in applying such an approach to the domain of CRVS is to develop a shift in mind set, and be able to conceptualize the entire system as a set of interconnected processes. The existing systems of fragmentation and compartmentalization serve as significant impediments to the application of such an approach. Another challenge comes in the manner in which such an approach has been applied in business settings. The approach taken has often been to neglect history, by eliminating existing processes, and rebuild them by starting from a clean slate. However, history can never be eliminated, and there always will be an installed base – both technical and institutional – which will shape the trajectories of all new interventions. A challenge in design is thus to foster a deep understanding of these existing processes, and how they can be leveraged to shape future trajectories.

Another key challenge experienced is largely institutional in getting the different stakeholders to adopt a radically different way of working and conceptualizing the CRVS domain. There may be resistance coming from the stakeholders because of fear of visibility, a sense of loss of control and other such reasons. These will have to be gradually dealt with through strong and clear governance mechanisms. Another challenge would concern aligning the different processes so that they can meaningfully communicate with each other. As pointed out earlier, redefining business processes in CRVS necessarily involves also changes in the legal framework, for example of accepting computer-generated documents for the generation of a birth or death certificate. Legal changes are much more difficult to make, so high-level political will need to be cultivated. Another challenge is technically linking systems which are naturally distributed, such as a VA carried out in a community within the death certification processes. While there are potentially technologies that can enable these linkages, not all areas and groups of people have effective access to them. Ensuring infrastructural enhancements equally will thus be another key challenge.

Approaches

Since the business process reengineering technique came into vogue in the 1980s, much experience has been gathered on what works and what does not. Similar experiences exist from the social sector in low and middle income countries. An underlying design guideline is to learn from these experiences, and to understand how they must be customized to the particular conditions of the CRVS context. A key aspect to the approach taken is to undertake a visioning exercise, where the different business process owners are brought to a table to understand the approach and its constituent ingredients, the benefits to be achieved by adopting such an approach, and how technologies can enable the process. Once a common vision is adopted, the challenge is to present the entire CRVS system through this business process approach and to identify the various sub-processes and how they interact, both historically and as envisaged for the future.

4.5 AUTOMATION OF CRVS PROCESSES

Digitizing and computerization of CRVS systems bears with it the potential for enhanced effectiveness and efficiency by automating processes. First, automated systems can have the capability to generate and issue legal documentation such as birth certificates for the completion of the act of CR. Second, another area of opportunities is automation to enable the triggering of next steps such as notification and registration based on certain events and actions. For example a death notification, beyond triggering a notification process, can also help to initiate a VA process. Third, and related to integration as discussed above, a notification in one system can also trigger actions in other, interconnected systems, benefiting registries as well as HIS. The biggest advantage of automation is the development of centralized and shared databases, which can enable multiple actions to be triggered from the same source.

Opportunities and how they are exploited

The MOVE IT projects provide a range of examples on how various CRVS IS-related processes can be effectively automated: recording, notification, registration, generation of VS, and analysis and use of data. Further, a range of technological options – computers, mobile phones and digitizing and scanning technologies – are available and have been tested to help support the automating functions. For example, several of the MOVE IT projects used SMS on mobile technologies, such as in Kenya and Rwanda, to help automate the process of recording and notifying a birth or death event. Countries such as Albania and India have demonstrated how large databases can be used to create central repositories of data and their sharing across institutional actors. Projects in Thailand and the INDEPTH network demonstrate the power of computers to carry out analysis of data, often integrating hitherto fragmented data sets to generate more integrated analysis. Sri Lanka has shown the value of using digitizing and scanning technologies to deal with the challenge of legacy data. Similarly, Mozambique demonstrated how the process of death and COD (based on ICD codes) can be automated, to develop very useful COD profiles.

Challenges experienced

Challenges experienced in the above examples are often similar to those seen in other computerization projects carried out in the public sector of low and middle income countries. These relate to weak infrastructure, poor human resources capacity, scaling and sustainability challenges, and issues of change management. However, these challenges are not insurmountable, and efforts in sectors such as health have demonstrated approaches on how they can be overcome. Again, as has been emphasized earlier in this report, while the technical options are becoming more widespread, costs are falling, and there are more integration options technically possible, the institutional and political challenges remain a thorny challenge. There are often inappropriate technical choices made, for example the use of proprietary systems, which then go on to impede further computerization efforts in the future when scaling of systems is required. Automation leads to “informating”, where

through automation, information becomes visible which was not possible before. For example, automating and linking of VA and death registration data may highlight how many death certificates are not carrying the COD information. Such visibility of information may have institutional and political implications, as people may resist such visibility of their work processes.

Approaches

Examples of approaches to rise to these challenges are many, and can be found especially in the literature concerning information technology for development studies. For example, Braa et al. (8) describe the networks of action approach in the context of HIS development and implementation in low and middle income countries, to enable the sharing of learning and experiences in the network, so that the same mistakes can be avoided and it is not necessary to replicate the work in developing solutions. This networked approach, Braa et al. have argued, can help to overcome the challenges of sustainability and scalability inherent in HIS automation and implementation efforts. Designing within an architectural perspective, keeping in mind future computerization requirements and how existing efforts need to relate to them, is another key approach to deal with inherent challenges. Designing for flexible and hybrid systems that cater to uneven infrastructure environments and capacities is another valuable approach towards computerization and automation. Adopting multilevel and ongoing capacity-building approaches that cater to mind set and attitudinal changes in addition to building skills to use systems is another key ingredient for an effective approach.

Table 4. **Summary of opportunities, challenges and approaches**

Opportunities
Various technological opportunities now exist, including the use of mobile technologies and social media
Advances in database technologies enable opportunities for hosting large centralized databases that can speak to each other
Various integration opportunities exist, especially based on the widespread use of the Internet, mobile networks, and systems based on client server architecture
The growth of the cloud architecture provides opportunities for hosting large databases
Wider acceptance by global and national authorities for the use of open source technologies and open standards
Many positive examples, such as from the MOVE IT projects, on how technologies (eCRVS and mCRVS) can be effectively deployed to strengthen the CRVS process. Effective learning can be attained through the study of these experiences
Challenges
The challenge of bringing changes to the legal systems to enable the deployment of new technical solutions to existing processes
The absence of an architectural thinking to support the design process
An institutional inertia to proactively manage change processes, especially those that are radical in nature as often inscribed in new technological interventions
Lack of appropriate technical and institutional strategies to deal with vast amounts of paper-based legacy records that exist in countries
Poor data quality, both in terms of coverage and quality of data, especially relating to COD. As there may be good organizational reasons for poor data, the challenge here lies in focusing on institutional reasons, which may not necessarily involve technological solutions
Weak culture in the analysis and use of data, especially that involving data from cross-cutting business processes
Approaches
Build more multisectoral approaches that emphasize the inherent nature of a CRVS IS to involve multiple stakeholders and sectors
Consciously adopt architectural approaches to design that emphasize the role of history, future needs, and the interconnection between systems
Learn from best practice experiences from within the CRVS domain and also related domains such as health on how to design, build and implant systems. Adopting a “networks of action” approach to enable sharing experiences in a collective
Give primacy to bringing in required legal changes; this requires much stronger advocacy efforts through global and national players
Promote the use of open source technologies, tools and standards as a platform for the architecture development
Link research and practice in CRVS IS, as we are charting new and relatively unexplored domains

SECTION 5. REFLECTIONS ON DESIGN PRINCIPLES FOR MODERNIZING CRVS IS

The first part of this section develops a set of design principles at the strategic and operational levels, which have been inductively derived from the best practices described in the previous section. The second part of the section contains a discussion of how these principles may or may not be adapted in the context of a low or middle income country, illustrated by the ongoing reform effort in Tajikistan.

5.1 FIVE DESIGN PRINCIPLES

Given the multisectoral nature of the CRVS IS, a fundamental principle of a well-functioning and effective system is to foster strong mutual interests (by citizens and private and public entities) in maintaining a central registry of the population with updated and high quality data. Data should be based on inputs from the public sector, the private sector as well as citizens, and made easily available for the production of high quality VS. With these points in mind, some key properties of the system include the following.

- One centralized database (CPR) under the control of one agency providing quality assurance and being accountable for the quality and access of data.
- Accessibility and ready at hand infrastructure for enabling electronic flows of information to and from the CPR and the other agencies sharing the CRVS infrastructure.
- The CRVS is based on a PIN that is ideally standardized and legally mandated at a national level.
- There are well-defined institutionalized practices in the public and private sectors that use the PIN as the unique identifier/key for different operations such as issuing a passport, opening a bank account and other similar operations.
- The CPR is the master for personal information and for the updating of specific information systems, such as births, deaths and change of address.
- Free and open access to data provides strong incentives to use and report data, and to maintain the high quality of data.

These properties point to modernization of the CRVS IS system as involving more than just technological fixes. Rather, CRVS systems must be conceptualized and designed as parts of larger architectures, which is crucial for their good functioning and for the quality of the data they hold based on maintaining and strengthening mutual interests. While central authorities can introduce major changes as they may control larger parts of the architecture, they still have to engage with the wider network of private entities and citizens to guarantee the necessary information sharing and reporting practices. Further, conflicts of interest between

different public entities must be eliminated and replaced by a mutual interest in information sharing and open information. This will require changes in laws and regulations. CRVS modernization requires changing existing institutions and supporting the establishment of new ones, especially relating to legal structures such as data ownership, and assuring their sustainability. It is a long-term process that needs a strong political mandate over time. Thus, it has to be a process that is based on top-down initiatives from the government that trigger bottom-up participation by public and private entities as well as citizens. In short, it involves a large-scale cultural change in how CRVS data are seen and used, as compared to what systems currently exist in most low and middle income countries. These initiatives thus have to be nurtured over time, and will not take place in the short term.

Based on these guiding assumptions, five key design principles across the strategic and operational levels to support the modernization of CRVS information systems are summarized in Table 3.

Table 3. **Design principles for the modernization of CRVS information systems**

Strategic level
<p>1. Establish CRVS as a public good Public or collective goods are goods that all members of society will benefit from, regardless of whether they contribute to creating or sustaining them. Of particular relevance to CRVS is how public goods support and strengthen the dependencies between the citizens, the private and the public sectors, and public sector entities. A common situation is that the public sector entity owning the CPR and producing statistics also controls and restricts the usage of its content. This may severely impede the value of CRVS for the more general public and thus undermine the sustainability of the CPR.</p>
<p>2. Establish institutional incentives to keep the CRVS IS updated and of good quality Citizens, public and private sector need incentives (and not disincentives) to take part in securing the functioning of the CRVS IS. For example, making it an obligatory passage point to access social services or propagating changes to many public registries will incentivize citizens to have their information up to date. At the same time, usage of the CPR as the master register by public entities will encourage their reporting as well as those administering the CPR to make certain the data are accurate.</p>
Operational level
<p>3. Establish a holistic approach to CRVS design Designing CRVS IS requires the establishment of a holistic approach, which includes all existing CR and VS events, their supporting information systems – both input and output – and surrounding legislation. Legal acts must mandate the CPR to secure the privacy of the citizens while, at the same time, must offer wide access to the registry and support the sharing of data between authorities as well as with private enterprises to the benefits of the citizens. A CRVS system must not only be based on an understanding of existing institutions of public entities and information systems, laws, practices and the interrelationships between these, but must also carefully build on these foundations.</p>
<p>4. Establish the business relationships of identified information flows with the CPR The way in which the information in the CPR is updated by citizens and public entities and used by other public and private entities must be established and supported by the CRVS. Changing a CRVS information system must be designed carefully to support these flows of information as well as to establish the flows necessary to generate high quality data in a sustainable way.</p>
<p>5. Develop the technical approach for operationalization of these relationships, using tactics of integration and interoperability A CRVS IS must be based on the integration of independent systems with the CPR for reading and updating information. The key to support information exchange is a unique PIN, enabling the linkage of not only the CRVS but also the CPR with a range of public and private entities. Other factors such as legal and policy frameworks must also be aligned to support interaction.</p>

The strategic principles relating to public good and institutional incentives provide the broad template within which the CRVS IS should evolve. An example of a public good can be maps that are part of a spatial data infrastructure, which are developed through public money but need to be made available to citizens, government departments and the private sector for different purposes. For example, the health department can use them for mapping health facilities, the transport department for creating bus routes, and citizens for marking hiking trails. These different users should not have to create these maps separately, but should be able to use the publicly available map database. However, in return for free access, the different users have the obligation to contribute to keeping the database updated and of good quality by providing inputs where possible, which would be subjected to the scrutiny of a central quality assurance agency before being committed to the database. A similar kind of public goods framework is being proposed for the CRVS involving multiple users and mutual interests. Institutional incentives, the second strategic principle, then play an important role in defining the rules of behaviour of the different actors with respect to the CRVS system.

The three operational principles need to be designed and implemented within the strategic framework. The principles of holistic design and defining and operationalizing the business relationships would need to be created to strengthen the use of CRVS as a public good, and follow the institutional relationships and incentives that are envisaged.

5.2 A CASE-STUDY FROM TAJIKISTAN

To illustrate the applicability of the design principles suggested above, this section introduces a mini case-study from Tajikistan. Tajikistan has a well-established and robust system for CRVS, though almost totally without support of ICT (28). Here, the CR is handled by Civil Registry Offices, which are located in all 68 districts of the country under the responsibility of the Ministry of Justice. Tajikistan provides an example of strong routines and an institutionalized system, still relying on paper, which was also reported to be adequate during an earlier HMN-supported assessment. Later assessments, however, have reported serious shortcomings. A significant number of neonatal deaths are not being recorded; these typically happen within Ministry of Health facilities, so the data end up in a different system. Since the CRVS system relies mainly on paper records, there is no easy way of accessing and sharing this information. There are also other challenges not related to the technology, such as disincentives to report early deaths and payment requirements for patients. There are plans to computerize the system: starting from 2013, support for CRVS will be included in the new Ministry HMIS supported by the European Commission, which will use DHIS2 as a web-based database. The data warehousing approach enabled through DHIS2 should support the integration of the health and judiciary systems and their data, as both systems will be using the same software. This example also emphasizes that, while new technologies are adopted in different ways to tackle each country's particular challenges, they are part of the larger systems and infrastructures in the country that make scaling of projects a complex task.

In Table 4, the relevance of the five key design principles detailed in Table 3 is examined in the context of the on-going modernization of the CRVS system in Tajikistan. This analysis helps to identify the challenges that exist in making the design principles and guidelines work on the ground. While the Tajikistan case-study is an example of an effort to build an integrated system, similar challenges will also be experienced in other low and middle income countries.

Table 4. **Design principles of CRVS IS in relation to Tajikistan**

Strategic level
<p>1. Establish CRVS as a public good</p> <p>In Tajikistan, information collected and stored by the authorities is not commonly handled as a public good. A move towards open information requires making institutional changes. Further, the supporting technology and infrastructure must enable the establishment and maintenance of relations amongst the different stakeholders of the CRVS IS. A key area of concern in this respect is to establish a central database, ensure quality assurance mechanisms, practise an open access policy, put in place access routines and legislations, apply the technology necessary to serve multiple purposes and users, and be able to deal with the changes required over time.</p> <p>In Tajikistan, in common with most ex-soviet republics, there tends to be a strong centralized bureaucracy and slow changing systems, which make information access an inefficient task. While open information is not the rule, the establishment of a single window centre under the customs service for export/import and transit of goods to and from Tajikistan shows that institutional changes are indeed possible. This requires a strong political will and a multiplicity of coordinated initiatives towards customs control, standardization, certification and quality inspection. Learning from such experiences, and based on a strong political mandate, gradually institutional norms can be created to treat CRVS as a public good.</p>
<p>2. Establish institutional incentives to keep the CRVS IS updated and of good quality</p> <p>Tajikistan lacks institutional incentives, impeding the smooth flow of information at different levels of the IS and in the recording of events. From the perspective of the citizen, there are few direct incentives for registration of vital events as they occur. For example, only low income families receive a funeral allowance in case of registering deaths. Moreover, payment of significant fees for issuing certificates and other paperwork acts as a disincentive and a deterrent to timely registration.</p> <p>While at the individual level, incentives have to be created for citizens to register the vital events in a timely manner, simultaneously the existing disincentives of their having to make payments would need to be eliminated. Along with this, at the institutional level, the different organizations contributing to the CRVS system and database would need to have incentives to share their respective data, ensure good quality and compliance, and participate in processes involving the collective. For example, a passport office would only use the identification details included in the central database to issue a passport. While some additional information may be stored locally at the passport office, identification details should not be duplicated. In such a structure, the passport office has an institutional incentive to keep the central database efficient. While technology, effectively designed, can enable the technical part of the central database and its flows, an equally important challenge is developing the legal and institutional frameworks around these mechanisms, such as making it law that the CRVS identification number will be the sole one to be used for various institutional transactions. This requires understanding and political will at the highest level.</p>
Operational level
<p>3. Establish a holistic approach to CRVS design</p> <p>To make a CRVS information system work in Tajikistan, there are a few key areas to be attended to at multiple levels. At the first level is the legal basis regulating the registration of vital events, which is of equal importance for the government and the population. Tajikistan has a well-established legislative framework regulating CRVS activities. This will need to be modified to reflect the new demands coming from a coordinated CRVS IS. At the second level are the organizational and institutional arrangements that are directed towards unification of the CRVS with the other public and private stakeholders. At the third level is the technology, which will enable and support the unification of CRVS and the other related public and private systems. These three levels will need to be designed for enabling interlinkages and mutual support. For instance, a networked and online system can potentially allow many institutional actors to join and, in the same way, create incentives for the population. If the Tajik address bureau gets connected to CRVS system, it creates incentives for the population to register in the CRVS in order to use the address bureau's services. So technology can enable the data exchange, which in turn generates a larger user base, founded on the principles of a public good.</p>

4. Establish the business relationships of identified information flows with the CPR

In Tajikistan, different CR-related activities are under the responsibility of different public entities. For example, addresses are registered by the address bureau at the Ministry of Interior and its passport desks at the districts. Upon reaching the age of 18, each citizen is obliged to obtain a national passport. Once the passport is issued, the citizen is registered into the Ministry of Interior system. The situation gets more complicated because there is no PIN and each document type (certificate, passport) has its serial ID making it difficult to reference. Mapping the business relationship would then require defining the norms of the interlinkages between these entities, including how should data be shared, what are mutual benefits, how to resolve conflicts and other such processes.

Similarly, business relationships will need to be defined to support the ongoing attempts to introduce a unique PIN. For example, the tax committee of Tajikistan has its own taxpayer identification number (INN), and the labour and social welfare administration has introduced social security numbers (SIN). INN is mandatory for all citizens above 18 years, and there are incentives both related to INN as requirement for employment and for doing private business. INN is stamped in the national passport and the passport serves as a proof of INN. Unifying these and the related data flow through introduction of a PIN would be advantageous for all.

5. Develop the technical approach for operationalization of these relationships, using tactics of integration and interoperability

Initially, a full featured computerized CR system linking all CR office divisions with a CPR should be established. The CPR should be based on a unique PIN design, according to the Danish system for example. Once the system is fully implemented and operational, other public actors could be attracted by the means of providing (limited) access to the database and involving them in CRVS. This unification will be a long political, legal and institutional procedure, though ICTs could be used to catalyze the processes. With the establishment of a CPR, incentives will be generated for other public actors to join and benefit from it, at the same time contributing to the sustainability of the system by improving data quality and availability.

SECTION 6. CONCLUSIONS

This report has analysed the current state of play in CRVS IS existing technological and institutional trends, and has also sketched some future directions on the strengthening of these systems. A point of departure in this analysis is the argument that CRVS IS is currently by and large unsatisfactory and needs to be strengthened urgently. There are various developmental priorities such as reinforcing the health of citizens, increasing interventions towards universal health coverage, improving human rights of citizens, and supporting international declarations such as the CoIA, which bring into focus the urgent need to strengthen CRVS IS particularly in low and middle income countries. The report is a step in this direction, in trying to identify some of the existing limitations and also the best practices from both developed and other country contexts to extract lessons from them and help define an agenda for strengthening CRVS IS.

CRVS IS interventions undoubtedly carry the potential to enable innovations in the CRVS domain and thus break the inertia and stagnation that has characterized these systems for more than three decades (1). While trying to understand the potential of technology – computers and mobile phones – to strengthen the CRVS domain, it is at the same time important to place the technology within the broader sociopolitical–legal multisectoral context within which the CRVS application unfolds. History shows that we often tend to adopt a technologically deterministic approach, assuming that technology can be posited as the silver bullet that can solve particular developmental challenges (29). While acknowledging the tremendous potential that new technologies such as the mobile phone provide to the domain of CRVS (30), putting it within the framework of the businesses processes, other technological systems in operation, and the broader context is essential. IS research, for example Walsham (31), has historically and emphatically argued for the fundamental need for sensitivity to context and a sociotechnical form of thinking to design and implementation, as contrasted to a technological deterministic approach which tends to place technology as the end rather than the means of development.

IS to support CRVS represent just one among a multiplicity of other flows that intersect the CRVS domain. For example, the HMN technical framework (32) described CRVS as one of the five data sources, which also includes surveys, census, health and disease records and health service records, as well as input sources related to resources and finances. The various data systems have their own usages, and are typically supported by a range of IS including also paper based, and involving the application of technologies in diverse ways. For example, VA systems are grounded in medicine to generate COD information; VS systems are oriented towards generating consolidated indicators based on statistics; while census systems come with a decadal frequency and a household focus. There is a need to emphasize such linkages across systems, while the linkages are composed of much more than just the technology

and the nuts, bolts and wires that connect them. There is importantly the historical and political–institutional–legal context within which these systems need to be understood and implemented. Only based on such a perspective can we understand the challenges in getting these technologies to work on the ground, and the unintended consequences that typically occur, as people and institutions always provide surprises with unexpected ways in which they respond to technology. The strategic and operational principles towards adopting an architecture approach to CRVS, presented earlier, can help to deal with some of the challenges and cautions that have been identified with respect to CRVS IS.

To summarize, this project presented five design principles to guide the building of integrated CRVS IS.

1. Establish CRVS as a public good.
2. Establish institutional incentives to keep the CRVS updated and of good quality.
3. Establish a holistic approach to CRVS design.
4. Establish the business relationships of identified information flows with the CPR.
5. Develop the technical approach for operationalization of these relationships, using tactics of integration and interoperability.

A second objective of this report is to provide guidance to global development partners, donors and national policy-makers on how to invest in ICT-based initiatives to strengthen CRVS systems. While the design guidelines should prove useful as input on this level, this report also offers the following guidance.

1. CRVS IS should be made an integral part of national HIS and the health infrastructure strengthening plans.
2. National, as well as regional and international agreements must be made on standards and mechanisms for their compliance to ensure interoperability of CRVS IS with other systems.
3. CRVS IS can only be operationalized within a framework of national policies on health-data sharing that ensure data protection, privacy and consent.
4. Scaling of CRVS IS, geographically and functionally, must be an explicit aspect of considerations in the design of any new system or intervention.
5. Interventions should follow an incremental approach to implementation and scaling, where the system is introduced in a gradual manner particularly to be able to gain quick initial successes, and then slowly be able to move to more complex domains.
6. CRVS IS interventions must consider and take into account the existing systems and institutional ways of doing things, and not focus too much of their project effort on building software and databases from scratch.

7. The interventions must be designed to support all types of existing systems: paper-based, using computers, entering data through mobile phones or any other method.
8. A CRVS IS should be seen as part of a larger “information infrastructure” with no finite start and end date nor a confined set of users, but designed with evolution in mind.
9. A CRVS IS should follow an architecture approach with a focus on (a) the boundaries between different systems and components and how they communicate; and (b) loose coupling between components and favour open standards and open source to support flexibility and enabling a future we cannot anticipate.
10. Strong programme logic should drive the system strengthening efforts, rather than the fact that a new technology is now available.

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