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# CRVS analyses and evaluations

Mapping sources and silos of mortality data: Case studies in Peru and Ghana

May 2019



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## Acronyms and abbreviations

BDR	Birth and Death Registration
BPM	Business Process Management
CHPS	Community-Based Health Planning and Service
COD	Cause of Death
CR	Civil Registration
CRO	Civil Registration Office
CRVS	Civil Registration and Vital Statistics
D4H	Data for Health Initiative
DIRESA	Dirección Regional de Salud
DHIS2	Digital Health Information System 2
DTDIS	Technical Directorate for Demography and Social Indicators (DTDIS)
FTE	Full-Time Equivalent
GHS	Ghana Health Services
GSS	Ghana Statistical Service
ICD	International Classification of Diseases
ID	Identity
INEI	Instituto Nacional de Estadística e Informática
IT	Information and Technology
LMIC	Low and Middle-Income Countries
MCCD	Medical Certificate of Cause of Death
MHD	Municipal Health Department
MINSA	Ministerio de Salud (Ministry of Health)
MOH	Ministry of Health
OGTI	General Office for Technology and information
ORA	Auxiliary Registration Office
OREC	Oficina de Registro de Estados Civiles
ORG	Office of Registrar
RENIEC	Registro Nacional de Identificación y estado civil
SDG	Sustainable Development Goals
SwissTPH	Swiss Tropical and Public Health Institute
TAG	Technical Advisory Group
TOGAF	The Open Group Architecture Framework
UoM	University of Melbourne
VA	Verbal Autopsy
VE	Vital Event
VS	Vital Statistics
WG	Working Group

## Mapping mortality data: from sources to silos

The purpose of this paper is to present an overview and analysis of all the contrasting and disparate information systems that capture information about mortality in a country, regardless if they currently contribute to the standard Civil Registration and Vital Statistics (CRVS) system.

This is a novel application of process mapping and an adaptation of other systems thinking tools to understand the information architecture for mortality. This has been applied in two countries: Peru and Ghana, and results are the subject of this report.

### Background

The Sustainable Development Goals (SDGs) set out the vital importance of providing a legal identity for all, including birth registration by 2030.<sup>1</sup> At present, 44% of countries worldwide do not have comprehensive birth and death registration.<sup>2</sup> Millions of people worldwide do not leave a trace in the official administrative records in their entire life, yet information is collected but not always used. Officially their birth is not registered, important vital events such as marriage are not recorded, they are never in an electoral roll and thus never voted, and when they die, neither the death is counted, nor the cause of death known and reported for inclusion in national vital statistics. Addressing this deficit is essential to meet the global aspiration to **Leave No One Behind**.

Civil Registration and Vital Statistics (CRVS) systems contribute to public administration and governance by providing individuals with legal identity and civil status, which in turn helps them access basic services, entitlements and opportunities, and by generating information that can be used as the source of population registers to inform planning and resource allocation decisions.

Countries vary in their CRVS organization, implementation, processes, scale, partners, and capacities. All CRVS systems are part of larger political, economic, social, health, and information systems, but nest within further sub-systems concerned for example with legal identity, civil registries, vital statistics, information technologies, etc. All these systems are often fragmented and non-integrated which leads to bottlenecks in information flow between them and to multiple duplicities within the country. Consequently, vital events (and deaths among them) are recorded in multiple public and private institutions. Civil registration, health sector, burial administrative system, police, funeral homes or cemetery records are some of the information sub-systems where a death can be recorded.

Little is known about the different sources of information of vital events already existing in LMIC countries. This includes their information architecture or the potential of these sources to be integrated into and strengthen the wider CRVS system. Most of these sources still operate in silos, partially because they are paper-based systems owned by different agencies. Their data is not used to increase registration completeness.

As a first step towards the integration of all these sources of mortality data, countries need to catalogue all such potential sources and to understand how they interact/overlap (or not) with each other and with the routine CRVS system. **This project aimed to identify all sources of mortality data in Peru and Ghana and to gather the information requirements, information flows and business rules of each sub-system.**

<sup>1</sup> Mills S, Abouzahr C, Kim J, Rassekh BM, Sarpong D: Civil Registration and Vital Statistics (CRVS) for monitoring the Sustainable Development Goals (SDGs). In: The World Bank; 2017

<sup>2</sup> Mikkelsen L, Phillips DE, Abouzahr C, Setel PW, de Savigny D, Lozano R, Lopez AD: A global assessment of civil registration and vital statistics systems: monitoring data quality and progress. *The Lancet* 2015, 386(10001):1395-1406.

# Peru

## Setting

Peru consists of 25 **regions (or departments)**, which are further divided into a total of 196 provinces. These **provinces** are then split into 1,874 **districts**. The total estimated population in 2017 was 31,237,385 according to the 2017 Census of the National Institute of Statistics and Informatics (INEI). Around 79% of the population lives in urban areas. The current state of CRVS in Peru is good with about 95% of annual births and 70% of annual deaths registered.<sup>3</sup>

Within each district, there are local civil registration offices operated by the civil registration authority (RENIEC) or the Municipalities (local government), where births and deaths can be registered. The RENIEC system slightly varies from the official administrative structure by the fact that the country is not divided into 25 regions, but rather into 16 Administrations (Jefaturas).

There are three main types of offices: *Oficina de Registro (OR)*, *Oficina de Registro Auxiliar (ORA)*, and *Oficina de Registro de Estados Civiles (OREC)*. The last census of offices conducted by RENIEC reported a total of 54 OR, 171 ORA and 4881 OREC in the country. These offices register vital events (birth, death, marriage, divorce and adoptions) and issue the national ID card to citizens above 16 years old. Most of the offices use the electronic system called SIRCM to do the registrations and issuance of certificates. OR and ORA are part of the RENIEC infrastructures and they are entirely funded by RENIEC. ORAs are usually located in hospitals and health centres to improve the accessibility of registration. OREC offices are municipal government offices that have been assigned the function of registering vital events and issuing certified copies of registrations. Personnel in OREC offices usually hold multiple functions in addition to the civil registration function.

In the health system, each region is monitored and supported by the Regional Directorate of Health (DIRESA). A region is divided into health networks (Red de Salud), which consist of hospitals and various smaller networks (Micro-Reds). These smaller networks are made up of health centres and health posts. Births and deaths are notified by midwives and physicians respectively. Births are notified using an electronic reporting system named "CNV online" that feeds the information to the RENIEC system. Deaths are notified using either an electronic system called "SINADEF" or using the medical certificate of cause of death (MCCD) in paper. Whereas

most births are reported electronically, just 60% of the deaths are reported through SINADEF. In addition to this, during the field visit, three different MCCD forms were identified and some of them not compliant with international standards.

## Field visit and activities in the country

As a first step to identify and map sources of mortality data, the stakeholders and users of mortality data were identified:

- Public hospitals from the Ministry of Health
- Social security system (ESSALUD) hospitals
- Military and police hospitals
- Private clinics
- Health posts and health centres
- Regional Health Directorate (Dirección regional de salud [DIRESA])
- General office of information technology (Oficina General de Tecnología de la Información)
- Institute for Legal Medicine
- Police department
- Coroner
- Funeral homes
- Cemeteries
- RENIEC
- INEI.

A review of the information processes of each institution was conducted as well as interviews with personnel to understand the information flows. The documents and books used to register the deceased were recorded and a soft copy was collected if available.

The following systems were identified:

- Death certification in MINSAs hospital
- Death certification ESSALUD hospital
- Death certification in military and police hospitals
- Death certification in a private clinic
- Death certification in legal medicine institute
- Death registration in RENIEC
- Burial of corpse
- Death notification to OGTI-MINSA
- INEI's mortality report.

<sup>3</sup> Instituto Nacional de Estadística e Informática. Estadística de población y vivienda. 2018. Available at <https://www1.inei.gob.pe/estadisticas/indicetematico/poblacion-y-vivienda/>

In addition to the visits conducted in Lima, the team also travelled to the Amazon area. The objective of this field trip was to verify the death information systems in rural areas. The following systems were identified in this area:

- Death certification in a rural area
- Death registration in municipality of rural area
- Burial of corpse in rural area.

## Information architecture for mortality

A total of 18 information subsystems were identified in Peru. Half of the subsystems were operating at the local level (individual-level data) and the other half at the national level (aggregate information). **Table 1** shows a brief description of each sub-system. All subsystems were considered “pull systems” where the information must be requested by another instance except for the national statistics office (INEI) that disseminates mortality statistics on a regular basis.

**Table 1 Mortality information sub-systems in Peru**

Name	Scope	Brief description
<b>ESSALUD health facility</b>	Local	Medical certification of the fact and cause of death (natural causes)
<b>Morgue</b>	Local	All deaths due to external causes (potential criminal cases)
<b>Military Force health facility</b>	Local	Medical certification of the fact and cause of death (natural causes)
<b>Private clinic</b>	Local	Medical certification of the fact and cause of death (natural causes)
<b>RENIEC local office</b>	Local	Registration of the death
<b>Municipality</b>	Local	Registration of the death
<b>Burial system</b>	Local	Administrative system to provide the burial permit
<b>Family</b>	Local	The beneficiary of the system
<b>Funeral homes and Cemeteries</b>	Local	Public and private institutions that provide burial services to families
<b>Public health facility (MINSA)</b>	Local	Medical certification of the fact and cause of death (natural causes)
<b>INEI</b>	National	National statistics
<b>RENIEC national</b>	National	Aggregated mortality statistics for all registered deaths
<b>MINSA national</b>	National	Aggregated mortality statistics for deaths in health facilities
<b>ESSALUD national</b>	National	Aggregated mortality statistics for deaths in health facilities
<b>Justice system</b>	National	Criminal cases
<b>Military force central office</b>	National	Aggregated mortality statistics for deaths in health facilities
<b>Comprehensive Health Insurance (SIS)</b>	National	Aggregated mortality statistics for deaths in health facilities Health insurance purposes
<b>Peruvian Government</b>	National	National statistics and planning

The interactions between the different stakeholders are displayed in Figure 1 and Figure 2. Each node represents one institution or individual that is involved in the flow of information. The arrows represent the direction of the information shared, and their colour represent whether the interactions are local (e.g. within the municipality) or national/regional.

Examining the structure and linkages among the different information sub-systems (**Figure 1**), it is easy to see the degree of fragmentation in the overall information system. First, there are several endpoints where the information is stored and not integrated. For example, the Ministry of Health (MINSA), the justice system,

EsSalud national information system, military forces health information system, INEI and RENIEC national are located on the edges of the network. This represents how siloed each information system of the institutions is. These organizations are supposed to have similar information but each is capturing different populations in the country. For example, MINSA only captures death occurred in public health facilities whereas EsSalud captures deaths among formal workers with access to this social security system. RENIEC and INEI capture deaths that have been registered but not necessarily all deaths that have been medically certified. None of these information systems are complete and all of them are missing deaths that could be recorded in any of the other sub-systems.

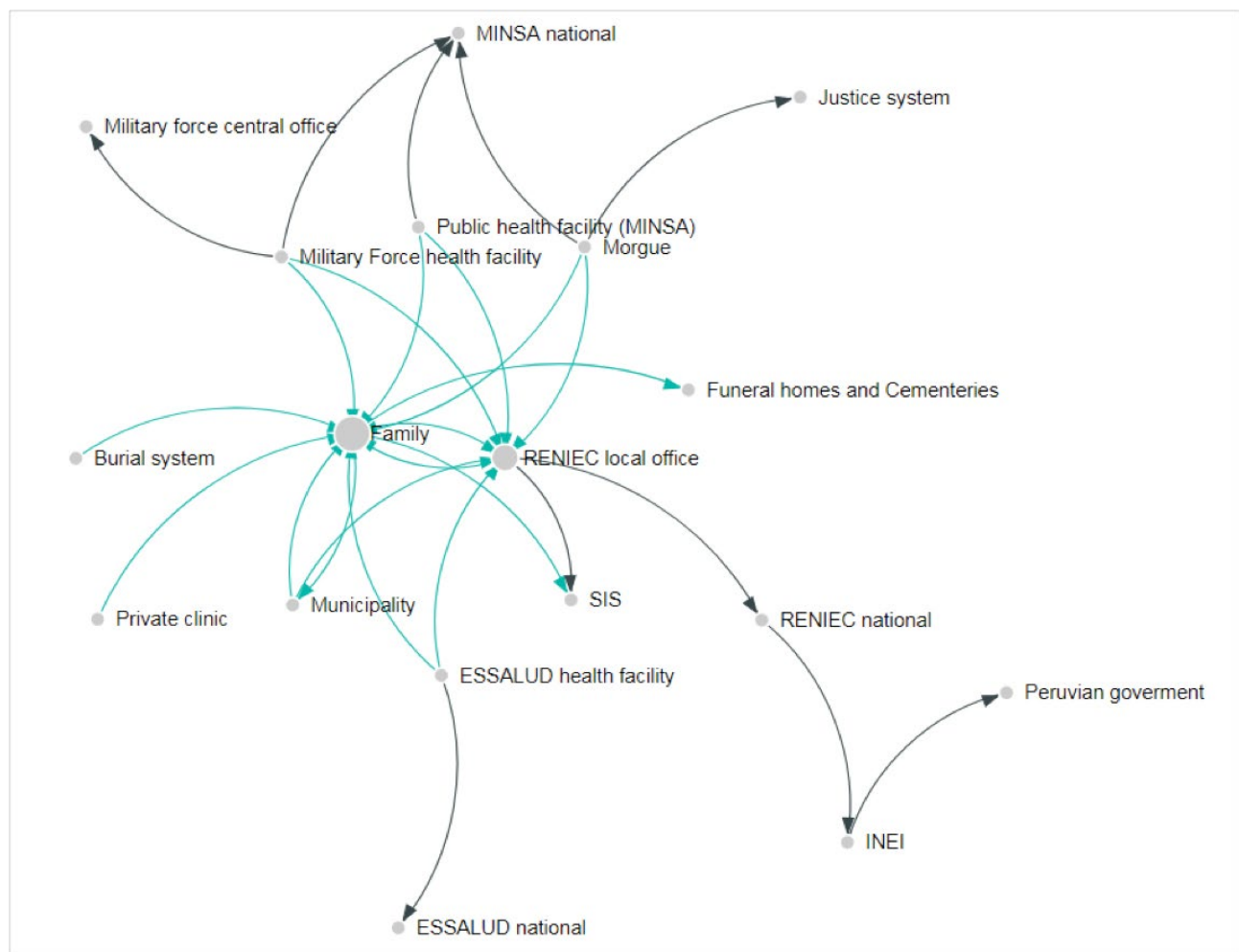


These information silos respond to the reporting systems of each institution above the local level (black arrows in the diagram). At the local level (greenish arrows) the interaction among the institutions and the exchange of information is more prominent.

There are two main hubs of information in the system: the family and the RENIEC local office (**Figure 2 and Figure 3**). The family of the deceased acts as one of the main hubs of information in the Peruvian system.

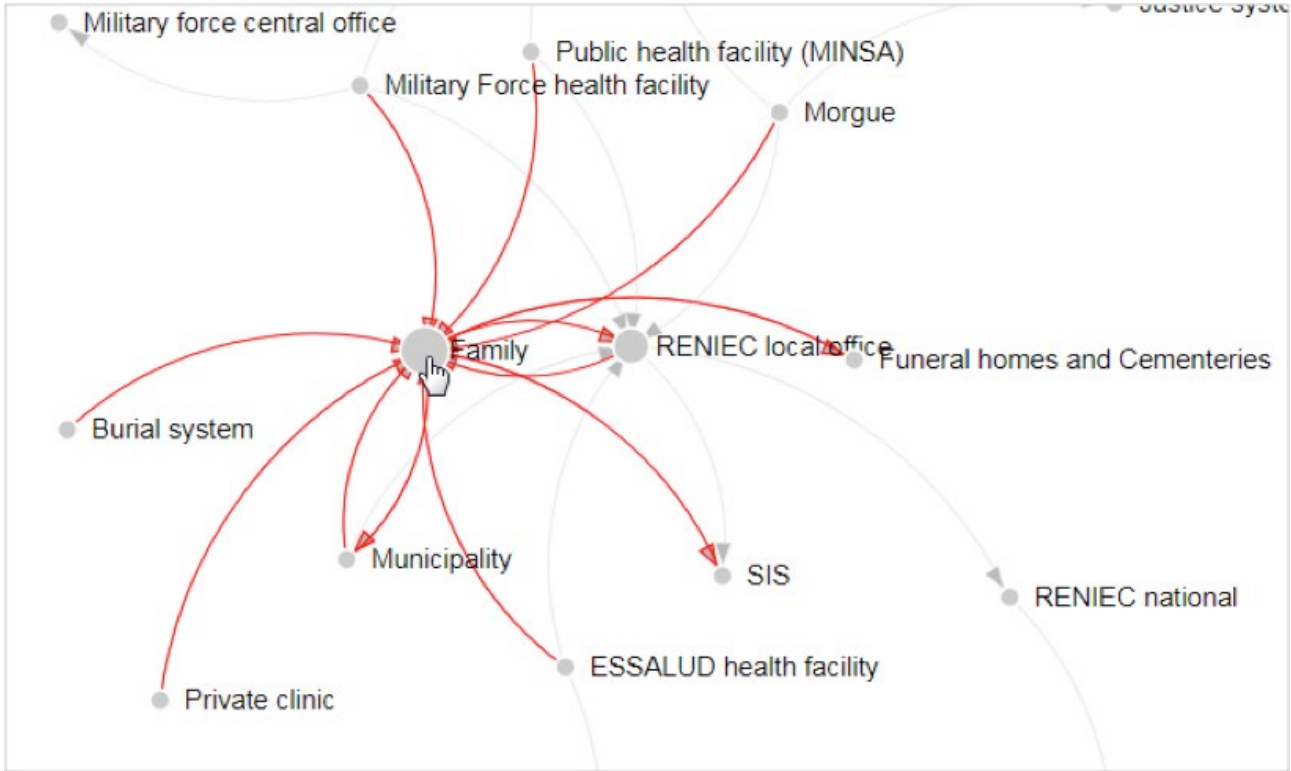
A significant amount of the information is transmitted by the family from one institution to another and they must interact with up to six institutions to get the death registered. Although health facilities and registration offices are sharing information about the death, the family still needs to visit in person each office to complete the different administrative tasks. This creates significant inefficiencies in the system and poses an unnecessary burden on the family.

**Figure 1 Information architecture in Peru**



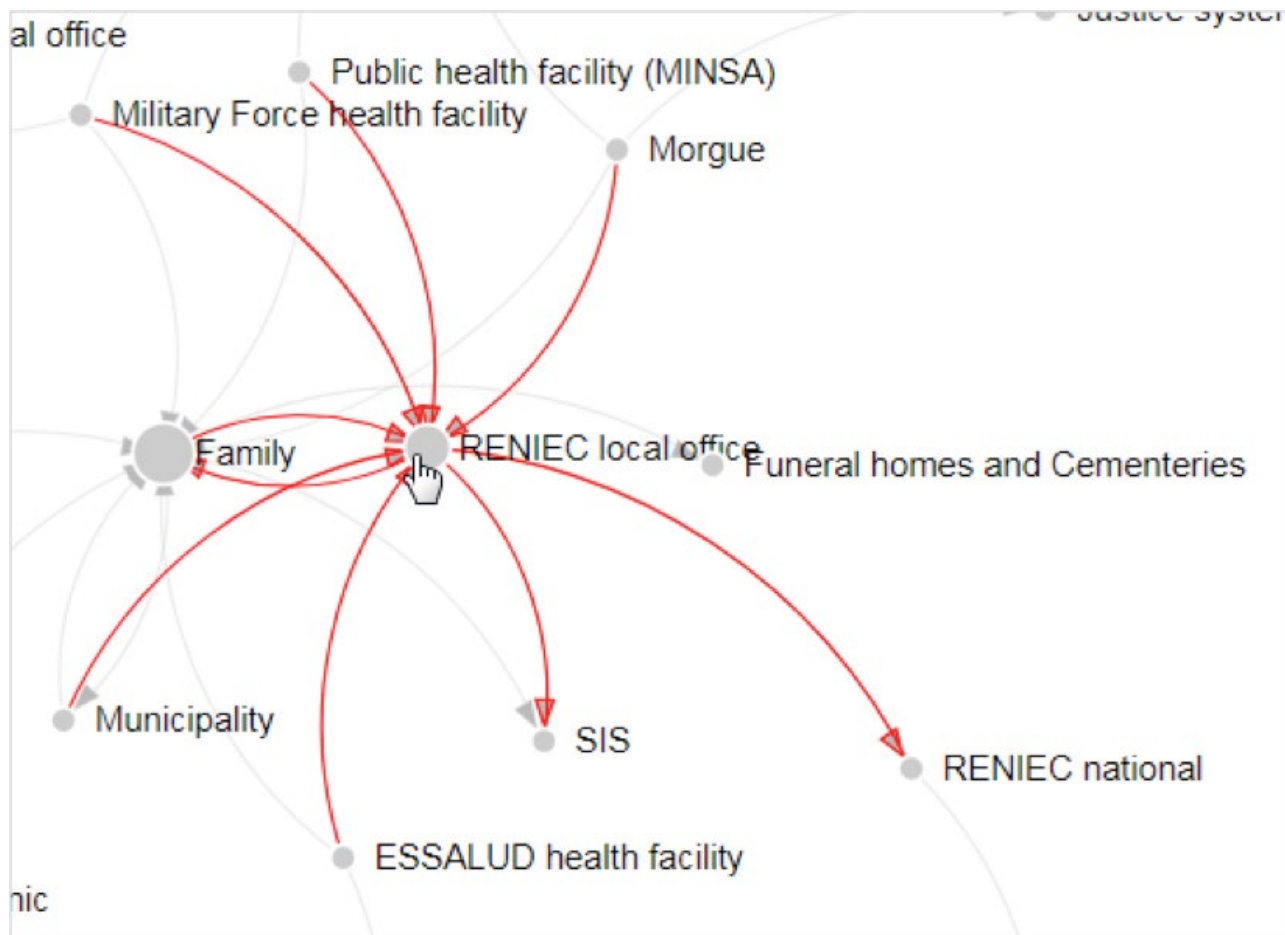


**Figure 2 Network connected to the Family in Peru**



The other hub in the system is the local office of RENIEC (civil registration authority). They receive information from all types of health facilities via the electronic system to medically certify deaths (SINADEF) and they push information to the Comprehensive Health Insurance (SIS) on behalf of the family of the deceased.

**Figure 3 Network connected to the local RENIEC office in Peru**



### Forms and data elements related to mortality

A total of 42 forms, reports and records were identified during data collection. Of them, 36 forms contained information at the individual level (for each death) and six were used to transmit or store aggregated information. Most of the forms were used at the health facility level (20) for the different sub-systems (public health facilities, EsSalud, military forces and private health facilities). In addition, multiple versions of the different forms (e.g. MCCD form) were used within the different institutions. 10 forms were used in the coroner system and six in the funeral and burial system.


Of the documents identified, 29 forms were in paper, six were digital and seven were accessible using both platforms. The documents identified were mostly used to transfer information of the deceased or to archive that information (17 to transfer information, 13 to archive and 8 served both purposes). Four forms were used for statistical purposes. More information about the different forms can be seen in **Table 2**.

The data elements captured by each form varied widely among them. From the 74 data elements predefined in the data collection tool (see data collection tool for more information) the maximum number of data elements captured was 32 (necropsy report) and the minimum number of data elements was two (laboratory test request form with full name of the deceased and place of certification of the COD; and the necropsy report with full name and the date of issuance). However, there were data elements originally not in the predefined list that were collected in some forms (see **Annex 2**).

**Table 2 Description and main features of each form, report or record in Peru**

Official name of the document	Institution responsible	Purpose	Who fills the form	Paper/ digital	Data quality measures
<b>Acta de entrega de cadaver sin necropsiar</b>	Institute of Forensic Medicine	Release of corpse form morgue	Admission's staff	Paper	No
<b>Acta de levantamiento de cadaver (fiscal)</b>	Prosecutor General Office	Initial investigation of the event	Coroner	Paper	No
<b>Admission report (Military force hospital)</b>	Military Force Hospital	Admission and discharge of the patient	Admission's staff	Paper	No
<b>Authorization of corpse removal</b>	MINSA, EsSalud and Military force hospital	Release of corpse from hospital	Emergency physicians	Paper	No
<b>Book of admission and discharge</b>	MINSA, Private clinic and Military force hospital	To know the admission and discharge of a person	Nurse or other health personal	Paper	No
<b>Book of perpetual burials</b>	Cemetery	Registry of the perpetual burial	Cemetery officer	Paper	No
<b>Book of temporary burials</b>	Cemetery	Registry of the temporary burial	Cemetery officer	Paper	No
<b>Burial order</b>	MINSA hospital	Release of corpse from hospital	Statistic's staff of the hospital	Paper	No
<b>Burial order (morgue)</b>	Institute of Forensic Medicine	Authorization for burial	Admission's staff	Paper	No
<b>Cemetery budget</b>	Cemetery	Cost of the burial	Cemetery officer	Paper and Digital	Double entry
<b>Clinical Necropsy report</b>	MINSA, EsSalud and Military force hospital	To know the cause of death	Pathologist	Paper and Digital	No
<b>Cold store request form</b>	Military Force Hospital	Store the corpse until removal	Mortuary's staff	Paper	No
<b>Corpse reception report</b>	Institute of Forensic Medicine	Information of the item of clothing of the corpse	Admission's staff	Paper	No
<b>Daily patient census</b>	Military Force Hospital	Daily information of patients in a service	Nurse	Paper	No
<b>Death Certificate (MCCD)</b>	MINSA	official certificate of death	Physician or other health professionals where there are no physicians	Paper and Digital	Yes
<b>Death registration document</b>	Municipality	Civil registration of the death	Municipality officer	Digital	Double entry
<b>Death registration list</b>	Municipality	Civil registration of the death	Municipality officer	Digital	Double entry
<b>Death report (EsSalud, Private clinic and Military force)</b>	EsSalud, Private clinic and Military force hospital	To take the corpse to mortuary	Nurse	Paper	No

Official name of the document	Institution responsible	Purpose	Who fills the form	Paper/ digital	Data quality measures
<b>Discharge report (Military force hospital)</b>	Military Force Hospital	Discharge report	Physician	Paper	No
<b>Donation of corpse form</b>	Institute of Forensic Medicine	Release of corpse form morgue	Admission's staff	Paper	No
<b>Medical record (epicrisis)</b>	All hospitals	Summary of the patient illness	Physician	Paper	No
<b>File of the deceased location</b>	Cemetery	File for an easier location of the deceased	Cemetery officer	Paper	No
<b>Funeral budget</b>	Funeral establishment	Cost of the funeral	Funeral officer	Paper and digital	Double entry
<b>Funeral establishment system</b>	Funeral establishment	Registry of the funeral	Funeral officer	Paper and Digital	Double entry
<b>Identification for corpse removal form</b>	Institute of Forensic Medicine	Release of corpse form morgue	Admission's staff	Paper	No
<b>INEI mortality report</b>	INEI	National mortality data	INEI officer	Digital	Double entry
<b>Informe de diligencia especial de levantamiento de cadaver</b>	Institute of Forensic Medicine	Initial investigation of the crime scene and corpse	Forensic Doctor	Paper	No
<b>Laboratory test request form</b>	Institute of Forensic Medicine	To know the cause of death	Forensic Doctor	Paper	No
<b>List of Death certificates - Archive (EsSalud)</b>	EsSalud hospital	Send copy of death certificates to archive	Admission's staff	Digital	No
<b>Medical-legal statement</b>	Institute of Forensic Medicine	To extend additional information of the corpse	Forensic Doctor	Paper	No
<b>Mortuary's book of death registration</b>	MINSA, Private clinic and EsSalud hospital	Admission and removal of a corpse	Mortuary's staff	Paper	No
<b>Necropsy certificate</b>	Institute of Forensic Medicine	Authorization for burial	Forensic Doctor	Paper	No
<b>Necropsy report</b>	Institute of Forensic Medicine	To know the cause of death	Forensic Doctor	Paper	No
<b>Online death registration system</b>	RENIEC	Civil registration of the death	RENIEC officer	Digital	Double entry
<b>Police report</b>	Police	Initial investigation of the event	Police	Paper	No
<b>Proof of corpse deposit (Military force hospital)</b>	Military Force Hospital	Admission of the corpse to the mortuary	Health professional	Paper	No
<b>Registration of death (EsSalud)</b>	EsSalud hospital	Signed by the family acknowledging the reception of the de death certificate	Admission's staff	Paper and Digital	Double entry



Official name of the document	Institution responsible	Purpose	Who fills the form	Paper/ digital	Data quality measures
<b>Registry of death (Epidemiologic and Statistic office- EsSalud)</b>	EsSalud hospital	Epidemiological report	Epidemiologist	Digital	Double entry
<b>Registry of death (Statistic book)</b>	MINSA and Military force hospital	Statistic report	Statistic's staff of the hospital	Paper	No
<b>Service's registry of death (EsSalud)</b>	EsSalud hospital	Statistic report of the service	Nurse	Paper	No
<b>Service's registry of death (MINSA)</b>	MINSA hospital	To deliver the clinic history to the economy's office	Nurse	Paper	No
<b>Single admission form</b>	SIS	Information of the patient for insurance system	Admission's staff, physicians, nurses, other health staff	Paper and digital	No

# Ghana

## Setting

The total estimated population in Ghana in 2017 was 28,956,587 according to the estimates of the Ghana Statistical Service (GSS) with half of the population living in urban areas. Administratively Ghana consists of 10 regions, which are further divided into a total of 216 districts (2017). Within each district, there is one or more local Birth and Death Registration (BDR) offices. A total of 426 functioning BDR offices are spread across the country. The health system in Ghana has a slightly different administrative structure. Health districts are divided into sub-districts, which consist of various Community-Based Health Planning and Service (CHPS) Zones.

Even though the law ensures that every birth, death or foetal death is registered, the current state of CRVS in Ghana is weak with only 65% of annual births and 23% of annual deaths registered. The low coverage is a consequence of a highly complex and bureaucratic CRVS design, inadequate legal framework, poor funding, scarce human resources, insufficient public information, inadequate physical access for rural communities, and high travel costs for the public to obtain birth and death certification. The onus of registration is placed on the family. Additionally, due to issues in system design, there is a lack of connection between civil registration and vital statistics, particularly concerning the cause of death. In 2014, Ghana completed a comprehensive CRVS assessment and the results of this assessment were translated into a national CRVS strategy.

### Field visit and activities in the country

As a first step to identify and map sources of mortality data, the stakeholders and users of mortality data were identified:

- Public hospitals from the Ministry of Health
- Teaching hospitals from the Ministry of Education
- Public mortuaries
- Military and police hospitals
- Private clinics
- Health posts and health centres
- Ghana Health Services
- Ghana Statistical Services
- Birth and Death Registration
- Police department
- Coroner
- Funeral homes
- Public Cemeteries
- Private Cemeteries
- Religious entities.

A few institutions were visited in Accra to review their information processes. In these visits we conducted interviews with personnel working in each of them, as well as collecting the documents and books used to register the deceased. Although most of the interviews were conducted in Accra, the team tried to capture the detail of processes outside urban areas based on their knowledge about the system. Most processes and the type of stakeholder identified during the data collection would be the same in urban and rural areas. Some sub-processes specific for rural areas might be missing from the processes described in this section. However, we do not expect them to account for a substantial number of deaths.

### Information architecture for mortality

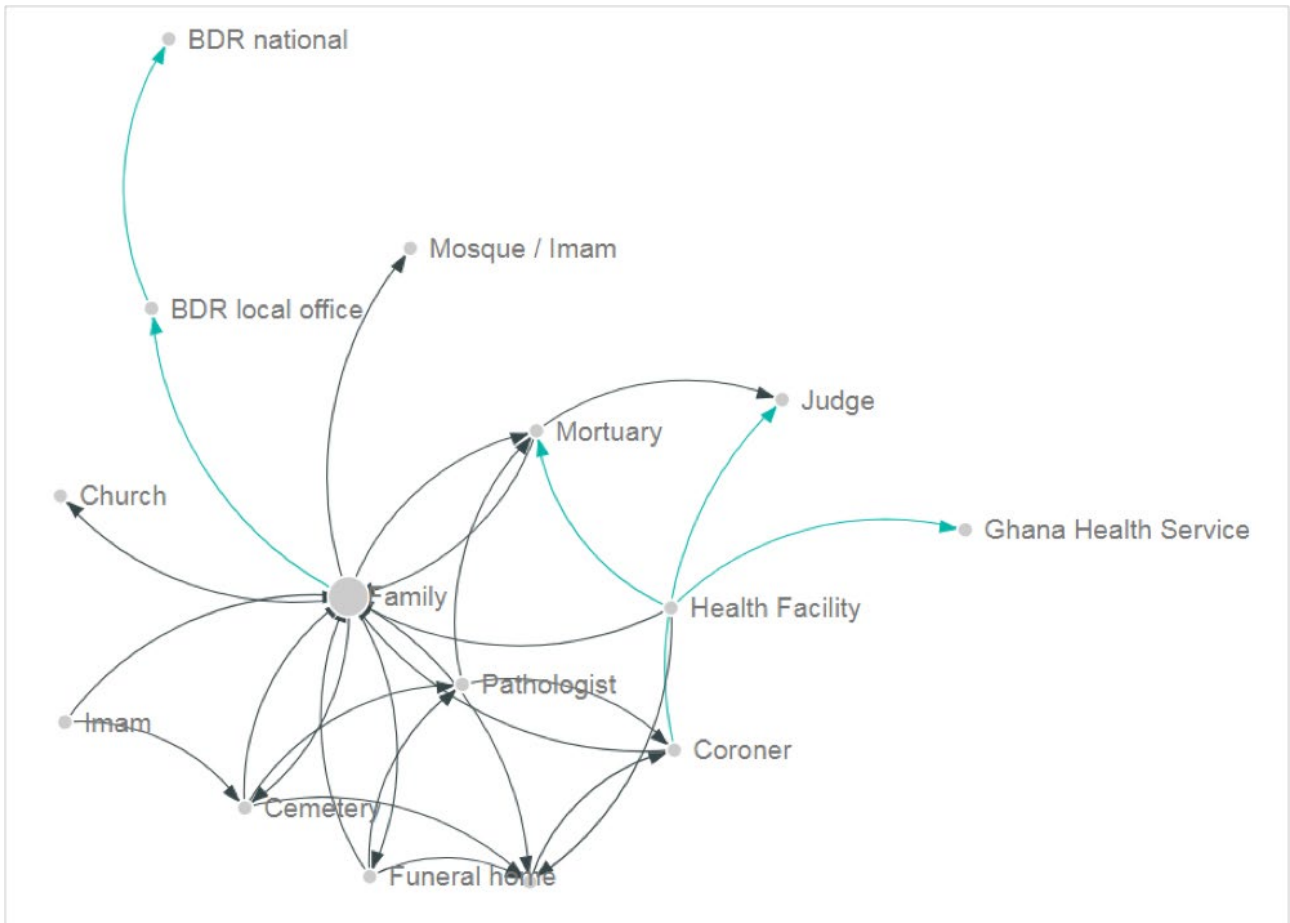
A total of 16 information subsystems were identified in Ghana. Of the subsystems, 13 were operating at the local level (primarily individual level data) and three at the national level (primarily aggregate information). **Table 3** provides a brief description of each sub-system. All subsystems are considered “pull systems” where the information must be requested by other instance.

The structure and linkages among the different information sources (**Figure 4**) shows that the family acts as the main hub that connects all the other information sub-systems. The family interacts with the health facility to get the MCCD form, with the police in case of external causes of death, with the mortuary until the burial, with the funeral home to organize the burial process, with the cemetery and, if they are religious, with the Imam or other churches (**Figure 5**).

**Table 3 Mortality information sub-systems in Ghana**

Name	Scope	Brief description
Family	Local	The beneficiary of the system
Health Facility	Local	Medical certification of the fact and cause of death (natural causes)
Police	Local	All deaths outside a health facility
Coroner	Local	All deaths outside a health facility
Mortuary	Local	Facility in national and regional hospitals where autopsies are conducted
Pathologist	Local	Scientist who studies the causes and effects of diseases
Funeral home	Local	Burial
Cemetery	Local	Burial
BDR local office	Local	Registration of the death
Mosque / Imam/ Church	Local	Burial
Ghana Health Services	National	Aggregated mortality statistics for all deaths in a health facility
Judge	National	All deaths outside the health facility
BDR national	National	Aggregated mortality statistics for all registered deaths

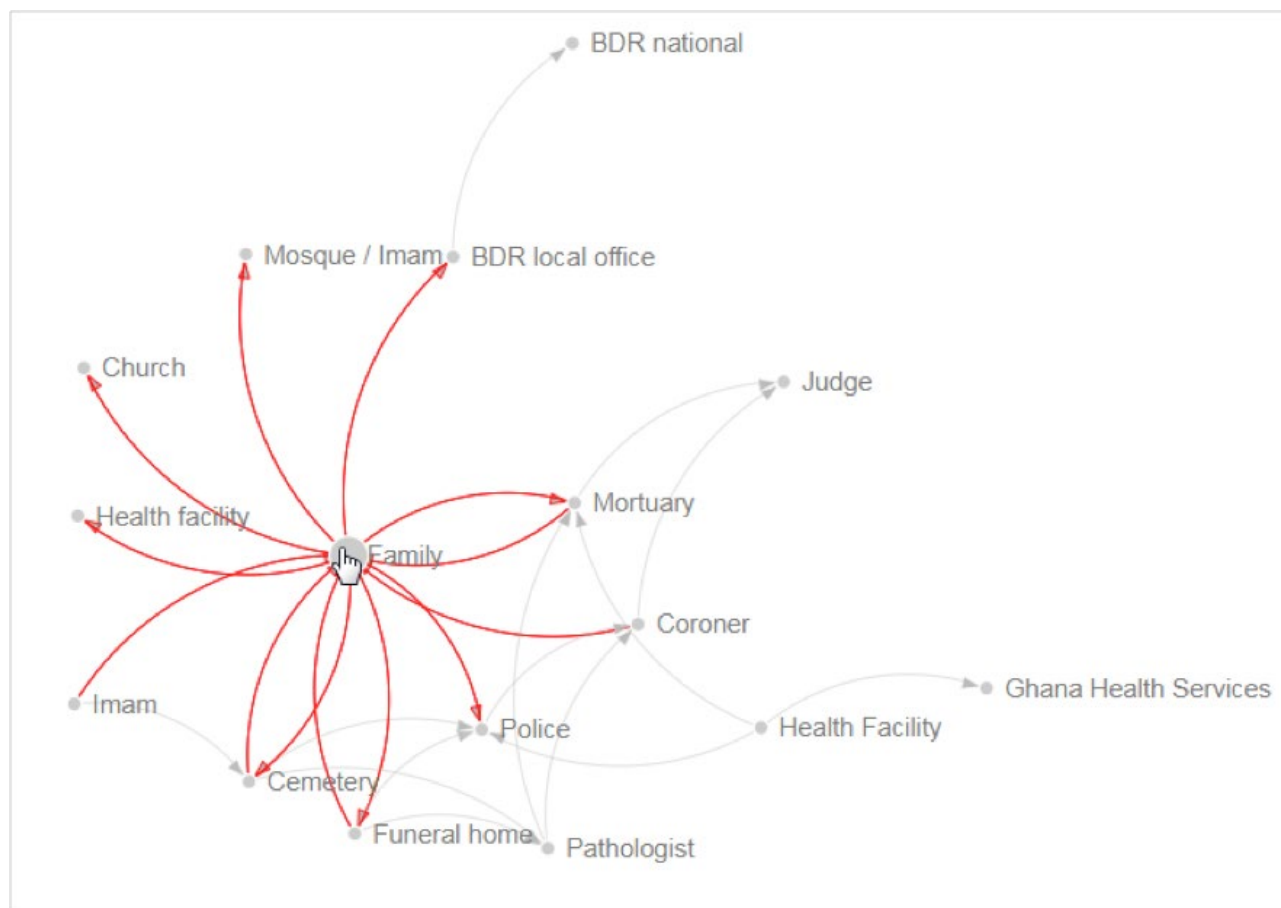
**Figure 4 Information architecture in Ghana**



There are a number of endpoints where the information is stored and not integrated (**Figure 6 and Figure 7**). The Ghana Health Service, the BDR national database and the judiciary systems are three silos of information where a fraction of the deaths is recorded. The BDR national database contains records of all registered deaths. Since not all deaths certified by physicians are registered, they do not have a complete register of all notified deaths. Conversely, the GHS has a record of all deaths occurring in public health facilities, but those deaths occurring in private health facilities or in the community are not recorded. Finally, the judiciary system only has information of deaths due to external causes. In summary, none of the databases are complete.

The degree of interaction at the local level (black arrows) is very high but with minimal integration of the information systems. One death could be recorded in at least seven different records with different information and none of the systems would capture that discrepancy. In addition to creating significant inefficiencies in the system, it is an open door for double counting, under counting, inaccuracies and fraud.

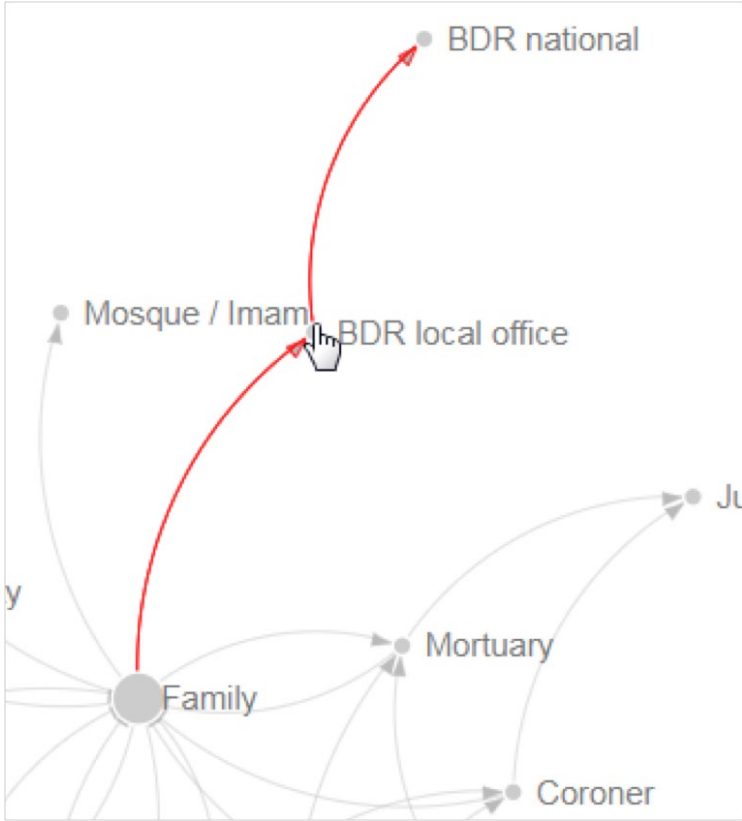
**Figure 5 Network connected to the Family in Ghana**







**Figure 6 Information sub-system for civil registration in Ghana**



**Figure 7. Information sub-system in the health sector in Ghana**





## Forms and data elements related to mortality

A total of 22 forms, reports and records were identified during the data collection. Of those, 20 forms contained information at the individual level (for each death) and two were used to transmit or store aggregated information. Six different forms were used in the funeral and burial system, another six at the health facility level, and five separate forms were used in the BDR system and the law enforcement system.

Of the documents identified, 17 forms were in paper, 4 were digital and 1 was accessible using both systems. The documents identified were mostly used to archive the information of the deceased (11) followed by forms used for transferring information and used for both purposes (5 and 6 respectively). More information about the different forms is in **Table 4**.

The data elements captured by each form varied widely among them. From the 74 data elements predefined in the data collection tool, the maximum number of data elements captured was 29 (MCCD form) and the minimum number of data elements was three (Waybill). However there were data elements originally not in the predefined list that were collected in some forms (see **Annex 3**).

**Table 5 Description and main features of each form, report and record in Ghana**

Official name of the document	Institution responsible	Purpose	Who fills the form	Paper/ digital	Data quality measures
<b>Registration book</b>	Funeral home	To keep records of bodies that are brought into the funeral home	The manager of the home	Paper	No
<b>Daily ward mortality form</b>	Hospital	To keep records of deaths that occurred in the facility and those brought in from else where	Nurse	Paper	No
<b>Patient folder (ridge)</b>	Hospital	To keep medical record of the patient of both in and out-patients	Nurse and physician	Paper	No
<b>MCCD form</b>	Hospital	It contains information on the cause of death of the deceased	Nurse and physician	Paper and digital	No
<b>Cemetery log book</b>	Local council	To keep records of all burials in the cemetery	The sexton	Paper	No
<b>Death report form</b>	Local council	To record details of deceased if Muslim, for BDR registration after burial	The relatives of the deceased	Paper	No
<b>Burial record</b>	Church	To keep records of all deaths that occur in the church	The priest	Paper	No
<b>Registration form (private cemetery)</b>	Private cemetery	To obtain information about the deceased and their relatives	Relative of the deceased	Digital	No
<b>Registration book (Korlebu)</b>	Mortuary Korlebu teaching hospital	Registration of bodies in the mortuary	The manager of the mortuary	Digital	No
<b>Personal body receipt note</b>	Mortuary korlebu teaching hospital	Registration and identification of bodies in the mortuary	The manager of the mortuary	Paper	No
<b>Way bill</b>	Mortuary korlebu teaching hospital	Record bodies that leave the mortuary and its destination	The manager of the mortuary	Paper	No
<b>Patient folder (Korlebu)</b>	Korlebu teaching hospital	It contains information about the deceased including medical record of the patient and the treatment received prior to death	Nurse and physician	Paper	No
<b>Informal registration book</b>	Muslim community	To record all deaths in the Muslim community	The imam	Paper	No



<b>Official name of the document</b>	<b>Institution responsible</b>	<b>Purpose</b>	<b>Who fills the form</b>	<b>Paper/ digital</b>	<b>Data quality measures</b>
<b>Inquest form</b>	Police national	To record all information about coroner's case	Coroner	Paper	No
<b>Autopsy report</b>	Funeral home, mortuary	To record details of COD	Pathologist	Paper	No
<b>BDR statistical report</b>	BDR	Report the number of births and deaths in each BDR local office	BDR officer	Paper	No
<b>DHIS2 statistical form</b>	GHS	Report the number of births and deaths in each health facility	Data clerk	Digital	No
<b>Registration book</b>	BDR	Record the details of the deceased	BDR officer	Paper	No
<b>Death certificate (simple copy)</b>	BDR	Record the details of the deceased	BDR officer	Paper	No
<b>Death certificate (Certified copy)</b>	BDR	Record the details of the deceased	BDR officer (national level)	Paper	No
<b>Form B</b>	BDR	Record the details of the deceased	BDR officer	Paper	No
<b>SMoL module DHIS2</b>	GHS	Record the details of the deceased	Physician	Digital	No



## Conclusions

- These country case studies (one from a relatively well performing CRVS and one from a much weaker CRVS) both show a **high degree of fragmentation in their information architecture** with several silos of information representing the parallel work streams of the different institutions involved in the system; It is likely that such realities prevail across CRVS systems in many low and middle-income countries;
- The **process is highly dependent on the family of the deceased to transfer the information** from one institution to the next one in the process. Even in systems like the Peruvian where the two main systems are digital and already sharing some information, the family still needs to go in person for the process to continue; There are ways that this weakness can be mitigated.
- **There are multiple local actors that are not part of standard CRVS processes as we understand them globally.** Cemeteries, religious leaders or funeral homes play a crucial role in fulfilling the requirements of the system. However, their only interaction with the system in both countries is through the family. This, in addition to being inefficient and posing a high burden on the family, opens the door for fraud and prevents some deaths from being registered.
- Given that both CRVS systems are digitized early in the process for most institutions involved, **technology is not a limitation to integrate the several parallel information sub-systems.** It is probably a matter of creating the appropriate institutional data sharing agreements and redesigning the underlying system processes to better accommodate the different information sources;
- None of the different sub-systems identified in this study contained a complete picture of mortality in the country. Each sub-system records a different population group. Some deaths will be recorded in all sub systems, some deaths in just a number of systems and some deaths in none of them. It is clear from this analysis that **integrating the different information sub-systems would increase death registration completeness.**
- A first step in moving to a more integrated, efficient and complete mortality registration system would involve using these process mappings to illuminate the fragmentation and opportunities across all the stakeholders responsible for the various silos, and continue the practice of harmonizing processes across stakeholders.
- These studies emphasize the challenge of developing omnibus CRVS implementation software such as OpenCRVS. Efforts to develop OpenCRVS could assist greater rationalization and use of the best mortality data sources.



# Annex 1. Methodology

## Goal and Objectives

The goal of this study was to map existing sub-systems where information about the fact or the cause of death (COD) is being captured (e.g. DHIS2, cemetery records, police records, village records), their information architecture, and the core processes of these systems.

The specific objectives were:

1. To identify all information systems and sub-systems where information about the fact and the COD is recorded and/or transmitted.
2. To collect graphical information of the different records and reports used (pictures of registers, burial permits).
3. To map all stakeholders that have access to the different sources of information and the rules to access the information.

## Overall methodological approach

This was a descriptive cross-sectional study to catalogue all mortality information sources nationally. Data was collected from the different levels of the government and private institutions to describe the number of information sub-systems collecting mortality data and to understand the information requirements in each system. A document review of the existing literature about mortality information sources in Peru and Ghana was conducted including papers written in Spanish and English. The study also included creating process maps of all information sub-systems with mortality data to identify duplicities, bottlenecks and potential new sources of information.

## Data collection

The objectives of the data collection were to map all the systems and institutions that recorded any information about a death event (e.g. hospital records, police, civil registration...); to document all the forms, reports and records use in that system to capture information about the deceased; and to list all the data elements (e.g. name, age, sex, cause of death...) included in each of the forms. Data was obtained through document review and a series of key informant interviews and contacts with officials at different levels of the government from facilities to national level stakeholders.

The information was collected in both countries using a standard data collection tool in Microsoft Excel®.developed for this purpose. Three main blocks of information was collected in each country:

1. **Map of information sub-system:** Describes the design of the different sub-systems related to mortality. It includes a general description section, a stakeholder's section to fill with information about stakeholders that are directly involved in the sub-system and a dependencies section, in which other systems that depend on this one are described. These other sub-systems use the information of the main system but are not directly connected with it, as they usually obtain information through an intermediary (such as the family).
2. **Document forms:** Designed to collect information about the documents and forms used in the different sub-systems. Each form that is listed in the "Information sub-system" tab is described here in detail and following information given: General description (official name, institution responsible, etc.), Information flow related to the form (who fills in the form, where does it go to, etc.) and Technology (paper, electronic and if this is a push or pull system).
3. **List of data elements:** Records information about all data elements included in each form (e.g. name, sex, age, place of death...)



## Data Analysis

Several visualization tools were used to synthesize and systematically display the information collected in Ghana and Peru. First, Bizagi Modeller was used to visualize the flow of activities and stakeholders involved throughout the entire system. All sub-systems were included in a single country-specific map where all stakeholders and their interconnections were displayed.

In a second step, information about the links and flows of information of the different databases were represented in an adaptation of the diagrams used in Social Network Analysis to visualize. A custom visualization in Power BI named "Force-directed graph"<sup>4</sup> was used to create the diagrams. In this type of graph, the different entities (information sub-systems in our case) are displayed as nodes (circles). The arrows represent the direct exchange of information between two entities showing the direction of the exchange.

The analysis of the two types of visualizations was focused of understanding the degree of integration of the different information subsystems and the flow of information related to a death event.

<sup>4</sup> Available here: <https://appsource.microsoft.com/en-us/product/power-bi-visuals/WA104380764?src=office>



## Annex 2. Peru: detailed mapping and tables

### Description of the mortality information sub-systems in Peru

#### Death certification in MINSAs hospital

When a patient dies in a public hospital run by the Ministry of Health, two options are possible. If the patient dies within 24 hours of entering the hospital and it was not a previous patient, then the physician informs the police department in order to bring the deceased to the morgue and conduct an autopsy. If the patient dies after 24 hours of being admitted, then the physician issues the MCCD. If the hospital has internet, then this certificate is filled in online (SINADEF), but otherwise on paper. The same physician must fill the medical record (Epicrisis) and sign the single admission form (FUA) in which it will indicate the date and time of death, the name of the physician that certified the death, the nurse that assisted the physician, as well as the name of the auxiliary nurse that will bring the body to the mortuary.

The nurse fills in the admission and discharge book with the details of the cause of death. The auxiliary nurse brings the body to the mortuary together with the Registry of death form. The nurse will also bring the medical record of the patient which will contain the medical record (Epicrisis), the death certificate and the FUA to the SIS. The SIS is then responsible to verify that everything is included in the SIS database and the documents are consistent. The family then receives the death certificate. The auxiliary nurse will go to the emergency ward and let the head sign the authorization for corpse removal.

If the physician doesn't know the COD, they may request an autopsy. If the family agrees, the pathologist will conduct an autopsy and fill in the autopsy report. Once the autopsy report is completed, the statistics staff will bring the corpse removal order to the mortuary and fill in the registry of death book.

The family must bring the death certificate to the mortuary in order to remove the corpse. The mortuary's staff fills the mortuary death registration book and gives the family the burial order and authorization of corpse removal.

The death certificate is the most important document of all the above mentioned as the family will use this to register the death in the RENIEC offices.

#### Death certification ESSALUD hospital

When a patient dies in the hospital run by ESSALUD, the process is very similar to the one in hospitals run by MINSAs. The only difference is after the autopsy report is issued after the autopsy is conducted. Following this, the epidemiology staff from the hospital will revise the COD together with the medical records of the patient to verify the correctness of the COD and enters this into the Hospital registry of death system.

#### Death certification in military and police hospitals

When a patient dies in a military or police hospital, the process is very similar to the one in hospitals run by MINSAs. Additionally, the physician will fill in the date and COD in the admission report and the nurse will fill in the death report, the daily patient census and the proof of corpse deposit.

If no autopsy is needed, then the family will have to go to the mortuary where they will receive the inquiry form to use the fridge and will proceed to pay for this. In order to remove the body the mortuary's staff will give the family the authorization of corpse removal and the death certificate.

#### Death certification in a private clinic

The death certification process in a private clinic is also very similar to the MINSAs process. In this case the only difference is that after the auxiliary nurse brings the body to the mortuary, the documentation will be brought to the billing office. The office will then say the price to the family who will pay and then receive the MCCD.

#### Death certification in the institute for legal medicine

When a person dies due to an external COD, within 24h since being admitted in a hospital or if the physician cannot assign a COD, the police are informed. The police will write all the facts in the police report and inform the attorney and the coroner in the judiciary system. When the attorney finishes their investigation, they fill in the corpse removal certificate and the medical examiner the special report of corpse removal. With these two documents the police bring the body to the morgue.



The admission officer in the morgue fills the corpse reception report. If the death was due to natural cause and the family reports to have a family physician, then the coroner indicates that it's not necessary to conduct an autopsy and will give the approval for an autopsy exemption. This document will be given to the family.

If an autopsy is required, then the admissions officer will enter the deceased data in the FORENSIS electronic system and the pathologist will conduct the autopsy. They will fill in the autopsy report; the request for additional examinations and depending on internet availability, the death certificate will be entered directly into SINADEF or handed in paper.

The autopsy report is then sent to the coroner who will revise and if additional data is needed. They will request a medical-legal report that will be provided by the coroner. The autopsy report is the key document for the judiciary process that will continue after.

The family will pick up the body from the morgue and will get the burial receipt, the receipt for body identification, the death certificate and the autopsy certificate, that will allow them to retire the body.

If the deceased doesn't have a family, some universities will request the body for investigation. In those cases, they will fill in the request for body donation and the university gets the body.

### **Death registration in RENIEC**

If the death is due to a natural cause, the family can register in an auxiliary office (ORA) which are located in some hospitals or the family can go to the RENIEC local office (in urban areas). The family or anyone with ID must bring the deceased ID and death certificate to these offices. If the deceased ID is lost, it is necessary to fill in an ID loss report. The registrar will fill the details in the system online and print a copy that the family and the registrar itself will sign.

If the death is due to an external cause, then the process is the same as above but also the police can trigger the registration process by providing all relevant information to RENIEC. For this latter case, it is necessary to provide the number of the police report.

The registrar will send the documents to the regional civil registration office (subgerencia de registros civiles), where the documents will be scanned in the system. Then the (oficina de depuración) will change in the system the status of the deceased to deceased.

The death certificate given by RENIEC is the most important legal document as it is necessary for burial, insurance payments, and to transfer the title of the properties of the deceased.

### **Burial of corpse**

The burial can be organized directly by the family or by a funeral home. The funeral home will need the MCCD and the autopsy report (in the case of external COD). It will provide a budget for the family and this will include the registration with RENIEC and the coordination with the cemetery for date and time of burial.

Then the family does the administration by themselves. They will need to go to RENIEC with the MCCD and with the death certificate arrange with the cemetery the burial details.

The cemetery has two ways of burial (1) perpetual and (2) temporary, in which the buried body can stay up to 10 years. After this time the family must remove the body and bring it to another cemetery, cremate it or pay for an additional period.

If the cemetery is in an urban area, staff will record the burial in the cemetery log book and indicate what kind of burial will take place. If instead, it is a rural cemetery, then there will be no such record. These cemeteries are open and often families bury without coordination or payment for the burial.

### **Death notification to OGTI-MINSA**

When the physician certifies the death in a health facility or at home, if there is internet, this will be done online, otherwise in paper.

If there are data clerks at the health facility there are two different pathways: (1) the physician gives the complete report to the family and this brings it to RENIEC or to the municipality to register the death and the registrar sends then the report to the DIRESA where the statistical report will be entered into SINADEF or (2) the physician sends the statistical report directly to the DIRESA where it will be entered into SINADEF.



Finally, the staff in the OGTI office from MINSA will verify that all deaths are entered into SINADEF.

### INEI's mortality report

INEI sends a yearly request to MINSA and RENIEC to get their mortality data. MINSA sends the database with a courier in CD format. RENIEC sends this in an excel file containing date of registration, type of registration, sex, age and district.

INEI evaluates the consistency of this data and if something arises it sends it back to RENIEC or MINSA. Once the data is clean INEI publishes a mortality report on its webpage.

### Death certification in a rural area

When someone dies in a rural area at home, the family brings the deceased to the nearest health facility (health post or health centre). This facility may or may not have a physician. The process will be the same as in an urban area but if no physician is present the death certificate will be filled in by another healthcare provider.

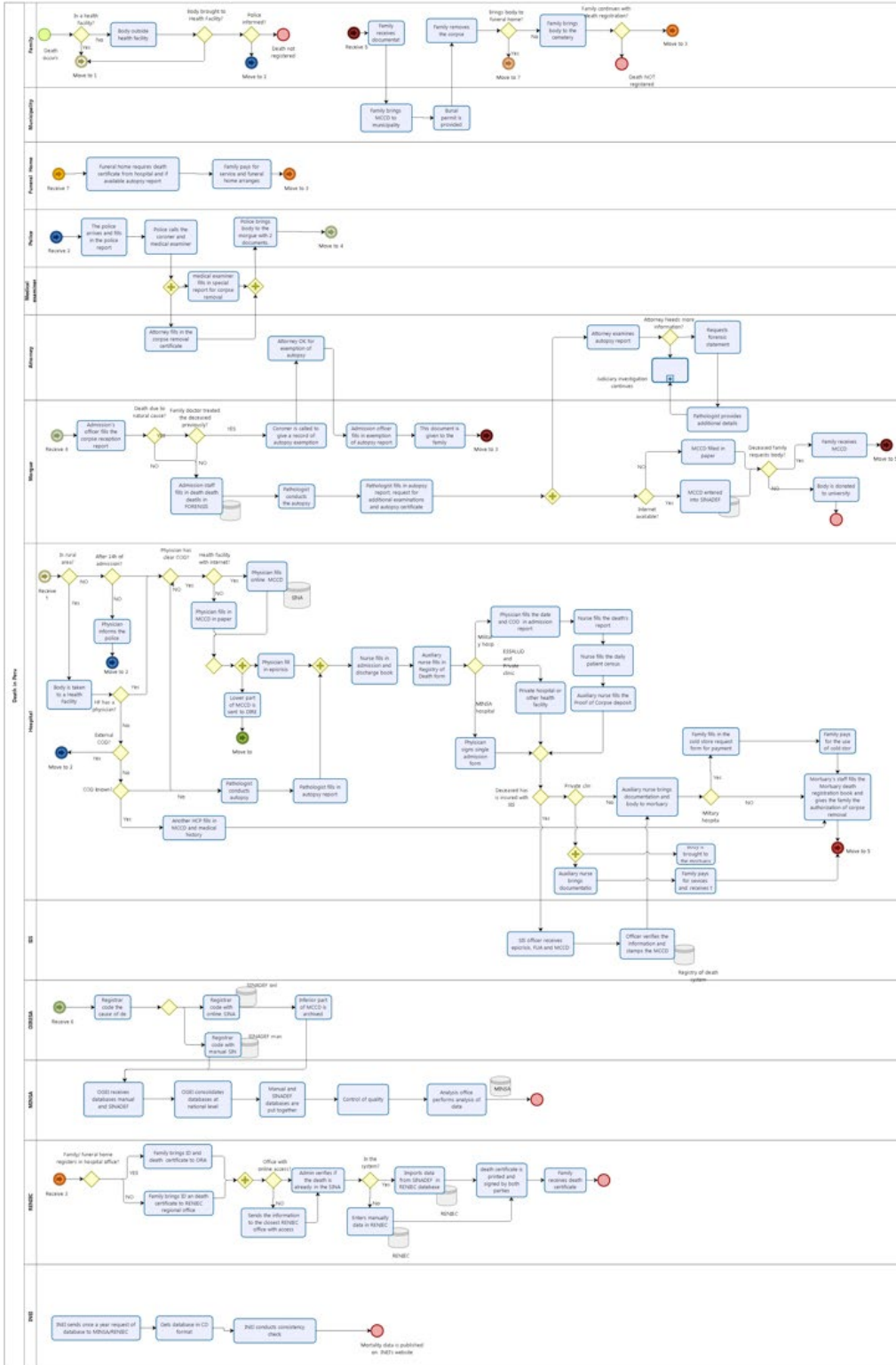
### Death registration in the municipality of a rural area

In rural areas, the registration of death occurs in the municipality of the locality. The process in this office will be the same as in the urban area for registering the death. In this case, though, the information will be sent in a monthly base to the closest RENIEC office.

**Table 6 Data elements not included in the standard list and recorded in the different forms in Peru**

1	Bed number	28	Address of the family	48	Description of the examination of the body
2	Conclusions	29	Name of police officer	49	Description of the examination of the corpse
3	List of cost	30	Ward number (hospital)	50	Name and ID of the family that removes the corpse
4	Registry date	31	Type of organ donation	51	Information on the item of clothing of the corpse
5	Time of burial	32	Cemetery phone number	52	Name and ID of the representative of the institution
6	Receipt number	33	Judicial file ID number	53	Id and signature of the person who receives the corpse
7	Type of client	34	Type of funeral product	54	Name of the person who takes the corpse to the mortuary
8	Exams requested	35	Signature of the family	55	Description and cost of what it is needed for the funeral
9	Sector of burial	36	Statistician's signature	56	Date of perpetuation or exhumation or transfer or cremation
10	Nurse's signature	37	Death certificate number	57	ID and Signature of the person who takes the corpse to mortuary
11	Necropsy findings	38	Cost of the cold storage	58	Name and signature of the person who receives the corpse in the mortuary
12	Name of informant	39	Necropsy report ID number	59	Name and signature of the person who removes the corpse from the hospital
13	Name of the nurse	40	Address of the institution		
14	Informant's email	41	Emergency physician's signature		
15	Treatment received	42	Name and address of the cemetery		
16	Other observations	43	Description and cost of the burial		
17	Funeral house name	44	Institution that removes the corpse		
18	Insurance ID number	45	Garden and number of the burial place		
19	Informant's address	46	Service where the patient was admitted		
20	Summary of the case	47	Summary of symptoms and signs of illness		
21	Informant's address				
22	Laboratory findings				
23	Pathological history				
24	ID of police officer				
25	Physical examination				
26	Degree of dependence				
27	Police request number				

Figure 8 Process map for non-standard information systems capturing mortality in Peru





## Annex 3. Ghana: detailed mapping and tables

### Description of the mortality information sub-system

#### Death certification in public hospital

When a death occurs in the hospital emergency ward, it is recorded in paper in the daily ward mortality form and in the patient folder, which contains the medical history of the patient.

If the death occurred after 24 hours since admission, the physician who last attended the patient will issue the MCCD. The MCCD will be filled in paper and the physician will also enter this information into DHIS2 using the SMoL module (exception teaching hospitals). The body is then transported to the hospital's mortuary together with all documentation. The family will collect then the MCCD to start the death registration process at BDR. Once the death is registered, the body is given to the family that continues with the burial process. Death certification in Death Accident and Emergency Centre.

Deaths that occur to people that have been admitted for more than 48 hours are certified by the physicians and then taken to the main mortuary with all the necessary documents including the MCCD. The patient folder goes with the body, but it is never returned to the ward. This folder exists only in paper, therefore when it is taken to the mortuary the centre doesn't have any copy of the deaths that occurred in it. **Ideally, the patient folder should return from the mortuary to the emergency centre but this doesn't happen.**

Deaths that occur within 24-48 hours of admission are sent to the mortuary at the Accident and Emergency centre, the case is referred to police, and the coroner begins an investigation to ascertain the cause of death. When the investigation is complete the body is then sent to the main morgue after the cause of death has been ascertained and documentation is given to the relatives to initiate the death registration process.

In some cases, in which the person died within 24 hours since admission, but where some laboratory tests were performed, the physician may be able to issue a MCCD.

#### Death certification for coroner cases

There are at least four scenarios in which the police should be informed and a forensic investigation to identify the COD must be conducted:

- deaths that occur within 24 hours since admission;
- cases brought in dead to a health facility;
- deaths not certified by a physician (usually deaths outside health facilities); and
- deaths due to an external (unnatural) cause

The police will go to where the body is placed and will fill in a police report. If the body is outside a health facility, a coroner will be called and the body will be moved to the mortuary. If the body is in the hospital, the police will take all the hospital records available for the investigation.

The police start a coroner's inquest and fill in the coroner's inquest form on paper with all the information around the death. When the body arrives to the mortuary it will be recorded in the mortuary's logbook and an autopsy will then be performed to ascertain the cause of death. In some cases, the family may reject to conduct an autopsy and the family has the option to go to the judge being in charge of the case and ask for an autopsy exemption. The judge will then ask the family for their reasons and try to ascertain the COD based on this story. If the judge decides that no autopsy is needed, they will write the COD in the coroner's report. If instead, an autopsy is required, the pathologist will conduct the autopsy as usual. The pathologist will fill in the autopsy report with a detailed description which will be then included in the coroner's report. The coroner will bring this report once finalized to the judge to review and stamp. The coroner as well will pick this up and bring it to the family, who will be able to bring this report to BDR to continue with death registration.

### Death registration in public mortuary

The public mortuary usually manages the administrative process of deaths (1) from a body that has died in a health facility after 24 hours of admission but the COD is not clear, (2) a body that was brought in dead or (3) a body that died in the health facility within 24 since admission. The mortuary staff will record all deaths in the mortuary logbook and in an electronic system. This electronic system will create new unique identification numbers to enhance easy identification of the bodies by the family, but the number of medical history is not added or linked with this. If the death occurred in the health facility and bodies come with MCCD, the bodies will be embalmed and documentation will be given to the family for death registration.

Those that come from outside the health facility where the causes of death are not known become a coroner's case and as such referred to the police and subsequently to a coroner for investigation to ascertain the cause of death. The coroner asks for an autopsy, which is conducted at the mortuary. When this is complete the report is given to the police while body is embalmed and put in the morgue. No copy of this documentation is stored at the mortuary.

Bodies are then usually released only with a burial permit, but this is not always possible as some families don't know at this stage where they want to bury the body. The body is released with a way bill which includes the name of the deceased, the destination of the body. It is given to whoever takes the body and a copy is kept at the entrance of the mortuary.

### Death recording in a private funeral home

The funeral home usually receives bodies delivered directly by the families and preserves them for at least a month or more before burial. Deceased who are brought into the home are physically examined. If the deceased passed away in a health facility, the MCCD is demanded before the body is accepted into the morgue of the funeral home. If the death occurred outside the health facility the relatives are asked to go to the police and bring a coroner's report before the body is accepted. The death is recorded in the registration book based on the information provided by the family and the official documents. Bodies are usually released when the family provides a burial permit, but this is not always the case, as many families transport the bodies to other funeral homes without knowing where the body will be buried.

### Burial of corpse in the public system

The council is responsible for two public cemeteries in Accra: Awudome and Osu cemeteries. Usually, families should contact the manager of the cemetery in order to get assigned a grave and to pay for this service.

The family brings the burial permit received from BDR to the council for inspection after which a grave is assigned for burial. All payments for the grave are made at the council. Once paid, the family is directed to the sexton<sup>5</sup> to get assigned a grave and to arrange the practicalities of the burial.

The family will have to bring the burial permit and the sexton will record the information about the deceased in the cemetery logbook. The burial permits will be archived in the cemetery. These should usually be sent to the city's archive, but this hasn't been done for over 10 years. This process applies for non-Muslim citizens. For Muslim citizens refer to 4.2.5.9.

In situations where the deceased are not identified, a mass burial is organized by the council to bury all the bodies together. The council then seeks the registration of these deaths at BDR.

Another scenario is for deaths due to a contagious infectious condition. In these cases, the family is not allowed to do anything related with the burial and the council or sexton will fulfil all the administrative requirements related to the burial and registration of the death.

### Burial of corpse private system

Private cemeteries have a similar system as public ones. These are however better organized and don't accept any body without a burial permit. The main religion of the bodies that are so buried is Christianity. When the family brings the body with a burial permit, the administration will allocate a grave with a grave number and record all details in the electronic record system. Some copies of the burial permits are archived here in paper.

<sup>5</sup> A sexton is an officer of a church, congregation, or synagogue charged with the maintenance of its buildings and/or the surrounding graveyard



### **Death record in Orthodox Church**

The church has an official burial register in which deaths that occur within the church constituents are recorded. The information collected includes; name, age, date of birth, cause of death etc. The church also insists on burial permit before they bury any death, but they do not keep copies. Every member of the church has a class leader and this person is responsible for informing the church about deaths that occur in the church.

### **Death certification for Muslim citizens**

Muslim citizens are required to bury their bodies within 24 hours of death. It is therefore challenging to go through the usual BDR process for obtaining burial permit.

If the death occurs in a health facility, the process will be as described above but if the death occurs in the community the family will contact the religious leader first. This religious leader will then briefly talk to the family and decide if it was a natural COD. If the religious leader does not suspect any external cause of death, the imam or the family will contact the cemetery to organize burial (usually within 4 hours).

Some mosques will have at this stage a logbook in which the death will be recorded, but this is not common practice.

For Muslim citizens, the cemetery has developed an expedited process in order to facilitate burial as quickly as possible. The imam will contact the sexton and will be asked to fill in the death report form with the details of the deceased. The sexton will then decide if he thinks it was a natural COD or not. In case it was not it will call the police and a coroner case will be started, if the sexton thinks it was a natural COD, a grave will be assigned and the body will be buried.

The sexton will then advise the family to retrospectively register the death and obtain a death certification. In order to do so, a pathologist can be called that will conduct an autopsy and issue an autopsy report without seeing the body. This report will then be given to the family who will be able to obtain a death certificate with this.

### **Birth and Death Registration**

The family is responsible to go to BDR for death registration and certification. This can be done after it receives the copy from the MCCD from a health facility or with the coroner's report in case the death occurred before 24 hours of hospital admission or if it was due to external COD.

The BDR officer fills then a notification form (Form A for births and Form B for deaths). The information is then transferred to a registration book (paper) and a certificate is issued to the family. The notification forms are then sent to the District and Regional BDR offices where they are scanned and transcribed to an electronic system. This database is then used by the national office of BDR as a proof to issue "certified copies" of vital events and to generate some indicators. This information is not transferred to the Ghana Statistical Service and the vital statistics of the country are not generated based on civil registration data.

### **Ghana Health Services**

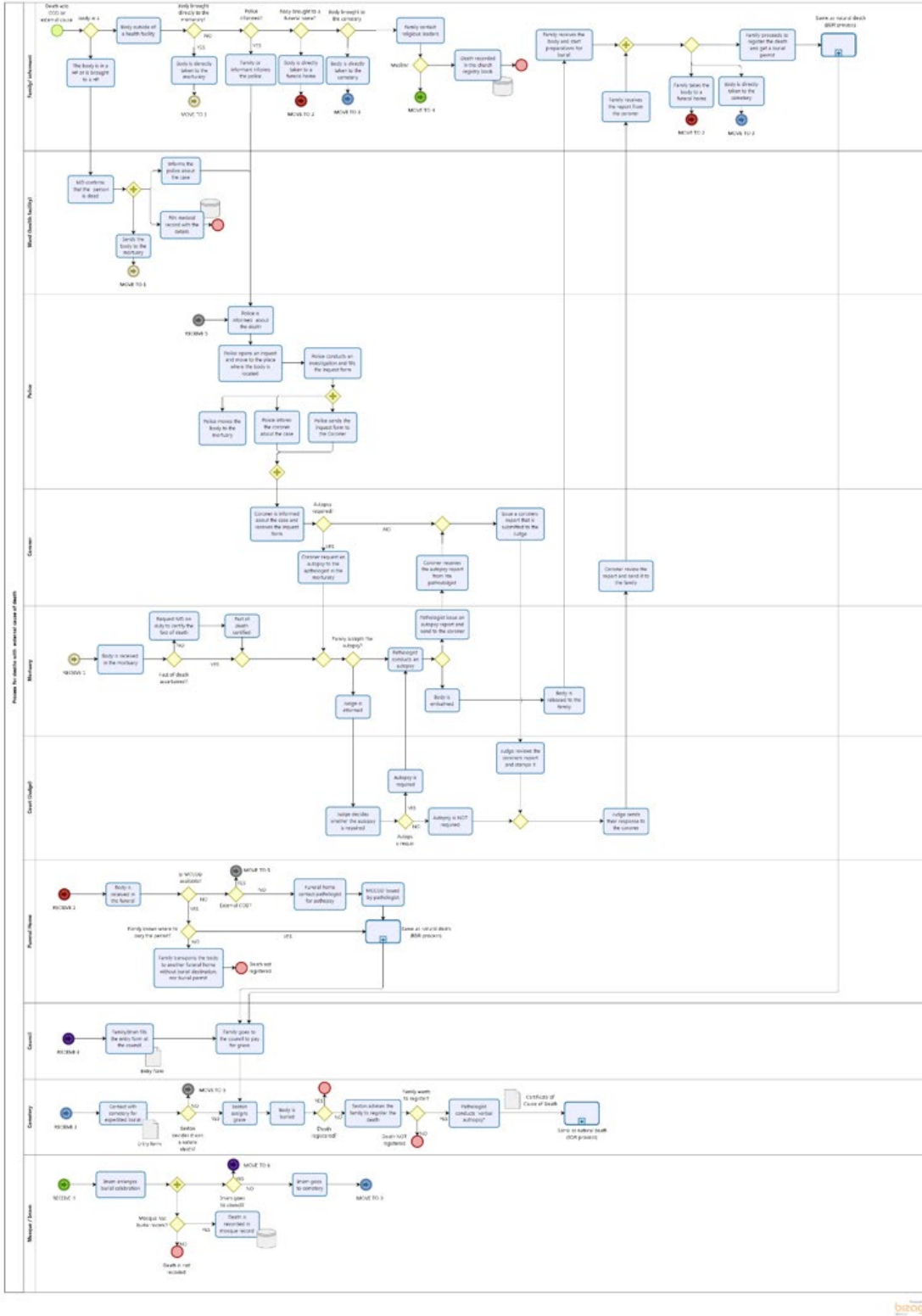
At the national level, the GHS compiles the information from the different facilities and generate mortality statistics coming from death occurred in health facilities.



**Table 6 Data elements not included in the standard list and recorded in the different forms in Ghana**

1	Where the body came from	13	Surgery performed?
2	Destination of the body	14	Date of surgery
3	Information about deceased circumstances	15	Reason for surgery
4	Informant relationship	16	If external cause or poisoning, specify date of injury
5	Informant residential address	17	How external cause occurred
6	Mother's age	18	Place of occurrence of external cause
7	Mother's education level	19	If death perinatal, state conditions of mother that affected foetus
8	Mother's occupation	20	Time from pregnancy
9	Father's age	21	Pregnancy contributed to death?
10	Father's education level	22	ICD-10 SMoL
11	Father's occupation	23	Late registration
12	Patient number		

Figure 10. Process map for non-standard information systems capturing mortality in Ghana





## Related resources and products

### University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Library [crvsgateway.info/library](http://crvsgateway.info/library)

*Peru: An exceptional example of CRVS system advancement.* CRVS country perspectives.

*Fellowship profile: Assessing the impact of death certification interventions in Peru.* CRVS country perspectives.

*Fellowship report: Implementing verbal autopsy in Ghana.* CRVS country perspectives.

*Strengthening Perú's national death registry information system.* CRVS summaries.

*Ghana: Developing a CRVS-VA management dashboard.* CRVS summaries.

*Action guide on process mapping for CRVS system-strengthening.* CRVS action guides.

*Enhancing CRVS system performance through effective legislation.* CRVS development series.

*Improving registration: Best practice guidelines.* CRVS summaries.

*Intervention: Improving CRVS system design.* CRVS summaries.

*Intervention: Improving registration practices.* CRVS summaries.

### University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Learning Centre [crvsgateway.info/learningcentre](http://crvsgateway.info/learningcentre)

Topic 1: Introduction to CRVS.

Topic 2: CRVS governance and architecture.

Topic 3: CRVS processes.

Topic 6: CRVS tools – CRVS system assessment tools; Legal review tools; Process mapping.

### University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Courses [crvsgateway.info/courses](http://crvsgateway.info/courses)

Enterprise architecture/business process mapping for countries.

## Further reading

Africa Programme for Accelerated Improvement of Civil Registration and Vital Statistics (APAI CRVS). *CRVS digitisation guidebook*. Available at <http://www.crvs-dgb.org/en/> (accessed 3 January 2018).

Cobos Muñoz D, AbouZahr C, de Savigny D. The 'Ten CRVS Milestones' framework for understanding Civil Registration and Vital Statistics systems. *BMJ Global Health* 2018; 3:e000673.

Cobos Muñoz D, de Savigny D. Process mapping and modelling: a tool for visualizing system processes from end-to-end. In: de Savigny D, Blanchet K & Adam T (eds). *Applied systems thinking for health systems research*. Maidenhead, UK: Open University Press; 2017.

Owen M, Raj J. BPMN and business process management: Introduction to the new business process modelling standard. 2004. Available at [http://www.omg.org/bpmn/Documents/6AD5D16960.BPMN\\_and\\_BPM.pdf](http://www.omg.org/bpmn/Documents/6AD5D16960.BPMN_and_BPM.pdf) (accessed 3 January 2018).



United Nations Department of Economic and Social Affairs (Statistics Division). Handbook on Civil Registration and Vital Statistics Systems: Management, Operation and Maintenance, Revision 1. New York, USA: UNSD; 2017. Available at [https://unstats.un.org/unsd/demographic/standmeth/handbooks/CRVS\\_Mgt\\_Draft-Third2.pdf](https://unstats.un.org/unsd/demographic/standmeth/handbooks/CRVS_Mgt_Draft-Third2.pdf) (accessed 29 December 2017).

The program partners on this initiative include: The University of Melbourne, Australia; CDC Foundation, USA; Vital Strategies, USA; Johns Hopkins Bloomberg School of Public Health, USA; World Health Organization, Switzerland.

Civil Registration and Vital Statistics partners:



**The University of Melbourne recognises the Swiss Tropical and Public Health Institute for their partnership and contribution**



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