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Research Article

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Nnamdi Ifeanyi Maduekwe

Olufunmilayo O. Banjo

Mike O. Sangodapo

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Nnamdi Ifeanyi Maduekwe[1]

Olufunmilayo O. Banjo[2]

Mike O. Sangodapo[3]

Aisha Abdulazeez[4]

Abstract

BACKGROUND
Multidimensional issues confront the use of standard verbal autopsies (SVAs), such as the WHO's verbal autopsy standards and the Population Health Metrics Research Consortium's gold standard verbal autopsy, to improve the mortality data performance of civil registration and vital statistics (CRVS) systems in low- and middle-income countries (LMICs).

OBJECTIVES
This paper attempts an inclusive analysis of these issues and their implications for policies intending to integrate routine SVAs into CRVS systems to enhance mortality data coverage in LMICs.

METHODOLOGY
Issues were identified from the verbal autopsy and CRVS literature, official documents, and the authors' field experiences with the Nigerian CRVS system. These were analysed using a problem (key issues) analysis methodology.

RESULTS
Two classes of issues were shown to impinge on the use of SVAs within CRVS systems. One class is generic to SVAs (technical complexity, cost, and standardization issues) and

[1] Corresponding author. Population Studies Department, National Population Commission, Abuja, Nigeria. Email: nnam6p@yahoo.com.
[2] Department of Demography, Obafemi Awolowo University, Ile-Ife, Nigeria. Email: banjoolufunmilayo@gmail.com.
[3] National Open University, Nigeria. Email: sangomike@yahoo.com.
[4] Population Studies Department, National Population Commission, Abuja, Nigeria. Email: kashuwa66@yahoo.com.

to CRVS systems (contextual, resource, and infrastructural limitations) in LMICs. The other is related to the incompatibility of SVA and CRVS system functions, operations, instruments, and data.

CONCLUSION
The results indicate a need for alternative solutions to the mortality data challenges of CRVS systems in LMICs that are more pragmatic than SVAs, especially in the short and medium term. Such alternatives must involve less complex data procedures and costs and must be adapted to CRVS system functions, operations, and socioeconomic contexts in LMICs.

CONTRIBUTION
The paper contributes to the discourse on the use of SVAs to improve the mortality data capacity of CRVS systems in LMICs.

1. Introduction

Mortality and cause of death (COD) data are indispensable to effective routine health systems planning and management, epidemiological interventions, and target-driven, time-bound developmental goals such as the UN's Sustainable Development Goals (SDGs) (Mills et al. 2017). The need for reliable mortality data is strongly amplified by endemic and emerging global health challenges such as the COVID-19 pandemic (NISR 2021; Vital Strategies and WHO 2020). Civil registration and vital statistics (CRVS) systems are the primary social and administrative structures for continuously collecting mortality data as well as other demographic, socioeconomic, and health data types. However, mortality and COD data collection remains a major challenge for CRVS systems in many low- and middle-income countries (LMICs). LMICs referred to in this paper are classified as lower-middle-income countries and low-income countries (World Bank 2023; World Bank 2018; UNDESA 2019). Data on coverage and quality of mortality data are lacking for many LMICs, especially in Sub-Saharan Africa (UNSD 2023; Yokobori et al. 2020). Available data show that the level of completeness of death registration is low in some lower-middle-income countries, such as Ghana (25%) and Kenya (39%), and much lower in low-income countries, such as Niger (4%), Guinea (2%), Malawi (6%), and Yemen (12%) (UNSD 2023).

1.1 Verbal autopsy as a solution to mortality data challenges in LMICs

Verbal autopsy (VA) is a community mortality data mechanism (CMDM) often implemented as a solution to the mortality and COD data challenges of LMICs (Sankoh and Byass 2014; Boyce and Reyes 2020; Bratschi 2021). VA is a procedure for collecting mortality and COD data from populations through various community survey techniques. VAs can provide insight into patterns and causes of death at community or population levels (WHO 2017a). Thus verbal (and sometimes associated social) autopsy surveys have become increasingly common in LMICs. VA surveys have been implemented in LMICs such as India, Brazil, Bangladesh, and Sri Lanka (Serina et al. 2015). A number of verbal and social autopsy (VASA) surveys have also been implemented in Nigeria, Niger, Cameroon, and Malawi (Garba and Umar 2013; Koffi et al. 2016; Lasisi et al. 2018). A nationally representative VASA survey was conducted in Nigeria in 2014 to determine COD amongst children under 5 (U5) as a follow-up to the 2013 National Demographic and Health Survey (NDHS) (Koffi et al. 2017). Recently, as a follow-up to the 2018 NDHS, a national sample VASA survey was conducted to evaluate causes and social dimensions of U5 mortality in the country (Lawal 2019). These surveys indicate that VAs can be conducted independently or as part of other social data collection exercises. However data collected from such VA activities are episodic and do not meet the need for regular COD/mortality data for health and social policy development and programme implementation in LMICs.

1.2 Integrating routine standard VAs with CRVS mortality data mechanisms

One approach being adopted to stimulate regular mortality and COD data collection in LMICs is to integrate routine VAs with CRVS systems (Thomas, D’Ambruoso, and Balabanova 2018; de Savigny et al. 2017). Integrating routine VAs with CRVS activities can enable regular use of VA procedures to enhance mortality and COD data from routine CRVS activities. Opportunities to integrate VAs into CRVS systems have grown significantly with recent improvements in both CRVS systems and VA activities (UNECA 2017). CRVS system improvement in many LMICs, albeit modest, has taken place and is ongoing to tackle supply-side issues such as registration, infrastructure coverage, data quality, process, and technology (digitization and equipment) and manpower issues such as staff quality and numbers (Kavuma 2015; Lepang 2015; Round 2014). Emerging developments in CRVS mortality data utilization are also helping address the demand side of LMICs’ CRVS mortality data conundrum. An example is the increasing demand for CRVS mortality data as part of the data ecosystem for implementing SDGs (Maduekwe, Banjo, and Anyabolu 2018).

On the VA side, improvements have taken place in data instruments, applications, processes, analytical algorithms, and understanding the systems integration issues involved (Nichols et al. 2018; Murray et al. 2011; Fottrell 2011). VA instrument development is taking place in every component of the VA data ecosystem, including academia, demographic and health surveys, health observatories, national and NGO-based health sentinel infrastructures, and multilateral organizations, especially the WHO. As a result, a wide range of VA instrument types are being developed for use in various mortality research and applied situations. Concurrent developments are also taking place in VA applications and analytical algorithms applicable in different CRVS settings and social contexts (Hazard et al. 2020). One objective has been to reduce the need for VAs based on physician-determined COD, given the cost, the time involved, and the relative scarcity of physicians in LMICs (Weldearegawi et al. 2015). Efforts are also being made to adapt VAs to infrastructural, resource, and operational realities in LMICs. Thus there is increasing impetus for the use of these instruments within CRVS systems.

Two of the more commonly used VA instruments are the WHO VA standards and the gold standard VA of the Population Health Metrics Research Consortium (PHMRC) (WHO 2017b). Such commonly used instruments are designated standard VAs (SVAs) in this paper. SVAs are products of efforts to harmonize and standardize VA procedures, instruments, and data from various sources. The WHO VA standard is a product of the World Health Organization and various partners and has evolved over three versions: 2007, 2012, 2016. The PHMRC gold standard VA was developed by the PHRMC consortium within the Institute of Health Metrics and Evaluation (University of Washington). SVAs involve a number of data collection, handling, analysis, and COD determination activities. The instruments are modular, with different modules covering deaths at various age ranges. The WHO 2016 instrument comprises four questionnaire modules (general, under four weeks, four weeks to 11 years, 12 years and above), while the PHRMC instrument has three modules (general, neonatal and child, adults). In addition, SVAs are now mostly automated, involving the use of digitized data instruments coupled with algorithms for COD determination. Examples include the InterVA, InsilicoVA, and Tariff models. However, even with digitization and other measures to simplify their use, SVAs remain inherently complex procedures. This inherent complexity impinges on the process, cost, and logistics of using them (Serina et al. 2015), presenting a fundamental challenge to policies aimed at using SVAs to enhance national mortality data coverage in LMICs. Apart from the complexity of VAs, diverse issues on both the VA and CRVS sides are critical to the use of SVAs within CRVS systems. In spite of this diversity, not only are inclusive analyses of these issues lacking, but CRVS issues seem to be receiving less research and intervention attention. This has strong implications for efforts to enhance the mortality data capacity of CRVS systems using VAs and other CMDMs.

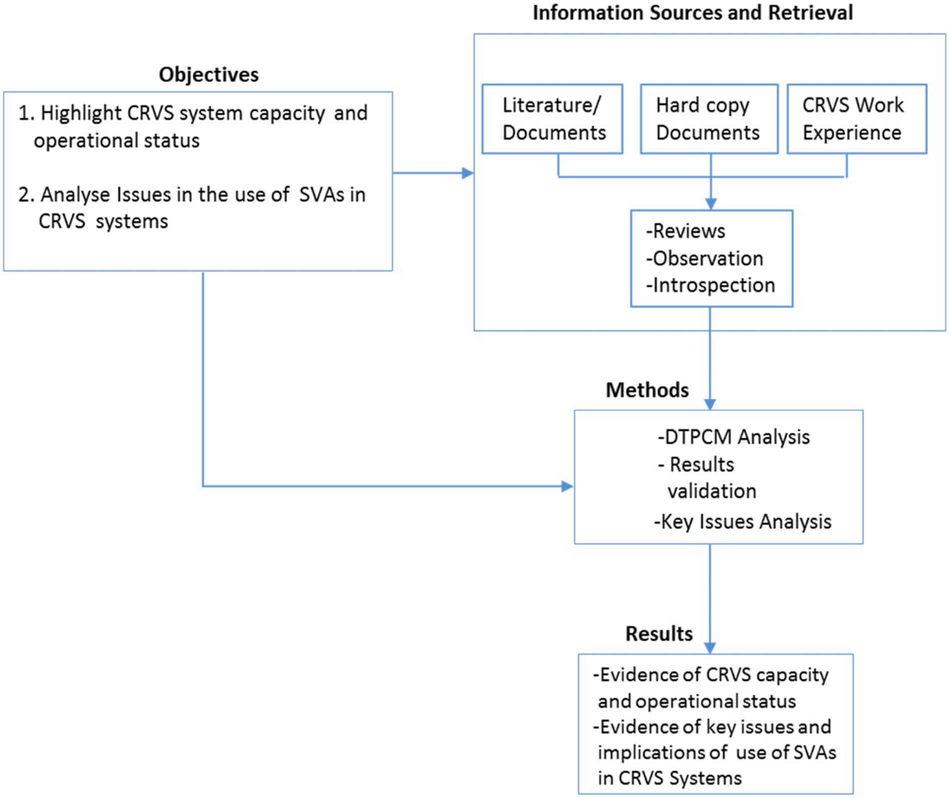
1.3 Paper objectives

This paper is based on the proposition that the mortality data challenges of CRVS systems in LMICs have strong systemic and contextual dimensions (Maduekwe, Banjo, and Sangodapo 2017). It highlights the need for inclusive analyses of the multiple dimensions and challenges involved in strategies and interventions to ameliorate the problems. Its main objective is to appraise issues involved in the use of routine SVAs in this respect. The intention is to stimulate and expand discourse on the use of the VA methodology to enhance mortality data production in these countries. The issues addressed mainly apply to policies promoting inclusive national use of routine SVAs to ensure expanded or comprehensive coverage of mortalities by CRVS systems in LMICs, although they might also apply to the use of VAs at subnational scales or within other demographic data structures. The paper also, as a prelude, presents evidence of the capacity and operational challenges of CRVS systems in LMICs impinging on mortality data productivity. The aim is to provide additional insights and to strengthen the discussion on issues impacting the use of SVAs to improve CRVS systems.

2. Methods

Critical issues in the use of SVAs to improve mortality data capacity of CRVS systems in LMICs are analysed in this paper through a systematic information collation and review procedure (Figure 1). However, the paper goes beyond a literature review procedure. It includes synthesis, appraisal, and depiction of secondary information from various sources. The sources of this information and the extraction, review, and appraisal process, including methods used to highlight capacity and operational challenges of CRVS systems, are described below.

Figure 1: Paper organization and methods



DTPCM: data type production capacity metric

2.1 Information sources

The information here originated mainly from internet-based literature searches using three major criteria: CRVS systems, VAs, and use of VAs within CRVS systems (Table 1). The search on each major criterion was expanded using several sub-criteria. For CRVS systems, sub-criteria were CRVS system in LMICs, death registration, and challenges of death registration in Nigeria/LMICs. For VAs, sub-criteria were characteristics/types of VAs, VA surveys/programmes, and functions of VAs. For use of VAs within CRVS systems, sub-criteria were use of VAs in CRVS systems, use of VAs in other CMDMs (e.g., health and demographic surveillance systems [HDSSs] and

VASAs), challenges of use of VAs. The objectives of these searches were to select documents with information on (1) the structure, operations, contexts, death registration/mortality data activities, and challenges of CRVS systems, especially in Nigeria and other LMICs; (2) VA characteristics, functions, types, operations, and limitations; and (3) the use of VAs within CRVS systems and other CMDMs (such as HDSSs and child, infant, and maternal mortality surveillance systems) to enhance mortality data production in LMICs. The literature search criteria were executed on the general internet search engine Google. This provided a wide search net to access literature from diverse journals and other publications. Apart from this general search, the websites of organizations active in the CRVS mortality data and VA fields, such as the WHO, UNECA, UNDESA, the World Bank, PHRMC, and INDEPTH Network, were also searched. Additional information and insights emanated from (1) relevant offline (hard copy) documents, (2) the authors' experiences as actors and managers within the Nigerian CRVS system, and (3) informal interviews and interactions with other stakeholders in the system. Information for the paper was extracted through literature reviews, field observation, and introspection on field experience (Figure 1).

Table 1: Literature search objectives and criteria

Search Objectives	Major Search Criteria	Search Sub-criteria
To provide information on CRVS systems' mortality data functions/activities and challenges in LMICs	CRVS systems	-CRVS systems in LMICs -Death registration -Challenges of death registration in Nigeria/LMICs
To provide information on VAs, including their use, functions, and operations	Verbal autopsies	-Characteristics/types of VAs -VA surveys -Functions of VAs -VA programmes
To provide information on the use of VAs within CRVS and other community data systems and associated challenges	Use of verbal autopsies in CRVS systems	- Use of VAs in CRVS systems - Use of VAs in other CMDMs (e.g., HDSSs, VASAs) - Challenges of use of VAs

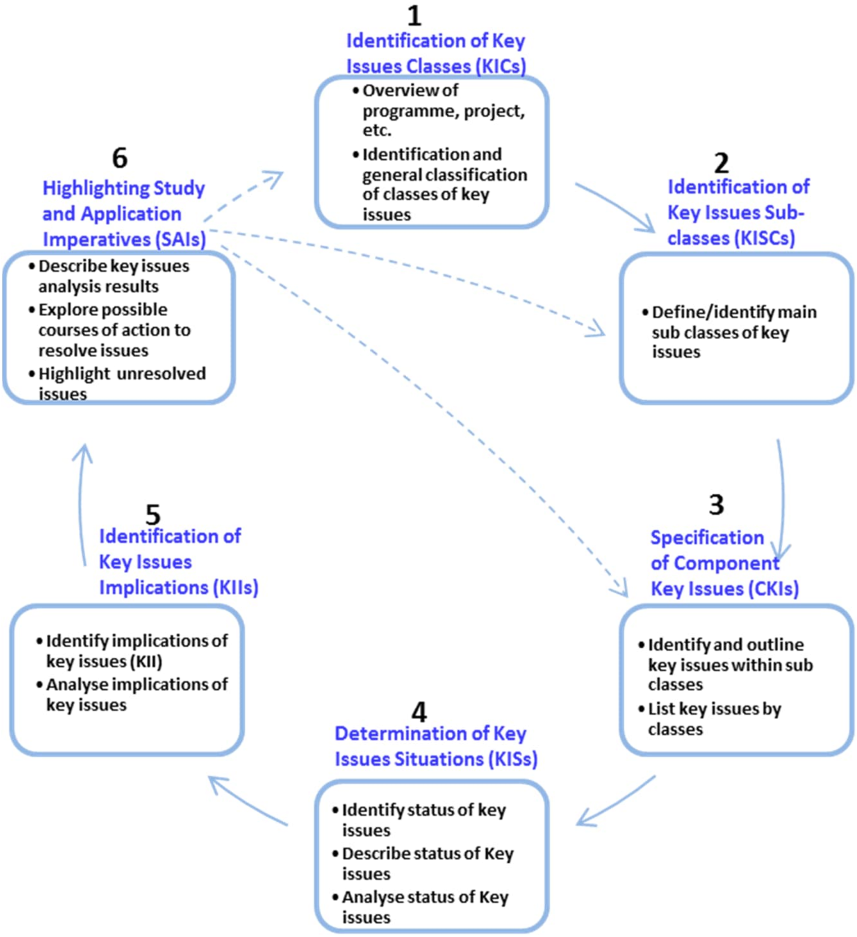
2.2 Illustrating mortality data capacity and operational challenges of CRVS systems

Salient mortality data capacity weaknesses of CRVS systems in LMICs are illustrated using the Nigerian CRVS system. Mortality data capacity challenges of the system are demonstrated with results of a data type production capacity metric (DTPCM) assessment of the system (Maduekwe, Banjo, and Sangodapo 2018). The metric was designed to evaluate the capacity of a data producing agency to generate a given data type. This supply side analysis awards data type production capacity scores (yes = 1, no = 0) on (1) existence of an enabling statutory environment, (2) existence of a data collection mechanism, and (3) robustness – i.e., deployment, regular and inclusive application of the data collection (registration) mechanism – and (4) regular output and publication of data type. The DTPCM study analysed the capacity of the Nigerian CRVS system to produce all CRVS data types (fertility, mortality, nuptiality, etc). This paper highlights only aspects related to the capacity of the system to produce mortality data (Maduekwe, Banjo, and Sangodapo 2018). Results from this analysis are presented alongside published evidence from seven other LMICs.

2.3 Appraising key issues in the use of SVAs in CRVS systems

Appraisal of key issues confronting the use of SVAs to enhance mortality data capacity of CRVS systems in LMICs is implemented through a problem analysis methodology, applied in this study as key issues analysis (KIA). The problem analysis approach enables comprehensive identification, listing, inventory, and analysis of a problem set impinging on an activity, project, or programme. Problem analysis takes a number of different formats as applied in fields as diverse as medical sciences, information science, strategic analysis, and project management (WHO 2019; WHO Regional Office for the Western Pacific 2005; Laney et al. 2004). In this study, the KIA approach is applied in the decomposition of the problem set impinging on the integration of SVAs into CRVSs to enhance mortality data collection in LMICs. In the study (Figure 2), KIA is formulated as a multistage activity enabling the identification of key issue classes (KICs), key issue subclasses (KISCs), component key issues (CKIs), key issue situations (KISs), key issue implications (KIIs), and study and application imperatives (SAIs). KICs are primary divisions of a body of problems or challenges. KISCs are main subdivisions of KICs. CKIs are specific issue types making up KICs and KISCs. KISs denote observable or measurable states of CKIs in an entire problem space. KIIs are the effects of CKIs and KISs on outcomes of an activity, project, or programme. SAIs are identified, proposed, or expected necessary studies and application responses to CKIs and KISs used to execute an activity, project, or programme in pursuit of a desirable outcome. The KIA implemented in this study is in respect of policies intended to use or scale up use of SVAs to effect comprehensive national coverage of mortalities by CRVS systems in LMICs. In the context of continuous output and quality improvement, the KIA process may be implemented in a cyclic manner. So the SAI stage may lead to identification and further analysis of KICs, KISCs, and CKIs and repetitive implementation of the KIA process.

Figure 2: Steps in the Key Issues Analysis (KIA) process applied in the study



3. Results

3.1 Search results

Results from the online search on the three main criteria and their sub-criteria are shown in Table 2. Search on the CRVS systems criteria expanded with its three sub-criteria yielded 19 pieces of literature for review. A search on verbal autopsies with three sub-criteria yielded 13 pieces of literature, while a search on use of VAs in CRVS systems with its four sub-criteria yielded 14 publications. Three documents were sourced offline or are hard copies. Most of the literature is sourced from journals (9 out of 18 documents for CRVS systems, 10 out of 13 for the VA search, and 9 out of 14 for the use of VAs in CRVS systems search).

Table 2: Information sources search results

Main internet search criteria	No. of search sub-criteria	Literature accessed/ reviewed	Reviewed literature by source			
			Journals	UN	Official	Others
CRVS systems	3	19	Maduekwe, Banjo and Sangodapo 2018; Makinde et al. 2020; Haider et al. 2021; Maduekwe, Banjo and Sangodapo 2017; Setel, Macfarlane and Szreter 2007; Cobos Muñoz, Abouzahr, de Savigny 2018; Lopez, McLaughlin and Richards 2020; Kavanagh, Katz and Holmes 2005; Queiroz et al. 2020;	Vital Strategies and WHO 2020; UNECA 2020; UNECA 2017 UNDESA 2014;	DNRPC Zambia 2014	Mills et al. 2017; Round 2014; Azad et al. 2013; World Bank and WHO 2015; GSMA 2016
Verbal autopsies	3	13	Koffi et al. 2017; Thomas, D'Ambruoso and Balabanova 2018; Nichols et al. 2018; Murray et al. 2011; Fottrell 2011; Weldearegawi et al. 2015; Chandramohan 2011; Coboz Muñoz et al. 2018; Mclean et al. 2016; Joshi et al. 2015	WHO 2011		Fottrell 2008; Lawal 2019
Use of verbal autopsies in CRVS systems	4	14	Sankoh and Byass 2014; Boyce and Reyes 2020; Serina et al. 2015; Garba and Umar 2013, Lasisi et al. 2018; de Savigny et al. 2017; Hazard et al. 2020; Setel et al. 2020 ; Alabi et al. 2014	WHO 2017a; WHO 2017b		Kavuma 2015 ; Lepang 2015 ; USAID 2020; de Savigny et al. 2018
Hard copy/offline	-	3	Maduekwe, Banjo and Anyabolu 2018		Maduekwe 2011; National Population Commission 2004	

3.2 Illustrating the capacity latency of CRVS systems in LMICs

Adapted results from the DTPCM study showed that the statutory environment and mechanisms are in place for death registration and mortality data collection in Nigeria (Table 3). However, the mechanism is not applied regularly, it lacks comprehensive national coverage, and CRVS system–collected mortality data are published infrequently. The DTPCM result shows that Nigeria's CRVS system possesses only nominal or latent capacity to collect mortality data. This implies a lack of robust application of existing mortality data collection mechanisms, resulting in poor coverage of mortality events and consequent failure to produce regular and viable mortality data. It also implies lack of capacity to sustainably process, store, and disseminate whatever data has been collected.

Table 3: Analysis of the capacity of the Nigerian CRVS system to produce mortality data

Capacity element	Capacity questions	Response	Capacity score*	Details	Observation
Legal backing for mortality data collection	Is the statutory background for mortality data collection in place?	In place	1	The legal background for death registration, the Death Registration Act (CRA), has been in place since 1992	-Nationwide coverage of act -Challenges with overlapping statutes and enforcement
collection mechanism	Is mortality data collection mechanism in place?	In place	1	-National coordinating agency in place -Key registration infrastructure (centres) deployed across country	At least one registration unit (RU) deployed in each of the country's 774 local government areas (LGAs)
Robustness of mortality data collection mechanism	Is mortality data collection mechanism adequately utilized?	No	0	Infrequent use of mechanism	Arises mostly from low level of death reporting, especially in rural areas
	Does mortality data mechanism have inclusive national coverage?	No	0	Actual coverage limited mostly to major urban and administrative centres	One RU is inadequate for effective coverage of most LGAs
Dissemination of mortality data	Is mortality data produced/ disseminated regularly?	Infrequent	0	Data on registered deaths published infrequently	
	Overall score		2		
	Capacity status		Latent		

Note: *Adapted from Maduekwe, Banjo and Sangodapo (2018)

The result of the DTPCM analysis points to the inability of the Nigerian CRVS system to effectively provide death registration services to facilitate mortality data collection. This affirms the limitations that supply-side failures impose on CRVS performance in LMICs. However, irregular use of existing death registration and data collection mechanisms may also indicate that demand side challenges are significant elements of the poor performance of these CRVS systems. Evidence of mortality data incapacity or capacity latency of CRVS systems in LMICs from the DTPCM analysis of the Nigerian situation is largely corroborated by studies in other LMICs. Examples (in Table 4) include failure to produce disaggregated mortality data in Pakistan (Khan and Mursalin 2020); problems with completeness/coverage of mortality in Brazil (Queiroz et al. 2020); incomplete coverage of registration facilities in India (Krishnan et al. 2020); inadequate registration infrastructure relative to the size of registration districts in Zambia (DNRPC 2014); inadequate trained personnel, weak institutional structure, and financial challenges in Morocco and Sudan (UNFPA 2022); and limited information and communication technology (ICT) access and use and a weak death notification system in Bangladesh (Azad et al. 2013). As shown below, the limitations of these CRVS systems' mortality data capacity form part of the key issues impinging on the use of VAs within CRVS systems in these countries.

Table 4: CRVS systems mortality data capacity issues in selected LMICs

S/N	Country	CRVS System Mortality Data Capacity Issues	Source
1	Pakistan	Weak CRVS system; failure to produce disaggregated reports on mortality	Khan and Mursalin 2020
2	Brazil	Problem with completeness/coverage of mortality data; problem with quality of data	Queiroz et al. 2020
3	India	Incomplete coverage of registration facilities	Krishnan et al. 2020
4	Zambia	Registration infrastructure is inadequate relative to size of registration districts to be covered; insufficient and poorly developed manpower capacity	DNRPC 2014
5	Morocco	Inadequate trained personnel; financial challenges	UNFPA 2020
6	Sudan	Weak CRVS institutional structure; inadequate registration infrastructure	UNFPA 2020
7	Bangladesh	Limited ICT access and use (at the centre level); weak death notification system	Azad et al. 2013

3.3 Key issues in the use of VAs to improve mortality data productivity of CRVS systems in LMICs

Key issues analysis enabled a hierarchy diagram visualization of the nexus of issues operating at different levels that impinge on the potential use of SVAs to improve the mortality data capacity of CRVS systems in LMICs (Figure 3). This at once highlights the complexities and multiple dimensions of the issues involved. The analysis also facilitates a detailed unpacking and description of these issues at different levels – namely, key issue clusters, key issue subclusters, key issue situations, and consequently their implications and possible study and application imperatives (Table 5). It shows that the issues are both generic within VA and CRVS systems, cross-cutting the two.

Figure 3: Hierarchy diagram of key issues affecting use of SVAs in CRVS systems

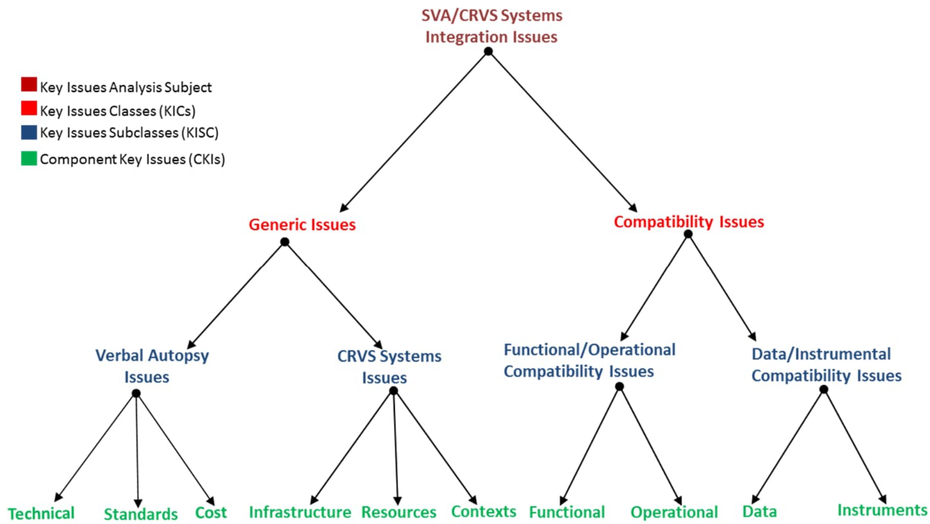


Table 5: Results of analysis of key issues in the integration of SVAs into CRVS systems in LMICs

Key Issue Classes (KICs)	Generic Issues		Compatibility Issues	
Key issue subclasses	Verbal autopsy issues	CRVS system issues	Functional/operational issues	Data/instrumental compatibility issues
Component key issues	-Technical complexity -Costs -Standards	-CRVS architecture -Infrastructure -Resources -Contexts	-Functional -Operational	-Data -Data instruments
Key issues situations	-VAs are technically complex activities -VAs are cost-intensive -VAs have diverse standards	CRVS systems in LMICs have: -Diverse architecture -Weak infrastructure -Resource constraints -Contextual challenges	-VAs are not compliant with full range of CRVS functions -VAs are not designed to follow CRVS time line and coverage	VA and CRVS may vary significantly in: - Data fields -Collection techniques
Key issue implications	CRVS systems in LMICs lack capacity to handle the high cost and complexity of routine SVAs	CRVS system issues are strongly limiting on VA options and integration strategies to be adopted	-Strong implications for integration process -Need for VA/CRVS functional and operational synchronization	Need to harmonize VA and CRVS data and instruments
Study and application imperatives	Design and implementation of simplified, country-specific data mechanisms	-Country-specific -Study of CRVS systems, constraints, and contextual issues	Need to develop models for VA/CRVS functional and operational integration	Need to develop templates for harmonization of VA and CRVS instruments and data

3.3.1 Generic verbal autopsy issues

From the KIA, three VA CKIs impinge on the routine use of SVAs within CRVS systems: technical, cost, and standardization issues. In terms of KISs and KIIs, SVAs are technically limited, often involve complex operations, have cost intensity, and are of diverse standards. Technically, VAs are not the same as medical or clinical autopsies and in a significant number of cases are unable to accurately determine causes of death (Chandramohan 2011). Optimizing and synchronizing CRVS and health system data collection, processing, and dissemination capacities remains the ultimate solution to mortality data challenges in LMICs. SVAs are only pragmatic stop gaps, intended at most to provide interim, proximate solutions. Yet VAs are not necessarily cheap to implement. In fact, the cost of rollout and routine operation will be a major challenge to the integration of routine SVAs into CRVS systems in many resource-poor countries. SVA costs are not easy to determine due to variations in types, as well as population, economic, and social contexts. However, one estimate puts the total annual cost of running an SVA in a group of rural communities in India (estimated population: 186,000) at $18,104 (or $12 per death) (Joshi et al. 2015). Another estimate suggests that the average cost per VA can range from $106 to $263, depending on economies of scale and country situations (Coboz Muñoz et al. 2018). This indicates substantial financial implications for integration of SVAs into CRVS systems. Costs will especially be challenging when an SVA is to be rolled out and implemented nationally. An alternative to a national implementation, the sample vital registration with verbal autopsy (SAVVY), also portends significant cost outlays (USAID 2020), especially when implemented on a regular basis. Apart from costs, SVAs are not simple to implement. They often involve complex multifaceted activities, from questionnaire design to administration, cause of death determination, and coding/tabulation of COD (Serina et al. 2015). And, as with many community surveys, they also involve intensive community sensitization, mobilization, and recruitment to ensure success.

Apart from these, KISs related to SVA standards have strong KIIs for routine use of SVAs within CRVS systems. There has been a recent push for standardization in VA instruments – though not necessarily in operational procedures – consequent on the diversity of VA objectives, implementing agencies, instruments, and data content (WHO 2017b). However, standardization could be a double-edged sword issue in the use of SVAs within CRVS systems in LMICs. On the one hand, standardization of VA instruments and procedures is necessary to meet minimum standards in mortality and COD data and to ensure comparability of results across VA types, programmes, countries, and regions (WHO 2017b). On the other hand, some aspects of standardization pose significant challenges to integrating SVAs into CRVS systems in LMICs. For one, it may not be easy or even feasible to adapt SVA instruments to existing CRVS death and COD data instruments and procedures. CRVS death data instruments in LMICs are often designed to meet the need for simplified instruments with minimal fields to enable rapid administration and data collection. This need for simplified instruments is contingent on the level of technical development and social and operational contexts of CRVSs in the country. SVA survey processes and data instruments may be inappropriate relative to limitations in CRVS manpower capacity, and social inertia, resistance to divulging mortality-related information, operational constraints (financial, technical, and manpower), and rollout and maintenance costs of mid- to high-end VA applications can pose significant challenges. Hardware, software, connectivity, infrastructure, and maintenance costs may prove prohibitive for many LMICS. This is borne out by other experiences in rolling out schemes related to national identity, birth registration, or even electoral registers in these countries.

3.3.2 Generic CRVS systems issues

As with VAs, some research and intervention attention is also being given to the systemic dimensions of the mortality data conundrum in LMICs. Studies indicate that persistent systemic issues impinging on CRVS systems, and by extension the use of SVAs to improve mortality data capacity, are located within CRVS systems and in their wider national systems contexts (de Savigny et al. 2017; Maduekwe, Banjo, and Anyabolu 2018; Maduekwe, Banjo, and Sangodapo 2017; Cobos Muñoz, Abouzahr, and de Savigny 2018). The KIA identifies four generic CRVS system CKIs. These are related to intercountry organizational architecture, status of the national socioeconomic infrastructure, resources, and sociocultural contexts of CRVS systems in LMICs (Table 5). The first KIS arising from these CKIs is that CRVS system architecture varies by country. Basic CRVS system configurations are described as either centralized or decentralized (UNDESA 2014). In reality there is no single best-fit CRVS architecture for all countries. Thus each country has a unique arrangement of CRVS system components: institutions, statutes, processes, and interactions. Whatever arrangement is adopted, an effective CRVS system must perform continuous and nationally inclusive mortality data collection (death registration), administrative (death and COD certification and documentation), and vital statistics production functions. These have important twofold KIIs for the use of SVAs within CRVS systems. On the one hand, this indicates the need for SVA programmes to be implemented in a way that will facilitate effective performance of the entire gamut of CRVS functions. On the other hand, it points to the need for country-specific SVA and CRVS system integration programmes based on studies of individual CRVS system architecture.

The second and third CRVS system KIS is that CRVS systems in LMICs are situated within weak socioeconomic infrastructure environments and have inadequate internal financial, human, and technical resources (Krishnan et al. 2020; Khan and Mursalin 2020). The resultant perennial functional ineffectiveness, especially the inability to produce useful mortality data, is well-known. Many interventions to improve coverage, data flow, and quality performance of these systems have been ineffective. This is strongly linked to the fourth system KIS, the overarching national sociocultural context of CRVS systems in LMICs. Most generic CRVS system key issues transcend CRVS systems and are rooted deep within the social, economic, and technological contexts of CRVSs in each country (Maduekwe, Banjo, and Sangodapo 2017). They include a country's governmental structure, national socioeconomic status, social and technology infrastructures, and national civic culture. Fundamental changes in national socioeconomy, technology, infrastructure, and civic culture are needed before CRVS systems in LMICs can attain effectiveness in mortality data production. Unfortunately, characterizations of CRVS situations in LMICs are often stylized. Thus they overlook country-specific contextual issues and throw only limited light on realities on the ground.

3.3.3 Compatibility issues

Like system issues, SVA/CRVS compatibility, CKIs, and KISs are multifaceted, with functional, operational, data, and instrument aspects (Table 4). Each of these aspects has strong KIIs for the use of SVAs in CRVS systems, though they have probably received less analytical attention than systems issues. Functional and operational compatibility CKIs and KISs are linked to CRVS system objectives and functions as noted above. It can be added that VA programmes are generally not designed with CRVS system architecture and functionality in mind. VAs are not designed to conform to basic CRVS functions of events registration, certification, documentation, data compilation, and dissemination. On the contrary, most VA activities have been implemented within research settings or within the operations of other data collecting entities, such as health and demographic surveillance systems or national demographic and health surveys. HDSSs have to a large extent driven the development of VAs but operate within limited predefined spatial and demographic niches and are generally independent of national CRVS systems (WHO 2011; Maduekwe 2011). HDSS operations present an opportunity for integrating mortality data generated from communities into CRVS operations given their experiences with VAs (de Savigny et al. 2018). However, given their niche characteristics, HDSSs are limited in terms of programmes targeting comprehensive national integration of SVAs into CRVS systems, structures, and processes. Similarly, other VA activities, such as VASA surveys undertaken in Nigeria, are parts or offshoots of periodic national sample surveys. Sample VASAs are not likely to meet the need for comprehensive coverage of mortalities in a country.

Instrumental and data compatibility issues have to do with differences in mortality data collection instruments and data collected through VA and CRVS activities. The KIS in this case is that VAs and CRVSs vary significantly in structure and content of data instruments, in data collection techniques and environments, and in data characteristics. As noted above, much research attention has been given to assessing differences between various VA data instruments (Weldearegawi et al. 2015). In contrast, little attention has been given to assessing differences between VA and CRVS data collection procedures and environments and their implications for VA/CRVS integration. Also lacking is comparative statistical analysis of characteristics of mortality data collected through VA and CRVS procedures. At least three VA/CRVS integration SAIs are cogent in this respect. One is the need to develop methodologies for harmonizing VA and CRVS data instruments, especially within each country's CRVS system. Two is the need for comparative evaluation of VA- and CRVS-generated mortality data. Three is the need to develop statistical models for VA/CRVS data integration.

3.4. Discussion of results of key issues analysis

The KIA methodology enabled the unpacking of the nexus of issues affecting the use of routine SVAs to stimulate continuous comprehensive national coverage of data on mortality in LMICs. This is likely the first attempt to implement a broad and inclusive analysis of the challenges inherent in the use of VA-based CMDMs to improve mortality and COD capacity of CRVS systems in LMICs. Such broad-based analyses are required for at least two main reasons. One, they are indispensable to an understanding of the multidimensional issues involved in the use of VAs in CRVS systems as well as to the implementation of effective solutions to the mortality data challenges of CRVS systems in LMICs. Two, they can help in developing a framework for other in-depth studies of a single key issue or a cluster of key issues identified at country or country group levels.

The KIA revealed a hierarchy of diverse generic SVAs and CRVSs as well as SVA/CRVS compatibility, KICs, KISCs, CKIs, and KISs impinging on possible routine use of SVAs within CRVS systems. The analysis hinted that generic SVA KICs, especially their technical complexity and cost, impact the use of SVAs at all spatial scales or data collection structures (including surveillance systems). Thus cost and technical complexity are major challenges to the rollout and implementation of VA programmes within CRVS systems in LMICs. As noted, some LMICs, especially India, Tanzania, Malawi, and Zambia, have attempted to mitigate the potentially excessive cost and organizational complexity of a national-scale rollout of VA programmes within their CRVS systems by applying the SAVVY model (Krishnan et al. 2020; Mudenda et al. 2011). The Indian CRVS SAVVY programme, dubbed Mortality in India Established through Verbal Autopsy (MINErVA), is one of the most expansive programmes integrating VAs into a CRVS system. This programme has achieved significant success in the coverage of mortality and COD data in the country and may be presented as a model for other countries. However, experiences with the MINErVA programme confirm that cost and capacity remain major challenges for countries intending to integrate VAs into their CRVS systems.

The challenges of cost and technical and organizational complexity of SVAs are compounded by generic CRVS KICs, especially the resource, technology, and sociocultural constraints of CRVS systems in LMICs. Using evidence from various countries, the KIA indicated that resource constraints faced by CRVS systems in these countries range from poor financing to inadequate registration infrastructure and insufficient and poorly trained human resources. Some 20% of countries in the Arab region, for example, lack functional centres for registration of births and deaths (UNFPA 2022). A review by the Africa Programme for Accelerated Improvement of Civil Registration and Vital Statistics (APAI-CRVS) indicated that the dearth of death registration infrastructure is also a major challenge in many Sub-Saharan African countries (APAI-CRVS 2017). Paucity of registration infrastructure implies a weak base for planning and implementing VA programmes within CRVS systems at national and subnational scales in LMICs. This challenge is amplified by the weak technological environment of CRVSs in LMICs. This is epitomized by poor ICT and power infrastructure, with adverse implications for the implementation of different technical aspects of VA processes. The KIA also indicated that adverse factors within the sociocultural contexts of CRVSs are already impinging on the demand and uptake of CRVS services (especially death registration). The same factors also affect the use of VAs to enhance mortality data collection in these countries.

Apart from these generic issues, the KIA indicated that cross-cutting functional, operational, instrumental, and data compatibility issues impinge strongly on the use of VAs within CRVS systems. VAs are essentially community-focused mechanisms for collecting data on deaths and CODs. CRVS systems, on the other hand, perform more diverse functions of data collection, documentation, certification, and vital statistics production. Operationally, CRVS systems are routine, regular, and continuous in nature, while VA programmes are periodic. Thus the data collection routines of CRVSs and VAs do not synchronize automatically. Also different are the data instruments and range of data types produced by the two sources. CRVS systems collect personalised data types to enable documentation, certification, and production of vital statistics on deaths. VAs do not necessarily produce data to support the certification and documentation functions of CRVS system activities. Differences in VA and CRVS functions, operation, data instruments, and data have implications for their function and operation as well as the possible integration of their data.

At least two important questions arise from the discussion above. One: Are available SVA procedures adaptable to current CRVS system realities in many LMICs? Two: Can CRVS systems be upgraded rapidly in the short term to adapt to the complexities and costs of available SVA techniques? Answers to these questions may hinge on the time, institutional and societal learning curves, and transformations necessary for the development of more effective CRVS systems in LMICs. The importance of time – a critical factor – in CRVS system evolution and development is well recognized (Boyce and Reyes 2020; Lasisi et al. 2018; Hazard et al. 2020). Time will play out in the short-, medium-, and long-term developmental prospects and trajectories for CRVS systems in LMICs. Expectations are that in the very long term, given momentum from socioeconomic and institutional development, ongoing interventions, and CRVS improvement aspirations included in the SDGs, CRVS systems in LMICs will attain the capacity levels necessary to produce high-quality mortality and COD data on a regular basis. In the short and possibly medium term, it seems almost impossible to rapidly upgrade CRVS systems in most LMICs to meet minimum standards to sustainably handle the financial, technical, and possibly manpower requirements of integrating complex VA applications and procedures.

The foregoing has a number of implications. One, it indicates the need for inclusive research and pragmatic intervention attention to be given to all aspects of the key issues revealed by the KIA. Inclusive research attention is important because evidence from the literature search shows that, comparatively, more research attention has been given to generic VA technical issues, especially challenges with VA instrument/application development, and COD determination. Generic CRVS mortality data issues have tended to receive less attention. Inadequate attention has been given, for example, to the implications of the operational status of CRVSs in LMICs – the human, technical, and financial resource challenges for the use of SVAs within CRVS systems. Also not well analysed are the potentially strong limitations to the use of SVAs imposed by the socioeconomic, sociocultural, and technological contexts of CRVSs in LMICs. This seems to betray inadequate appreciation of the complexities involved in the use of SVAs in CRVS systems and the need to make SVAs sensitive to CRVS system realties in LMICs. Inadequate research attention has also been given to the implications of functional and operational differences between SVAs and CRVSs for the use of VAs to ensure comprehensive coverage of mortalities in LMICs. This may have resulted in the absence of models for functional and operational integration of VAs and CRVSs.

A dominant focus on VA issues may also have contributed to the lack of robust research attention to death registration and other mortality data collection challenges of CRVS systems in LMICs, especially when compared to other vital events, such as births. Even with some recent exceptions (Maduekwe, Banjo, and Sangodapo 2018; Makinde et al. 2020; Haider et al. 2021), there is still a dearth of research attention on death registration and related functions of CRVS systems in LMICs. This includes a dearth of attention on capacity assessments and contextual analyses, necessary to explicate the roots of the mortality data incapacity. A pervasive VA focus may also have contributed to the paucity of interventions for CRVS system mortality data capacity development. Relative to births, death registration has attracted much less intervention. In Nigeria, for example, while birth registration and data collection have received sustained intervention from multilateral agencies, especially UNICEF, death registration has received very little attention (Maduekwe, Banjo, and Sangodapo 2017).

In addition, the literature also indicates a tendency to treat VAs mostly as technical procedures for determining COD rather than as inclusive community mortality data processes relevant to the entire CRVS mortality data function and operational chain. Accurate COD determination and data collection remain a major mortality data and public health need in many LMICs. Thus, as a part of their fourfold mortality data functions – data collection (events registration), documentation, certification, and vital statistics production – CRVS systems in these countries are required to ensure that CODs are accurately determined and recorded. However, there are indications that the mortality data needs in LMICs are even more fundamental than the failure to determine or collect data on CODs. Thus there are cogent reasons why VA programmes and other interventions to improve mortality data production in LMICs should go beyond a COD emphasis. An example is the need for mortality data for cleaning and updating personal identification systems and national security infrastructure, strengthening judicial systems and human rights, and cleaning and updating electoral registers. Lack of death data to sanitize electoral systems, for example, remains a major challenge to the stability of democracy in many LMICs. Much of these needs can be met with nominal mortality data obtainable through community mortality surveillance, death tracing, and listing.

4. Summary and policy implications

The need for accurate, timely, and reliable mortality data remains pressing in many LMICs. This pressing need is still largely unmet due to the weaknesses of CRVS systems in these countries. Verbal autopsies are community mortality data mechanisms being implemented as pragmatic solutions to the mortality data limitations of these systems. Using evidence from diverse sources, this paper has appraised key issues impinging on the use of routine standardized VAs, such as the WHO and PHRMC packages, for this purpose. The issues identified arise from the inherent characteristics and challenges of VA and CRVS systems and from the differences in their functions, operations, data instruments, and data types. A number of policy imperatives are evident from the discourse.

A key imperative is the need for more pragmatic solutions (than SVAs) to the mortality data challenges of LMICs, especially in the short and medium term. Such solutions will have to be based on innovative data acquisition procedures and instruments adapted to current CRVS organizational, operational, and socioeconomic contexts (Lopez, McLaughlin, and Richards 2020). The solutions must meet the need for simplified procedures and instruments for community mortality surveillance in the context of existing and emerging health, socioeconomic, and technological realities in LMICs. The first reality is the explosion of noncommunicable diseases (and the consequent need for regular, reliable community data on their prevalence and incidence), especially cancers, diabetes, hypertension, and organ conditions (Akakpo 2020; Setel et al. 2020). The second reality is the need for easily activated community surveillance mechanisms to provide data on emerging diseases and pandemics like the COVID-19 pandemic (Fottrell 2008). Furthermore, the proposed solution must be adapted to CRVS system functionalities and operational realities in LMICs. It must also be able to bridge the capacity gaps/weaknesses in the operation of CRVS mortality data mechanisms.

These realities tend to suggest that strategies for tracing, listing, compiling, and collating data on deaths, especially within populations, are more pressing vital statistics and public health imperatives in most LMICs (Vital Strategies and World Health Organization 2020; Kavanagh, Katz, and Holmes 2005). Presently, mortality statistics in these countries are based mostly on death records from hospitals. But at least 50% of deaths occur outside health systems and are not recorded. Thus, as with births, many deaths are lost to data and civic systems in these countries. Thus the crisis of civic invisibility suffered by many individuals in LMICs is as much an issue of unregistered deaths as it is of unregistered births (Fottrell 2008; Setel, Macfarlane, and Szreter 2007). The implications of unrecorded deaths are strong, not just for health systems but also for individual civic identity and rights, electoral systems, public administration, and national security. Therefore developing policies addressing the need for pragmatic mechanisms to trace, detect, inventory, and record deaths in populations must remain a major objective of interventions to improve the mortality data situation of LMICs.

Finally, a fundamental policy imperative arises from evidence of capacity latency and critical gaps in the utilization of existing mortality data infrastructure in LMICs. This implies, amongst other things, that CRVS systems in LMICs have existing, though limited, capacity to collect mortality data. This indicates, as pointed out, a lack of implementation resources, operational inertia, and constraints within these CRVS systems as well as challenges within their social, economic, and technological contexts (Lepang 2015). Thus strategies to ensure optimal utilization of existing mortality data capacity and infrastructure may be the necessary first steps towards improving mortality data collection and use in LMICs. Recent interventions in Rwanda, Bangladesh, and Colombia indicate that this can be effected through CRVS policy reviews, training, and capacity enhancement for existing CRVS staff and promotion of community visibility and access to death registration infrastructure.

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