THE UNIVERSITY OF MELBOURNE

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DATA FOR HEALTH INITIATIVE

CRVS best-practice and advocacy

Introducing verbal autopsies into CRVS systems: Guiding principles

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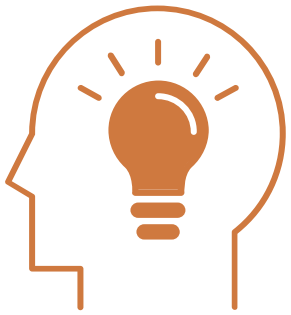

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Contents

Acronyms and abbreviations

BD4H	Bloomberg Philanthropies Data for Health initiative
COD	cause of death
CRVS	civil registration and vital statistics
CSMF	cause specific mortality fraction
DHIS-2	district health information system (2)
DOA	dead on arrival
HDSS	health and demographic surveillance site
ICD	International Classification of Diseases
ID	identification
IT	information technology
PCVA	physician-certified verbal autopsy
PHMRC	Population Health Metrics Research Consortium
SAVVY	sample vital registration with verbal autopsy
SOPs	standard operating procedures
SRS	sample vital registration system
TWG	Technical Working Group
VA	verbal autopsy
VAI	verbal autopsy instrument
WHO	World Health Organization

Introduction

Accurate cause of death (COD) information is fundamental to good public health practice. The principal sources of information are medical certificates of COD for deaths in hospitals and verbal autopsies for non-hospital deaths. A verbal autopsy (VA) is a process whereby relatives of the deceased respond to questions about the medical history and terminal illness of the decedent (i.e. the illness that led directly to death). These two sources of COD data are complementary.

Verbal autopsies, as a means to generate policy-relevant information on cause-specific mortality fractions (CSMFs) in a population, have three elements:

1. a questionnaire to collect information from the family of the deceased about signs and symptoms preceding death, known as the verbal autopsy instrument (VAI)
2. a method to diagnose the most probable COD based on the responses recorded in the VAI. This has traditionally been done by physicians, referred to as physician-certified verbal autopsy (PCVA). Today, automated algorithms are available to generate the probable COD, an approach that is more cost-effective, accurate and consistent across populations than PCVA
3. a target COD list, which includes all causes that can be diagnosed with reasonable accuracy.

Improvements to the certification of deaths in hospitals and the introduction of VAs for community deaths are complementary and should proceed in parallel. It is desirable that VAs be collected either for all deaths for which medical certification was not available, or for a representative sample of these. This will include deaths in facilities, where there is no physician, as well as home deaths and deaths in the community generally that took place without medical attention or where a doctor is asked to certify the cause without the body and sufficient information to certify the cause.

Medical certification and VAs should both be linked to the notification and registration of deaths through a country's civil registration and vital statistics (CRVS) system. In general terms, medical certification will provide a more detailed and legally recognised account of COD; VAs will be more representative of patterns of mortality at the population level. The principal purpose of VA is to describe the cause composition of mortality through the estimation of CSMFs in a population. However, in certain situations, VA can be also be used as an aid to physicians for recording the underlying COD and to write a death certificate for an individual.[1]

The introduction and integration of verbal autopsies into CRVS systems is arguably the most complex and difficult challenge that countries face in trying to improve data for policy, but as yet there is no viable alternative to obtain reliable cause of death data.

This report aims to:

- propose a generic approach in advising countries about the options available to them to implement automated VA methods
- lay out the broad steps in the preparation, field testing, phase one implementation and eventual national roll-out of VAs in CRVS systems.

This document can be read in combination with a companion piece that outlines systems level considerations for integrating VA into CRVS systems.[2]

1 As in the case of SmartVA for Physicians. An Overview and User Guide can be found at https://crvsgateway.info/file/15126/3919 and https://crvsgateway.info/file/14682/3844

2 Savigny, D, Riley, I, Chandramohan, D et al. *Integrating community-based verbal autopsy into civil registration and vital statistics (CRVS): system-level considerations*. Global Health Action. 2017, Vol. 10. Available at: https://crvsgateway.info/file/16363/51

Criteria for the introduction of verbal autopsies into civil registration and vital statistics systems

The introduction of VA will depend on a careful analysis of, and response to, the structure and capacity of peripheral health and statistical services in the country.

VA should be integrated with the civil registration systems. It should be noted that introducing VA outside civil registration and vital statistics (CRVS) systems may divert resources from efforts to strengthen those systems.

In making decisions about the introduction of VAs into settings with limited resources, three broad criteria need to be considered:

- Efficiency – This is the extent to which approaches for the introduction of VAs make the best possible use of scarce resources. A program needs to be sustainable (i.e. operate independently of external inputs) in the medium and long term.
- Effectiveness – This is the extent to which the chosen VA and diagnostic method can accurately predict COD from a sufficiently large sample of all deaths to provide valid CSMFs for national and subnational populations.
- Cost – It is important to compare the cost of ongoing collection of VAs with other strategies for the collection of COD data, such as placing physicians in all rural health facilities. This cost comparison will support decision-making in ministries of health, which are the principal users of COD data. It is also important to distinguish between start-up costs and ongoing operational costs. A tool and guidelines are available through the CRVS Knowledge Gateway to assist countries to understand the cost of implementing VA.

  A VA Costing and Budgeting Tool and User Guide can be found at:
  https://crvsgateway.info/Verbal-autopsy-costing-and-budgeting-tool~489

Need for national commitment

There is a risk that countries will agree too readily to the introduction of VAs into CRVS systems and not appreciate the level of commitment that will be required. Before committing, countries should understand that they will need to:

- review the institutional set-up and business processes for the notification, registration and certification of deaths in order to identify the most effective and efficient strategy for identifying the maximum number of deaths at community level
- be prepared to train and supervise health workers or other community-based workers in VA interviews
- establish that interviewers, if they have not been recruited for the specific purpose of collecting VAs, have sufficient time to collect VAs in addition to their routine duties; they must have the capacity to collect VAs and the means to visit families
- be assured that means of data transfer exist between civil registries and health facilities
- be prepared to develop processes for strengthening collaboration between staff of civil registries and health facilities.

The trade-off is between the need for high-quality population-level COD data and the need for high-quality and complete civil registration data. The general approach to the availability of high-quality population-level COD data should begin with a review of all available sources of such data and consideration of how best to obtain national estimates of COD.

The use of verbal autopsies in civil registration and vital statistics systems

Verbal autopsies within civil registration systems should follow registration or notification of a death. The introduction of VAs can be supported by verbal autopsy instruments (VAIs).

Model of common processes for data collection, entry and transmission for verbal autopsies within a civil registration and vital statistics system

This section provides a sequence of events that precede and follow the collection of VAs (see **Figure 1** for a simplified overview of this approach).[3] For this approach, it is assumed that:

- there is a process for the notification of deaths in addition to family notification and registration
- there is an organisation or agency that will take responsibility for the collection of VAs.

If such systems are not in place, they will need to be developed in parallel with the development of processes for the management of VA data.

1. A death occurs

Death may occur at home or away from the home. If it occurs in a health facility, the facility should notify the civil registrar. Jurisdictions vary in their rules about registering deaths in administrative areas away from the place of usual residence (e.g. in a different province or district). Some require the death to be registered in the area where the death occurred, others require the death to be registered in the area of usual residence. This is particularly relevant to the notification and registration of health facility deaths.

2. The civil registrar is notified of the death by the family, by an institution or by an individual empowered to notify deaths; notification should require all identification (ID) legally necessary for registration

Systems for the notification of deaths assume the selection of an agency that has the capacity to identify a high proportion of all deaths and report them. The health sector is likely to be involved because of the need to notify health facility deaths. If a country does not have a pre-existing structure for the notification of community deaths, we recommend that in the early phases of introducing VAs, notification procedures be as straightforward as possible. It will simplify matters if the agency empowered to notify deaths is the agency that organises the collection of VAs.

The minimum information for notification of a death should be:

- serial number of the notification form (for record linkage)
- full name of the decedent
- sex and nationality
- date (if not known, age) and place of birth
- date and place of death
- place of usual residence.

3 The approach in different settings may differ significantly from this simplified diagram.

3. A registration number is assigned, and details are entered into the civil register (ID data, place of occurrence, address)

The registration number becomes the permanent number for linkage of records. Alternatively, a notification number or national ID number may serve this purpose.

4. If a medical certificate of COD is not available (e.g. due to non-facility death, dead on arrival, or other factor), a death certificate (i.e. fact of death) can be issued and the decision to conduct a VA should be taken

In order to issue a medical certificate of COD, a physician should be familiar with the past medical history of the decedent and/or the terminal illness. Hospital physicians frequently declare themselves unable to issue a certificate for persons who are dead on arrival (DOA) or when the death has occurred within 24 hours of admission. In such cases, we recommend a VA. We also recommend VAs be collected for all deaths in health facilities not staffed by physicians.

If physicians issue medical certificates for non-facility deaths, the quality of these will need to be evaluated. In countries where a medical certificate of COD is necessary to obtain a permit for burial, physicians may issue a medical certificate based solely on the family account of the terminal illness as routine practice. We recommend the collection of a VA under such circumstances but acknowledge that operational research is required to establish best practice.[4]

Whereas a medical certificate of COD may initiate the registration process, a VA will most likely be collected weeks or months after the death. It will not be possible to predict at the time of registration whether it will be possible to assign a cause of death (there may be insufficient information to do so) or even whether it will be possible to collect the VA. Therefore, if certification of the fact of death is needed, that certificate is best issued at this point.

5. The registrar provides ID details and the registration number and requests a VA from the health facility

The registration number should be the permanent number that provides the essential link between the civil register and the VA. This number needs to be unique.

6. The health facility/ assigned staff member collects a VA, ideally within a minimum of 4 and a maximum of 12 weeks of death

In general terms, government health facilities are the best placed agencies to take responsibility for the collection of VAs because of their ethos, staff experience and expertise.

The aim should be to collect VAs between four and 12 weeks after death.[5] A delay of four weeks allows for a period of mourning. After 12 weeks, the accuracy of the assigned COD will be increasingly affected by symptom recall.[6] Nevertheless, it would be permissible to collect VAs for up to 12 months after death in order to maximise coverage. Under certain circumstances, such as death in a facility, or where it is a requirement for physicians to assign a cause of death for a death certificate, it may be better to collect the VA immediately after death. Such a decision calls for understanding and judgement.

7. VA data is collected and uploaded to a remote server

The VA interview should take place in a non-threatening environment where respondents can answer freely in accordance with local customs affecting confidentiality. Emotional support from other family members or the interviewer may be necessary. It is common in village environments for more than one family member to be present. The decision about who should or should not be present at the interview should be left with the principal respondent. Given the usual need for at least a four-week delay and the likelihood of active follow-up by the interviewer, the most usual place of interview will be in the home. An acceptable alternative would be in a health facility.

4 SmartVA for Physicians overview and User Guide can be found at https://crvsgateway.info/file/15126/3919 and https://crvsgateway.info/file/14682/3844

5 The timing of VAs should take into consideration the cultural context of the population and the feasibility of conducting the VA in the future. Conducting VA less than four weeks after death may be necessary in some cases.

6 Serina, P., Riley, I., Hernandez, B., Flaxman, A.D., Praveen, D., Tallo, V., Joshi, R., Sanvictores, D., Stewart, A., Mooney, M., Murray, C.L., Lopez, A.D. (2016). What is the optimal recall period for verbal autopsies? Validation study based on repeat interviews in three populations. Population Health Metrics, 14:40.

We strongly recommend electronic collection on a mobile device because the data can be automatically uploaded to a remote server and aggregated with other VA data ready for analysis. Training of field workers in electronic data collection should include instruction in how to upload data. In situations where internet connectivity is poor, VA information on mobile devices can be downloaded onto computers manually using a USB. If data collection is paper-based, we recommend data review by a supervisor as a quality check. To reduce data entry errors, double-entry is required

8. A COD is assigned, using automated VA methods

Once data from an individual death have been uploaded or, in the case of paper-based systems, entered into a computer, automated methods will assign a COD which should appear as the outcome of the interview.

Research indicates that the overall cause-specific mortality fraction (CSMF) accuracy of automated VAs is more than 75 per cent. The accuracy of assigned COD from automated VA for individual deaths is around 50 per cent.[7] As stated previously, the principal purpose of VA is to describe the cause composition of mortality through the estimation of CSMFs in a population. The distribution of COD is important for guiding policy responses to avoid premature deaths in communities.

Although COD can be provided to family members, we recommend that this not be done. Firstly, diagnosis is not sufficiently accurate at the individual level and secondly, the need for discussion about the implications of the diagnosis places too much of a burden on interviewers. We recognise that families have a right to know the diagnosis, but recommend that the assigned COD be discussed first with a trained health worker, and then the health worker can disclose the diagnosis to the family at a formal interview, if appropriate.

9. Interviewers are supervised and quality assurance processes are in place

Supervisors are responsible for ensuring that interviewers are adequately trained and supported, and ideally should have a background in health. It is important that all supervisors thoroughly understand the process of conducting a VA and can effectively pass on this knowledge to interviewers. We recommend that supervisors hold regular group meetings with interviewers to discuss issues and problems arising in the course of their work. Supervisors should be prepared to attend a small percentage of interviews as observers.

The interviewers need to be able to establish an atmosphere in which respondents are prepared to confide sensitive information. This requires tact and understanding. Unreliable information may lead to incorrect diagnoses. Responses must be entered accurately. For questionnaires delivered using a mobile device, responses will be programmed to fall within predetermined parameters. With paper-based instruments, supervisors should review responses in detail before computer entry where, again, the questionnaire should be programmed to ensure that responses fall within predetermined parameters.

10. COD data are transmitted to the registrar; the registrar records the COD in the register using the registration number for linkage

The integration of COD derived from VA into local systems will depend very much on the country information technology (IT) systems and capacity. In practice, the transfer of COD data to CRVS systems can be difficult. Resultingly, COD information from VA may, at least in the first instance, be transferred into a health management information system.[8] This does not apply in the case where VA information is used directly by a medical doctor to write the death certificate.[9]

7 Serina, P., Riley, I., Stewart, A., James, S., Flaxman, A., Lozano, R., et al. (2015). Improving performance of the Tariff Method for assigning causes of death to verbal autopsies. BMC Medicine, 13, 291.

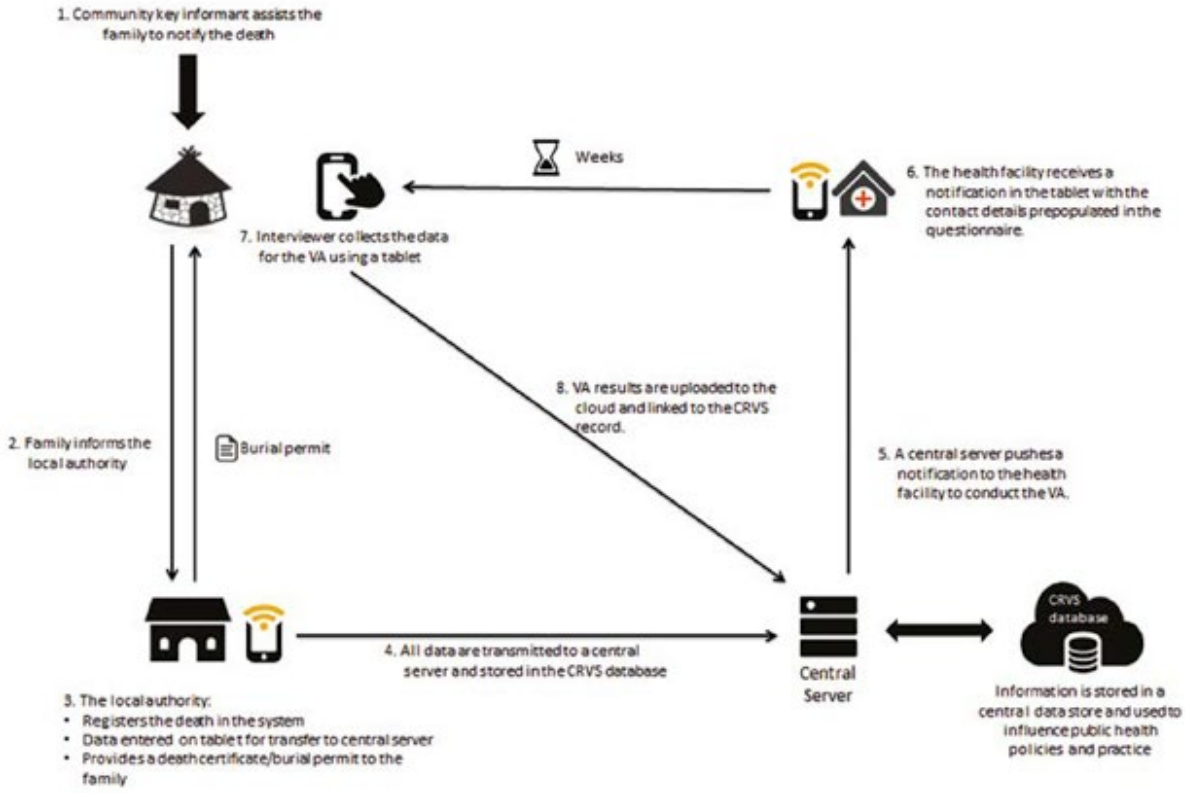
8 The importance of recording the critical information on 'fact of death' into the official CRVS system remains.

9 As in the case of SmartVA for Physicians. An Overview and User Guide are available at: https://crvsgateway.info/file/15126/3919 and https://crvsgateway.info/file/14682/3844

11. The distribution of CODs is reviewed for plausibility and processes are corrected as necessary

A VA Technical Working Group (TWG) should play a major role in the review process. This working group should be established to provide oversight of VA implementation. It is usual to compare results from VAs with data from other sources. This will be necessary at both local and national levels to ensure COD results coming from automated VA align with known distribution patterns in the country. Where there are few data on cause of death distribution from routine or other sources (such as large-scale surveys), expert opinion may need to be employed to assess the feasibility of the COD patterns.[10] For countries collecting large amounts of VA data as part of a routine system, a guidelines document[11] and associated tool (VIPER)[12] are available to assist with understanding and interpreting VA mortality and COD data.

Figure 1. Verbal autopsy processes in a civil registration system



Source: de Savigny D, et. al (2016). Integrating community-based verbal autopsy into civil registration and vital statistics (CRVS): system-level considerations. Global Health Action, 10:1

10 Serina, P., Riley, I., Stewart, A., James, S., Flaxman, A., Lozano, R., et al. (2015). Improving performance of the Tariff Method for assigning causes of death to verbal autopsies. BMC Medicine, 13, 291.

11 Guidelines for assessing verbal autopsy data. Available at: https://crvsgateway.info/file/13519/3231

12 Verbal Autopsy Interpretation, Performance and Evaluation Resource (VIPER). Available at: https://crvsgateway.info/VIPER

The status of cause of death data derived from verbal autopsies within civil registration and vital statistics systems

Data processing

The purpose of collecting birth and death data including COD is to establish a national vital events register. In addition to COD data, each entry will contain ID covariates. VA COD data and medical certificate COD data should both be entered along with ID covariates, but the source of each needs to be identified so that each can be analysed separately. National COD statistics will depend on harmonising results from the two data sources using advanced statistical techniques.

Civil registries might want to process COD data from VAs separately from COD data contained in a medical certificate. The medical certificate of COD is commonly used to initiate registration, and in almost all countries will be referenced in legislation. Because VA data are usually not obtained until a month or more after death, it will need to be linked to the record of the death after the death has been registered and a certificate of the fact of death has been issued.

Data storage and release

In addition to ID data and an assigned COD, the record of interview will contain background on the circumstances of the interview, responses to symptom questions and the open narrative. We recommend that the entire VA record have the same status as any other medical record, and it should be retained for a set period of time to enable:

- response to any legal issues that may arise. including family requests for information
- response to later questions about the most probable diagnosis
- data quality checking
- subsequent research.

The health department should decide how they will do this, where the record will be retained and what the processes for access should be.

One further issue is to decide whether a COD based on a VA should be entered onto a death certificate. In other words, what is the legal status of COD assigned by an automated process within a civil registration system? On the one hand, the COD assigned by VA could be wrong. On the other, it can be argued that a family may have a compelling reason such as an insurance claim to have an official death certificate that includes the COD. In line with the above, we suggest that a death certificate including the COD be issued only if authorised by a registered physician or panel of physicians after they have reviewed the record of the VA interview.

Verbal autopsy instruments and diagnostic methods

Available VA tools are described below. The development of automated diagnostic methods, and their corresponding instruments, remains an active area of research. In establishing a system of routine VA in countries, the focus should be on creating a flexible platform that can support the VA structure (i.e. death notification, VA interview, and automated analysis), while accommodating updates to the tools in the future.

A VA instrument comprises:

- an introductory section that provides ID data and gives the context of the interview
- questions about symptoms
- an open-ended narrative in which the respondent gives their own account of the terminal illness and events leading to death.

The introductory section is, or should be, common to all instruments, although countries may wish to adapt this to satisfy their own requirements for administration information. Symptom question items vary in terms of content, wording of the question, and order. Instruments also vary as to whether they are to be used by health workers or physicians.

Optimal characteristics of verbal autopsies for routine use in civil registration and vital statistics systems

The recommended optimal characteristics of a VA for use in CRVS systems are:

- **The shortest possible instrument that could provide valid cause of death information**
  The maximum period for asking symptom questions should be 30 minutes or less, including the open narrative, but not including time needed for introductions and collection of ID data, etc. The benefits lie not only in the amount of time that staff need to devote to interviews but in efficiencies for training and supervisory programs.

  Travel time for an interviewer is an important consideration. However, travel is a constant which cannot be changed, whereas the length of time that the respondent is asked to respond to questions can be altered by using a shorter, but still robust, instrument. A shorter interview has several advantages. Respondents are more likely to collaborate if they are informed about shorter rather than longer interview duration. The shorter the interview, the less likely respondents will be distracted or suffer respondent fatigue. Staff and data processing costs will be lower when only the minimum essential information to enable successful diagnoses is collected.

- **Age-specific criteria**
  VAIs should have separate modules for neonates, children and adults. Adult deaths are those aged 12 and above rather than the standard 15 years. Effectively, this reduces the lower limit of the reproductive age range in women so as not to miss maternal deaths.

- **Data collection on mobile devices**
  Data collection on mobile devices (tablet or phone) is less cumbersome than paper-based collection which has a greater need for supervision and review. The advantages of mobile devices include:
  - shorter interviews because of automated skip patterns
  - no need for checking for missing data post-interview
  - the programming of limits to data entry to minimise input errors
  - ability to demonstrate signs and symptoms through audio and visual aids
  - ability to upload directly to a server.

However, some countries may opt for paper-based collection, most probably because of lack of infrastructure and lack of technical support for IT at the periphery. It should be remembered that there is more room for error in recording the interview; secondly, either data will need to be entered separately into a computer for automated diagnosis or PCVA, or paper forms will need to be transferred to a central site for PCVA.

- **Automated diagnosis**
  The development of new VAIs over the last decade or more reflects general dissatisfaction with inefficiencies associated with PCVA. Arguments against PCVA relate to the difficulty of retaining an effective cadre of certifiers over extended periods of time and the associated salary costs. It should be recognised that in large systems, delays are to be expected with PCVA and results may not be available in a timely manner; this will translate into a greater length of time required to generate policy-relevant data. If PCVA is introduced because of lack of support for IT systems, it will need to be paper-based. If countries wish to adapt VAIs to meet particular interests, it should be stressed that this will compromise their amenability to automated coding.
- **Inclusion of open narrative**
  The open-ended narrative gives respondents the opportunity to tell their own story in their own words. Spontaneous recall of symptoms often carries more diagnostic weight than does prompted recall.[13]

Currently available verbal autopsy instruments

Over the past two decades or so, there has been considerable research carried out on the optimal methods for, and comparative performance of, various approaches to collecting and analysing data via the use of verbal autopsy. Two VAIs are available for consideration for routine data collection in national CRVS systems:

- the shortened version of the Population Health Metrics Research Consortium (PHMRC) instrument, which, along with an automated diagnostic method known as Tariff2.0, forms an integrated data collection and analysis package known as SmartVA.
- the 2016 World Health Organization (WHO) Verbal Autopsy Instrument (WHO 2016), which is intended to be applicable to several automated diagnostic methods, including InterVA, InSilicoVA, and Tariff2.0.

SmartVA was developed specifically for routine use in CRVS systems in developing countries and was intended for global use. It was based on the PHMRC VAI which, in turn, had been based on WHO 2007. The PHMRC study had the specific purpose of developing and validating automated methods for the analysis of VAs; these methods were to be based on empirical evidence and not on expert opinion. The PHMRC study led to the establishment of a validation database which contains 12,500 VAs paired with gold standard hospital death data where the COD was known as accurately as possible under the conditions of developing country hospital practice. The Tariff Method was among the most effective of a number of diagnostic methods, including PCVA. A short form of the PHMRC VAI was expressly developed for application and incorporation into national CRVS systems using an item-reduced VA questionnaire to collect only the essential information to successfully diagnose the probable leading causes of death.[14] This was achieved by a formal item-reduction process which took into account the contribution each question made to diagnosis. This analysis used the PHMRC Validation Database. The code for the short form of the PHMRC VAI was rewritten as SmartVA for use on mobile devices; it is automatically analysed by the Tariff 2.0 method. Both the electronic VAI (short form) and the SmartVA Analyze application can be found at: www.healthdata.org/verbal-autopsy/tools. The source code for SmartVA Analyze is available at: https://github.com/ihmeuw/SmartVA-Analyze

13 Serina, P., Riley, I., Stewart, A., James, S., Flaxman, A., Lozano, R., et al. (2015). Improving performance of the Tariff Method for assigning causes of death to verbal autopsies. BMC Medicine, 13, 291

14 Serina, P., Stewart, A., Flaxman, A., Lozano, R., Mooney, M., Luning, R., et al. (2015b). A shortened verbal autopsy instrument for use in routine mortality surveillance systems. BMC Medicine, 13, 302

An additional application of SmartVA is in countries where physicians are required to medically certify a death by law, even in cases where the doctor did not treat the deceased and was not present at the time of death. 'SmartVA for Physicians' differs from SmartVA performed by non-physicians. Firstly, the sequence in different sections of the VA questionnaire has been changed to make it more applicable to certifying physicians, commencing with the open-ended narrative and past history, followed by the system-based structured questions. The certifying doctor may find that the open-ended interview and past history provide sufficient information to write the death certificate without the need to continue with the full VA questionnaire. If not, he/she can conduct the full structured interview, download this to a computer and apply the SmartVA Auto-Analyse application to obtain the COD. Physicians can choose from up to three possible causes from the VA output (which also includes the likelihood of dying from each cause: possible, somewhat likely, likely, very likely) or an alternative cause based on their interview with the relative of the deceased.

WHO 2016 is derived from three preceding instruments – WHO 2007, WHO 2012 and WHO 2014 - and incorporates all SmartVA variables.[15] The intention is that it will be possible to use WHO 2016 to apply several diagnostic algorithms, including Tariff, InterVA and InSilico VA, requiring the user to separately develop and apply decision rules to choose the most probable cause of death in the case where the various diagnostic algorithms yield different causes of death. It is unclear how frequently this will occur, but previous research into differences in diagnostic outcomes across various methods suggests this scenario will not be uncommon.[16]

The InterVA (Interpreting Verbal Autopsy) diagnostic program has been widely used in association with the WHO VAIs, and is publicly available.[17] The current version is InterVA-5.1. Based on Bayes' rule for conditional probabilities, for each death, InterVA produces values for the likelihoods of each cause, given the indicators reported as present in a VA interview and a set of evidence. It makes use of physician- and evidence-derived conditional probabilities that give the likelihoods of various indicators being associated with various causes. For each death, InterVA reports single- s value point estimates for the likelihoods of up to three causes, with the largest likelihoods falling above a set threshold; otherwise, the cause is ruled 100 per cent 'indeterminate'. If the sum of likelihoods for a death's reported causes is less than 100 per cent, this reflects uncertainty around that case, and is recommended to be assigned as a residual 'indeterminate' component. Thus, the total likelihoods, summed over all cases, equals the total number of deaths. Full details, source code and compiled executables that implement InterVA-5 (version 5.0) are available.

InSilicoVA is a statistical algorithm that, for a set of deaths, identifies the most likely joint probability distribution of CSMFs and probabilities of each cause for each individual death. This is done using a Bayesian hierarchical model fit using a Gibbs sampling algorithm that uses information on both the presence and absence of VA indicators and the conditional probability of each VA indicator for each COD. Those conditional probabilities can be borrowed from InterVA or calculated from the PHMRC Gold Standard dataset or another source of reference deaths. InSilicoVA reports probability distributions and summaries of those distributions for each CSMF, as well as the probability of each COD for each individual death. This is a first step in accounting for the inherent uncertainty in assigning CODs using VA. The current version of InSilicoVA supports the WHO 2012 and WHO 2016 standard VA indicators and cause lists, identical to InterVA-4 and InterVA-5.[18]

The quality of the PCVA depends on the intensity of training and supervision, and is not considered to be sufficiently cost efficient in low-resource settings. Under routine conditions, it does not perform as well as Tariff.[19] Experience from long-running mortality surveillance systems such as Matlab in Bangladesh, is that it is difficult to maintain a cadre of physician-certifiers over the medium term.[20]

15 Nichols, EK., Byass, P., Chandramohan, D., Clark, S.J., Flaxman A.D., et al. (2018) The WHO 2016 verbal autopsy instrument: An international standard suitable for automated analysis by InterVA, InSilicoVA, and Tariff 2.0. PLOS Medicine

16 SmartVA for Physicians overview and User Guide can be found at https://crvsgateway.info/file/15126/3919 and https://crvsgateway.info/file/14682/3844

17 Available at: www.interva.net

18 Free, open-source software (including source code) implementing InSilicoVA is available for the R statistical programming environment at https://cran.r-project.org/web/packages/InSilicoVA/index.html

19 Murray, C, Lozano, R, Flaxman, A, Serina, P, Phillips, D, Stewart, A, Jakob, R. et al. *Using verbal autopsy to measure causes of death: the comparative performance of existing methods*. BMC Medicine. 2014 12:5. Available at: https://doi.org/10.1186/1741-7015-12-5

20 Fauveau V, editor. Matlab: women, children and health. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh, 1994:65-77. (ICDDR,B Special Publications, 35).

Preparation for the introduction of verbal autopsies into civil registration and vital statistics systems

Introducing VAs within a CRVS system requires a step-by-step process. The process should be guided by both a national CRVS committee and local experts with knowledge of mortality patterns.

Stage 1: Laying the groundwork

Step 1.1 Establish a national mortality technical working group and verbal autopsy subgroup

A national mortality TWG should be established with the overall aim of improving COD statistics. This group may be a sub-group of the larger CRVS stakeholder group that already exists in many countries. It should review mortality data from all available sources. It needs to be broadly representative of data collectors and users (civil registry, national statistics office, and ministry of health) and of medical professional organisations relevant to the implementation of improvements in COD data. It should become a vehicle for communication with different agencies and institutions.

Sub-groups should then be established to oversee and review the implementation of two major interventions:

- the introduction of the International Classification of Diseases (ICD) and improvements to the quality of medical certification of COD in hospitals
- the development of a fully-fledged VA function as part of a national CRVS system.

The VA subgroup (the VA TWG) may need to be led by the ministry of health, but should involve other sectors in the CRVS system. There should be links between the VA sub-group and the ICD sub-group. Technical issues for implementation of VA into CRVS might be left to the working group or sub-group, but wider issues such as changes in legislation, links and data flow between VAs and the CRVS system should be decided by the national stakeholder group.

Step 1.2 Consider the need to review and, if necessary, revise legislation and rules relevant to verbal autopsies as part of a civil registration and vital statistics system

The VA TWG, in consultation with the national stakeholder group, should review relevant legislation and rules to identify the changes or new legislation and rules needed to facilitate the integration of VAs within a CRVS system.

These are likely to include legislation and rules around:

- who is licensed to issue medical certificates
- obligations for families to report deaths and obtain a death certificate before cremation and burial
- requirements for physicians to certify or assign likely COD
- the recording and retention of data in the national civil registry
- confidentiality, data sharing and data security
- entitlements of families, including access by the family to the COD assigned by the VA and to the record of VA interview (it is suggested that these be equivalent to legislation and regulations affecting informed consent in hospital and the access of families to hospital records)
- the need for informed consent before a VA.

Step 1.3 Develop a detailed business process map delineating the processes that lead to registration of deaths and assigning cause of death

Detailed process maps[21] are a prerequisite for designing the integration of VAs into CRVS systems. These maps should depict all major steps, processes and activities related to notifying, registering and certifying deaths in the CRVS system and requirements, rules, and information flows concerned with capturing the mortality event.

This 'blueprint' of the CRVS architecture allows all stakeholders to have a common understanding of the current system. These maps are necessary to enable effective participation in designing how the CRVS and VA steps (declaration, notification, registration, certification, VA interview, VA analysis, linking COD and fact of death, validation, quality control, data transfer, production and dissemination of vital statistics and reports, etc.) are to be integrated into the CRVS system.

Step 1.4 Establish the roles, links and data flow between verbal autopsies and the civil registration and vital statistics system

To establish the likely roles, links (and possible barriers) to the integration of VAs into the CRVS system, the model of common processes should be compared with the business process map.

This step is to establish the principle of integrating VA within the CRVS system. It ensures the basis of the critical link between VAs and the CRVS system is understood and agreed. The issue of data flow also relates to hospital COD information within CRVS. It is imperative that there is a mechanism for flow between different sectors and stakeholders.

Recommended common processes:

- the notice to conduct VA should ideally come from the civil registrar
- links are needed between the registrar and health sector for reporting COD (including through medical certificates)
- collection of VAs should be supervised through the health sector, because of their expertise related to supervision for training, quality assurance, counselling for family members etc.
- ideally, the health sector would be responsible for notifying community deaths (and ultimately conducting VAs to identify COD) as well as reporting on COD from facility deaths in order to streamline the link for this data to the CRVS system.

Note: if there are no mechanisms or political will to create a mechanism to connect VA and CRVS, VAs should not be implemented in the country.

Stage 2: Reviewing the resources

Step 2.1 Review national experience and resources for the collection and interpretation of verbal autopsy data

Whether VA has been used in the country and in what format needs to be considered in the design. For example, field testing of instruments may not be necessary if this has already been done in- country. It will be important to identify the expertise that exists for VA in-country or in other countries in the region. This step is critical to understand the current environment under which the country will be implementing VA. Considerations might include:

- learning lessons from Health and Demographic Surveillance System (HDSS) sites and Sample Vital Registration with Verbal Autopsy (SAVVY) – what has worked and not worked from previous experience?
- establishing what existing expertise there is in-country. However, note that the level of program support for VA for research purposes will be higher than can be expected for routine VA
- deciding what value from earlier efforts can be applied to routine VA

21 This topic is covered in the companion paper: (de Savigny et al, 2016). and in 'Understanding CRVS systems:The importance of process mapping' Found at: https://crvsgateway.info/file/9847/46

- discovering what tools (instrument and diagnostic methods) have been used in-country previously. For example, what materials are currently available in the local language?
- understanding capacity in terms of human resources (HR), supervision and sustainability
- identifying what other institutional support is available. For example, what other agencies have been involved and how can we foster links?

The extent to which existing HR, materials and expertise from other initiatives can be used will need to be discussed and negotiated with the relevant stakeholders.

Step 2.2 Decide on the cadre of workers that will collect verbal autopsies

The accuracy of assigned COD from VA is heavily dependent on the quality of the interview.

The choice of the cadre of workers for VA in routine CRVS needs careful thought and will vary by country. Optimal characteristics include secondary education and formal links with the health sector (other factors, such as proficiency in various languages may take priority in some countries).

The advantages of collecting VAs through health services include their ethos and staff experience in dealing with matters of death and disease. However, the choice of instrument and data collection method (see Steps 3.1 and 3.2) will also be a factor since they may require different skill sets and tasks.

The level of health or community worker technically capable of conducting VAs needs to be identified. A simple guide to technical capacity is to relate the complexity of collecting VAs to workers' current clinical responsibilities. For routine VAs, the cadre of worker that has both the skills and time availability needs to be considered, as well as the preferences of the country (for example, regardless of what is believed to be the 'ideal' interviewer, some countries will prefer doctors or medical aides to conduct VAs whereas others will rely on a more peripheral health worker).

Then it needs to be assessed whether it is feasible to introduce this task to these workers. Some questions to consider are: What are the opportunity costs and absorptive capacity of this cadre? What are the total set of tasks assigned to this person (e.g. interview, downloading information onto the computer) in addition to other roles? It will also be important to factor in travel time; some ideal interviewers may not have the time to add this task to their work. It should also be noted that interviewers may experience burn-out and require emotional support; grieving families need to be handled carefully and appropriate de-briefing and other support should be provided to interviewers. Remembering that this is our model for routine VA, the sustainability and potential burn-out of workers needs to be considered.

This step also relates to Step 2.1, which assesses the capacity that already exists in-country. The current capacity of the workforce in country related to VA has implications for the speed of the roll-out and the extent of the training and ongoing support needed.

Step 2.3 Identify an appropriate cadre of supervisors

The supervisory role and mechanism are critical to the success of this intervention and to ensure that adequate quality control is maintained. A preferred ratio of supervisors to interviewers should be identified that takes into account the country context, previous skills and experience of both supervisors and interviewers, and estimated number of VAs to be conducted. Supervisors may have pre-existing supervisory roles. The more qualified the interviewers, the less supervision will be needed. However, a robust and reliable communication mechanism will need to be established between interviewers and supervisors. Given the range of supervisory tasks related to VAs, the capacity of potential supervisors to conduct these activities will need to be thoroughly investigated.

Ideally supervisors need to have capacity (skills and time) to:

- train interviewers
- assess the quality of interviewers and make necessary changes
- if feasible, allocate the most appropriate interviewers to conduct particular VAs (e.g. an experienced woman for neonatal and child deaths)
- schedule home visits (two to three months after death)
- provide a mechanism for counselling of interviewers (to prevent post-traumatic stress disorder)
- provide a mechanism for families to attend health facilities for counselling on probable COD
- oversee the mechanism by which VA results are fed back through the health system to the CRVS.

This is a significant task and supervisory capacity needs to be carefully thought through, particularly at peripheral levels of the system with few available staff.

It should be noted that supervisor travel to directly oversee interviewers is only one mechanism of supervision. Another is to use a key meeting where all VA interviewers would come to a facility/central point as a way to provide supervision and address queries and problems. A further mechanism is to take advantage of internet communications. These meetings might also provide an opportunity for de-briefing (group or individual counselling for interviewers) and for downloading VAs to computers from tablets.

Some resistance from supervisors to an increase in tasks can be anticipated. An assessment of absorptive capacity of both interviewers and supervisors is essential. Once a national strategy is identified, tasks can be institutionalised in training programs and incorporated as routine tasks for future staff. Indeed, the integration of VA methods into the pre-service training of both VA interviewers and their supervisors is an ideal way to ensure this task is considered integral to their role.

Step 2.4 Consider other workforce issues for routine verbal autopsies in a civil registration and vital statistics system

Other HR issues to be considered may include:

- the number and functions of staff available in civil registries, and what training and orientation they will need with any new processes
- the current functions and capacity for the management of IT services (see also Steps 2.5 and 2.6).

Step 2.5 Review existing IT services in relationship to the distribution of local civil registries and peripheral health facilities

It will be necessary to consider in detail:

- available wifi/mobile networks by which VA information can be transmitted from mobile devices to a central server[22]
- the distribution and availability of computers in peripheral health facilities which could be used for the uploading or entry of VA data in the absence of wifi/mobile networks
- processes and procedures for reporting of health information by peripheral health facilities
- the level(s) at which local reports are collated and prepared for reporting central authorities
- processes for data entry and data transfer among local civil registries
- capacity for electronic communication between health facilities and civil registries.

22 Note that VA data can be collected 'offline' and submitted later once internet/mobile network is available It is not necessary to have internet access to conduct a VA interview.

Step 2.6 Develop support systems for IT

IT systems will need the capacity to accommodate the various steps of VA needs. This should cover internet connectivity, interoperability between agencies (health and civil registry), protocols for communications and for conforming to the governance and rules and expectations of digital information, availability of necessary hardware, installation and trouble-shooting of software, and the availability of IT personnel.

This is also related to the information flow for VA COD between health and civil registration. It implies a level of integration and collaboration between agencies and their information systems. It also implies a basic level of IT infrastructure to run software, power tablets, upload information, analyse and interpret.

Stage 3: Setting up the model

Step 3.1: Select the verbal autopsy instrument and diagnostic method

Selection of the verbal autopsy instrument should be based on a careful consideration of the operational aspects of each method (e.g. interview time, diagnostic accuracy, COD list, etc.) and the optimal characteristics identified in this document.

The choice is essentially between the WHO 2016 instrument (fully compatible with Tariff, InterVA, Insilico automated diagnostic method) and SmartVA (fully compatible with Tariff 2.0). Countries will need to resolve how they wish to trade-off between criteria (e.g. of efficiencies associated with the retention of a specific method against the effectiveness of another).

Step 3.2: Decide on the data collection method

The collection of data on mobile devices is the most cost-efficient approach. A decision to continue with a paper-based approach requires more time to be spent on data collection and entry and costs associated with printing. A decision to introduce mobile devices, however, should consider the distribution of and support for IT services and the cost of hardware.

Both SmartVA and WHO 2016 are designed for use with mobile devices. This provides other benefits such as ability to show pictures and use sounds to aid symptom recall. It may also facilitate the link between civil registration and VA.

In an ideal system, registration details of the deceased may be pre-populated into the VA form on the device by the civil registrar before being sent to the health facility to conduct a VA. This ensures a unique identifier is assigned and that the COD information from the VA can be linked to the death registration file of the deceased once it is sent back to the registrar.

Questionnaires from SmartVA and WHO 2016 can be replicated in paper form if necessary. This is not optimal but may be necessary in some locations. Some believe a paper format is more personal and acceptable to interviewees. However, data collection by tablets has been done in various locations and found to be feasible and acceptable.

Step 3.3: Agree on output

The primary purpose of VAs is to provide a basis for estimating the patterns of CSMFs that are likely to prevail in a given population and, therefore, the use of VA in CRVS is useful for the purpose of providing better population metrics on cause of death for public health and population-level applications. One needs to be careful when using VA at an individual level and we are not advocating the use of VA to allocate individual CODs for legal reasons. The exception to this where physicians are required to write a medical certificate even in cases where they have not attended the patient before death. However, in this case, the physician uses VA as an aid to assigning a COD based on their interview of the relative of the deceased and it is noted that it is a VA death on the death certificate.

With respect to the aggregation of COD from hospital records and VA for the purposes of calculating population statistics, this is essential and achievable using appropriate modelling techniques. However, given the different methods for calculating the underlying COD, the means to identify where the information originated (i.e. in hospital record or through VA) needs to be retained. This is a technical issue and should be part of the quality assurance process.

The committee will need to decide if/how families will be informed about diagnosis. It is recommended that if a family requests an individual diagnosis they be given an appointment with a health professional who can review the VA report and discuss its implications.

The committee will also need to make recommendations about the circumstances and methods (e.g. a doctor does the VA interview and then certifies death) under which COD data derived from VAs will be included in a formal death certificate, and about the status of COD derived from VA on a national vital events register.

Step 3.4: Consider the final model for verbal autopsies that the country will be working towards

We strongly recommend that the final model be based on the collection of VA either from all registered deaths that lack an assigned COD, or from a representative sample of those deaths. The linkage of VA to death registration will help to define and strengthen civil registration generally.

VAs complement other COD data and provide additional information to these other sources (e.g. medically certified COD). Therefore, the strategy for VA roll-out will need to be considered alongside interventions to improve other information on COD and on the links between health and civil registration.

Step 3.5: Establish a means of integrating verbal autopsies with civil registration

Following a consideration of all the above aspects of implementation of VA, a plan for integration of VAs in CRVS systems can be presented to the national stakeholder group for consideration and approval.

This relates to notification of deaths to a civil registry, to requests from the civil registry to field staff to collect a VA, and to the subsequent reporting of the results back to the civil registry (see the model of common processes). Process maps developed at initial stages of CRVS strengthening (see Stage 1: Laying the Groundwork and Step 1.3: Develop a detailed business process map) will indicate the flexibility needed to accommodate the characteristics of the CRVS systems of a particular country and the possible entry points. The legal basis for these links will need to be established.

Step 3.6: Make recommendations about sampling

If a country does not have the capacity to collect VAs from all registered deaths without a medical certificate of COD, it will be necessary to design a method of sampling. This could either be a random sample of all such deaths within an administrative area or a sample of administrative areas.

Administrative units might be provinces, districts or subdistricts. The level will be determined by health and civil registry structures, by supervisory systems, and/or by the levels at which data is reviewed, collated and transferred.

Sampling of administrative units might be necessary because of lack of sufficient national support to cover the country as a whole or perhaps as part of a phased introduction of VAs.

Further details about possible sampling strategies for scale-up of VA in CRVS systems can be found in the companion paper.[23] Guidance on sampling is available to assist countries with their sampling strategy for VA.[24]

Operational and political considerations can be expected to affect plans for roll-out. Staged implementation may involve pragmatic decisions that do not provide a representative sample in the early stages. These early stages will be used to clarify the scale of the roll-out with regard to the need and availability of resources (i.e. HR, financial, infrastructure inputs). Purposive sampling may be necessary (i.e. starting where there is demand or political acceptability), or it may be best start in areas where capacity is greatest (due to previous VA work). However, there is also an argument to start in places with the poorest information on causes of death, since this will likely be of most policy value.

23 Savigny, D, Riley, I, Chandramohan, D et al. ***Integrating community-based verbal autopsy into civil registration and vital statistics (CRVS): system-level considerations.*** Global Health Action. 2017, Vol. 10. Available at: https://crvsgateway.info/file/16363/51

24 See: https://crvsgateway.info/Verbal-autopsy-sampling-strategy-tools~3123

Stage 4: Testing

Step 4.1: Review manuals

Three manuals to accompany the introduction of VA into CRVS systems are available (see *Training materials and support systems* in this document for links to access these resources online):

- technical user manual covering technical aspects of data collection, editing, and transmission and automated diagnostic methods for cause of death analysis
- interviewer manual covering interview techniques and ethics and all the questions within the VA questionnaire manual for the training of interviewers
- facilitator guide with suggested formats, sessions and associated materials for the teaching of VA.

Each of these will need to be reviewed to ensure that they are relevant to the circumstances of a particular country; they may also need to be translated.

Step 4.2: Translate the verbal autopsy instrument and or manuals into a local language, if required

Prepare a dictionary of local names and meaning for common signs, symptoms and diseases used in the VAI. Undertake cognitive testing. There are many issues associated with translation (especially those using non-Latin script) and sufficient time should be allocated for this purpose. The challenges associated with translation, digitisation and transcultural adaptation of VA questionnaires have been explored and recommendations made.[25]

Step 4.3: Arrange for assistance to download the translated instrument onto tablets

It will be very important to establish mechanisms for field support and trouble-shooting in countries, irrespective of which VAI and diagnostic method are chosen.

Step 4.4: Organise the training program

It is intended that staff who take part in the field testing will subsequently become trainers and supervisors (i.e. key staff in the implementation of VAs).

Step 4.5: Decide on the number of deaths for the field test

We suggest that the field test cover a minimum of 60 adult, 20 child and 20 neonate deaths. More deaths (e.g. 200 or 300) will provide more information on the applicability of the VA methods being considered. Procedures for the uploading of data onto a local computer for allocation of COD are covered in the technical manuals.

Step 4.6: Select a field site

Selection of a field site should take local circumstances, such as the presence of pre-existing mortality surveillance, into account. The site should be large enough to collect sufficient numbers of deaths and there should be good access to households. There will need to be a mechanism for identifying deaths. This is likely to involve household surveillance.

Step 4.7: Ensure quality assurance

Supervisors and trainers should observe interviews and debrief interviewers. This should be included in the initial training; the task could be rotated among trainees for practice. CSMFs should be reviewed for plausibility.

25 Challenges associated with automated VA training and rollout. Found at: https://crvsgateway.info/file/14702/47

Step 4.8: Design and evaluate a field test of the verbal autopsy procedures and make recommendations for implementation

The aims of this evaluation should be to identify problem questions, revise translation as necessary, modify training and training materials including instructions for uploading, evaluate adequacy of external support for trouble shooting, and to estimate the average person hours necessary for completion of a VA including uploading of VA interview data by staff category. These results should be formally evaluated by the VA TWG.

Step 4.9: Field test the verbal autopsy instrument

There needs to be careful timetabling of this phase. The accuracy of VA depends heavily on the quality of the interview. The success of the subsequent roll-out will depend on how well the field testing is done. In countries where instruments have already been tested, the TWG should consider moving directly to Phase 1 implementation.

Stage 5: Implementing verbal autopsies in a limited number of areas (Phase 1)

Step 5.1: Plan Phase 1 implementation

The TWG should review the results of the field test of the instrument and the implications for resourcing, and should provide guidance in developing and implementing Phase 1. It should set a clear timetable for the completion of implementation, typically three months or so.

This plan should also be considered alongside plans to improve COD data through hospitals, since there may be synergies or efficiencies for some activities.

Step 5.2: Select sites

The National Mortality Working Group should, if possible, select a minimum of two sites for implementation. Implementation may be phased between the two sites. This will necessitate obtaining local support and establishing local management. The selection of sites may be determined by demand, capacity or existing activities for VA. Health service staff should be fully informed about activities in their area and involved in the design of the implementation.

Step 5.3: Decide the target number of deaths

The National Mortality Working Group should establish indicative targets for the number of deaths that need to be collected as a basis for achieving the aims of the exercise as outlined above. The actual numbers of deaths collected will be dependent on mortality rates and the population size of catchment sites, as well as on the efficiency of procedures for notifying and registering deaths, and on staff and financial capacity, but should be of the order of 1000 to 1200 deaths for this phase. Staff capacity relates to the level of worker who will be collecting VAs, the average number of deaths to be collected by each worker over a set time period, and on their capacity to add VA collection to their existing workload.

It also relates to the availability of supervisors. Financial capacity relates, in particular, to travel costs. There will also be the initial costs of purchasing electronic tablets or IT infrastructure improvements.

Step 5.4: Review and revise the manual of procedures for field sites

Manuals will need to include standard operating procedures (SOPs) for linkage of VAs to the notification and registration of deaths, planning of home visits, quality control through observation of interviews and review of output, regular reporting, staff management, as well as SOPs for quality control for data management, including uploading data, storage, transmission, analysis, output, and reporting. Mechanisms for field support and trouble-shooting should be included.

Step 5.5: Implement program

The Phase 1 program can then be implemented.

Step 5.6: Evaluate

Once targets have been reached, the Phase 1 implementation should be fully reviewed. The results of Phase 1 implementation will determine how the national roll-out will proceed. Clear indicators are needed to evaluate different aspects of the process and of the data arising from the implementation. A suggested monitoring cycle on which to build indicators can be found in the companion paper.[26]

Step 5.7: Make recommendations for national roll-out

Once the implementation has been reviewed, a report should be made to the working group and the stakeholders about requirements for resources and the feasibility and extent of a national roll-out. The working group should also decide whether its own membership is sufficient for the implementation of a national program and report to the National Stakeholder Group.

Stage 6: Implementing a national plan for verbal autopsies (Phase 2)

Step 6.1: Design scale-up

Based on the review of Phase 1 and any recommendations that have been made, an incremental scale- up will need to be designed with inbuilt monitoring and evaluation.

Plans to provide ongoing technical or trouble-shooting support to countries will need to be established and resourced.

Step 6.2: Implement nationally

A fully functioning program can then be implemented.

26 Savigny, D, Riley, I, Chandramohan, D et al. *Integrating community-based verbal autopsy into civil registration and vital statistics (CRVS): system-level considerations.* Global Health Action. 2017, Vol. 10. Available at: https://crvsgateway.info/file/16363/51

Training materials and support systems

To ensure that VAs are as complete and useful as possible, it is important that staff are well trained in their collection.

Training materials

Information on various aspects of VA including IT 'How to' guides can be found on the CRVS Knowledge Gateway.[27]
To help interpret and understand the mortality data coming from VA, the following resources, also available on the Gateway, may be useful:

- Guidance for interpreting VA results:
  https://crvsgateway.info/file/13519/3231
- Verbal Autopsy Interpretation, Performance and Evaluation Resource (VIPER): https://crvsgateway.info/VIPER

For SmartVA, the following list of training materials to support roll-out of VA into CRVS systems are currently available:

- SmartVA: Technical user manual:
  https://crvsgateway.info/file/14920/60
- SmartVA: Interviewer's manual
  https://crvsgateway.info/file/14918/59
- SmartVA: Facilitator's guide (includes manual and associated slides and exercises)
  https://crvsgateway.info/file/16367/3130
- Electronic version of SmartVA instrument and media file (English)
  http://www.healthdata.org/verbal-autopsy/tools
- Paper version of SmartVA shortened questionnaire (English)
  http://www.healthdata.org/verbal-autopsy/tools
- SmartVA Auto-Analyse: User guide (also known as SmartVA for Physicians: User guide)
  https://crvsgateway.info/file/16365/3844

Similar support material for WHO 2016 VAI can be accessed at
https://www.who.int/healthinfo/statistics/verbalautopsystandards/en/

27 https://crvsgateway.info/

Technical support

It will be necessary to determine which of the following activities a country will be able to manage from its own resources and which will require external support:

- purchase of tablets
- preparation of VA questionnaire (local language) in Microsoft Excel (Excel) sheet
- conversion of local-language VA questionnaire Excel sheet into an electronic questionnaire form; this may involve change of script
- download and installation of ODK software onto tablets
- download and installation of VA electronic questionnaire and media files onto tablets
- development of processes for data transferring and uploading from tablet to central server
- develop communication between health facilities and civil registries
- training for IT personnel to support VA.

Ongoing support

The focus of this document has been on the initial phases involved in the introduction of VAs into CRVS systems. The next phase is the roll-out of national programs. In the next phase, more attention will need to be paid to scale-up and sustainability issues including the availability of technical and implementation expertise in-country or in the region. Countries will need to think in terms of establishing a community of best practice. In this next phase, countries might consider collaborative planning with regional CRVS partners such as the Asian Development Bank (ABD), United Nations Economic Commission for Africa (UNECA), United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), United Nations Children's Fund (UNICEF), WHO and the World Bank. They should be informed of national plans to incorporate automated VA into CRVS systems and encouraged to participate in collaborative activity in building local and regional capacity.

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