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CRVS best-practice and advocacy

Challenges associated with automated VA training and rollout

March 2018





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Contents

Abbreviations	4
Key terms	4
Key points	5
Challenges associated with automated VA training and rollout	6
The importance of cause of death data.....	6
What is verbal autopsy, and why do it?	7
Why use electronic VA data collection?	7
Challenges associated with automated VA training and rollout	8
Health worker use of the digital tablet.....	9
Digitising local script into android devices.....	9
Language and translation issues relating to the VA questionnaire	10
Transcultural adaptation challenges	10
What action can be taken to support automated VA rollout?	12
Recommendation 1: Pre-empting issues with non-English language scripts	12
Recommendation 2: Thorough translation process of the VA questionnaire	12
Recommendation 3: Comprehensive training of VA interviewers	12
Recommendation 5: Supervision and monitoring of VA interviewers	13
Recommendation 6: Research	14
Recommendation 7: Frequent follow-up from technical partners.....	14
Summary	15
Related resources and products	17
University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Library	17
University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Learning Centre	17
University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Courses	17
Further reading	17



Abbreviations

D4H	Bloomberg Philanthropies Data for Health Initiative
COD	cause of death
CSMF	cause-specific mortality fraction
CRVS	civil registration and vital statistics
IT	information technology
LMICs	low- and middle-income countries
MCCOD	medical certification of cause of death
PHMRC	Population Health Metrics Research Consortium
VA	verbal autopsy
WHO	World Health Organization

Key terms

Cause of death:	refers to 'all those diseases, morbid conditions or injuries which either resulted in or contributed to death and the circumstance of the accident or violence which produced any such injuries' (Twentieth World Health Assembly, 1967)
Underlying cause of death:	is 'the disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury' (World Health Organization, 1994).
Verbal autopsy:	is a structured interview carried out with family members and/or caregivers of the deceased to elicit signs and symptoms and other important information which can be used to assign a probable underlying cause of death.



Key points

- Cause of death information is critical for countries for effective health policy, planning, and resource allocation.
- In an ideal system, every death would have a medically certified cause of death. However, in many countries most deaths occur away from hospitals, in the home, in areas without physicians, or in health facilities with limited diagnostic capacity. When people die in these circumstances, it can be difficult to know what they died from.
- VA is a method for determining the most likely cause of death based on information collected from caregivers or family members about the signs and symptoms experienced by the deceased in the period before he or she died.
- Automated methods are now available to analyse VA questionnaire data and associate patterns in the data with a probable underlying cause of death.
- Process mapping how deaths are currently notified, registered and certified is an important first step before implementing VA.
- Automated VA requires a supportive IT environment, to ensure that the data collected can be transferred between all levels of the CRVS system.
- Countries taking steps to upskill health workers in how to use digital tablets or mobile phone devices to collect VA data, especially in rural areas, might come across challenges around:
 - health worker use of the digital tablet
 - digitising local script into android devices
 - language and translation issues
 - transcultural adaptation.
- Accurately translating the VA questionnaire into a country's local language is an important and time-consuming task, which should include forward- and back-translation and pilot testing.
- A range of strategies exist to prevent these challenges from arising, including:
 - configuring tablets with keyboards in the local language
 - ensuring smartphones used for automated VA data collection can display Unicode-supported scripts
 - ensuring a thorough translation process of the VA questionnaire
 - comprehensive training of VA interviewers
 - supervision, support and monitoring of VA interviewers.



Challenges associated with automated VA training and rollout

This *CRVS development series* paper explains what verbal autopsy (VA) is, and identifies and discusses some of the challenges associated with the introduction of automated VA data collection. Challenges range from broad governance-level issues including understanding how VA will be linked to the notification, registration and certification of deaths, and ensuring sound information technology systems are in place at all levels to support VA data collection, transfer, analysis, and storage.¹ The specific challenges that this paper focuses on relate to those that can arise during the translation and transcultural adaptation of the questionnaire, and technological challenges related to non-Roman (non-Latin) scripts. This paper can serve as a useful resource for governments and partner agencies, especially in low- and middle-income countries, looking to implement VA on a digital tablet or smartphone to be used by community-based health workers.

- **Why is cause of death data important?**
- **What is verbal autopsy, and why do it?**
- **Why use electronic VA data collection?**
- **What are some of the challenges associated with automated VA training and rollout?**
 - **Health worker use of the tablet**
 - **Digitising local scripts**
 - **Language and translation issues**
 - **Transcultural adaptation issues**
- **What action can be taken to support automated VA rollout?**
- **Summary**

Cause of death information is critical for countries for effective health policy, planning, and resource allocation

The importance of cause of death data

Health systems exist to maximise population health, prevent premature death and disability, and treat those who are sick. An efficient health system requires accurate, reliable, timely and complete information about who dies (age, sex) from what (cause of death), and where, to:

- monitor and evaluate disease, injury, and cause of death trends in populations
- evaluate the effectiveness of programs and policies to prevent premature death
- identify emerging challenges to health
- provide insights into neglected health problems
- informs epidemiological research priorities into the causes of disease and injury
- monitor progress with national, regional, and international health development goals.

In an ideal system, every death would have a medically certified cause of death

Cause of death (COD) information is critical for countries for effective health policy, planning and resource allocation. Without this information, the effectiveness of the health system to prevent premature death is likely to be severely compromised. Policy debates and health priorities will be developed in the absence of evidence, and national monitoring of health goals will be impossible.²

¹ de 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; 10: 1272882.

² AbouZahr C. Verbal autopsy: who needs it? *Population Health Metrics* 2011; 9: 19.



What is verbal autopsy, and why do it?

A verbal autopsy is a standardised interview, used to gather information about the signs and symptoms of the deceased prior to their death

Ideally, information about deaths would be provided by a well-functioning civil registration and vital statistics (CRVS) system, where every death is given a medically certified cause by a medical practitioner. However, this ideal is rarely met, especially in low- and middle-income countries (LMICs). Moreover, poor, marginalised and rural populations tend to die from different causes and at different rates than wealthier and urban populations. In many countries, a high proportion of deaths occur outside the medical system or in facilities with limited capacity to determine cause of death. Many of these deaths, even if registered, will not have a medically certified cause, meaning policy-makers lack the essential information to help prevent the deaths.

In countries seeking to improve their civil registration and vital statistics (CRVS) systems, verbal autopsy (VA) is the only practical alternative to the medical certification of cause of death (MCCOD), particularly in communities where a large proportion of deaths occur outside of health facilities.³

Verbal autopsy is a method for collecting information about an individual's signs and symptoms prior to their death from their family or next of kin, and interpreting these to diagnose the likely or most probable cause of death (COD).⁴ The principal purpose of a VA is to describe the cause composition of mortality through the estimation of cause-specific mortality fractions (CSMFs). Verbal autopsy also serves as a cost-effective tool for filling the gaps in mortality data.⁵ Studies suggest that VA can provide population-level COD data similar in quality and reliability to medical certification of cause of death in hospitals.⁶

The VA process consists of three basic steps:

1. Setting up an interview by a trained VA staff member at the household level (or other appropriate place).
2. Conducting a structured interview to collect information on signs and symptoms of illnesses, and events that the deceased suffered before death.
3. Interpreting the interview data to diagnose the most probable COD (historically, this was done by physicians, however automated methods are now widely available).

Why use electronic VA data collection?

Automated methods can analyse VA questionnaire data and associate them with probable underlying COD

In the past, VA questionnaire data were generally analysed by expert medical practitioners who had knowledge of the local context. In paper format, this method was costly and slow if human resources were unavailable. The reliability of this approach also suffered from observer bias. In addition, physician-certified VA is time consuming, taking doctors away from delivery of essential health services. This can be especially problematic in resource-poor settings.

In response, automated methods of analysing VA questionnaire data have been developed. Automated methods are as reliable as physicians in diagnosing COD from VA interviews, involve minimal ongoing costs, and can easily recognise symptom patterns in the data and correctly associate them with the most probable underlying COD.⁷

3 Sankoh O, Byass P. Time for civil registration with verbal autopsy. *The Lancet Global Health* 2014; 2: e693-e694.

4 de 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; 10: 1272882.

5 Joshi R, Praveen D, Jan S et al. How much does a verbal autopsy based mortality surveillance system cost in rural India? *PLoS ONE* 2015; 10(5): e0126410.

6 Hernández B, Ramírez-Villalobos D, Romero M et al. Assessing quality of medical death certification: concordance between gold standard diagnosis and underlying cause of death in selected Mexican hospitals. *Population Health Metrics* 2011; 9: 38.

7 Zhao Y, Joshi R, Rampatige R et al. Use of smartphone for verbal autopsy: results from a pilot study in rural China. *Asia Pacific Journal of Public Health* 2016; 28: 601-610.



Automated VA data collection methods (often using a digital tablet) have clear advantages over VA questionnaires in paper form that rely on physician review. These include:

- reducing or eliminating data entry costs and data entry errors
- speeding up dataset production and analysis
- reducing or eliminating missing or invalid data from VA questionnaire forms (by using real-time logic checks and preventing the interviewer from skipping relevant unanswered questions)
- speeding up the interview process (by using automated skip patterns)
- reducing costs (ie by not having to pay for physicians to review the questionnaires)
- being easily and rapidly deployed in the field, and
- being more consistent, accurate and reliable.

Challenges associated with automated VA training and rollout

Process mapping is an important first step before implementing VA

The Bloomberg Philanthropies Data for Health (D4H) Initiative has identified a number of potential challenges that may arise for countries in their training and rollout of automated VA. At a broad governance and system-level, countries need to understand how VA will be linked to the notification, registration and certification of deaths. For instance, a national CRVS committee (or subcommittee), through CRVS process mapping exercises,⁸ should conceptualise and consider how VA (including automated VA) could be best integrated into the country's CRVS system (see **Figure 1**).

Automated VA requires a supportive IT system

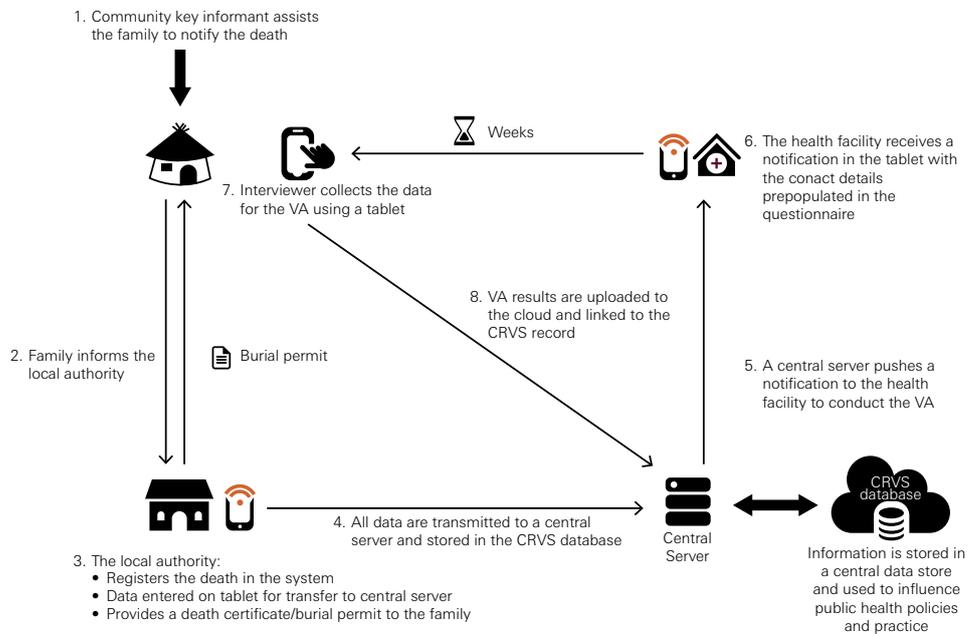
A second challenge is to ensure sound information technology (IT) systems are in place at all levels of the system. By introducing automated VA, policy-makers will have access to reliable information on patterns of mortality and COD for rural, remote and community deaths. However, these COD data will only be useful if governments can access them through sound IT systems. Countries must ensure supportive IT systems and IT support staff for effective integration of VA data.

Four common challenges, which have been identified as part of the BD4H Initiative, will be discussed in this paper:

1. Health worker use of the digital tablet
2. Digitising local script into android devices
3. Language and translation issues relating to the VA questionnaire
4. Transcultural adaptation issues.

⁸ de Savigny D, Cobos Muñoz D. *Understanding CRVS systems: The importance of process mapping*. CRVS development series. Melbourne, Australia: Civil Registration and Vital Statistics Improvement, University of Melbourne, Bloomberg Philanthropies Data for Health Initiative; 2018.

Figure 1 Integrating automated VA data collection into a CRVS system, example flow diagram



Source: de 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; 10: 1272882.

Health worker use of the digital tablet

VA interviewers who lack experience in using android devices will likely need close supervision and support from their supervisors as they grow more comfortable using digital tablets and other devices to conduct VA. Additional time may need to be invested in the training of VA interviewers who lack previous exposure to android technology.

Digitising local script into android devices

A number of countries, such as Bangladesh, Sri Lanka and Myanmar, do not use a Roman (Latin) written script; each has local languages with unique scripts. VA specialist technicians and their in-country partners might experience issues around ensuring that digital tablets can properly display the translated VA questionnaire in the correct script, and that the VA interviewer can type responses to questions into the tablet in the same language.

Issues may also arise relating to digitising written script on smartphones used for VA interviews.



Accurately translating the VA questionnaire into a country's local language is an important and time-consuming task

Language and translation issues relating to the VA questionnaire

Accurately translating the content of the VA questionnaire from English into a country's language (or languages) can be challenging. In-country field testing is important, because it is often during this testing phase that language and 'meaning' challenges come to light. Issues usually arise over the accurate translation of medical terminology and disease conditions or symptoms. Issues of translation and interpretation are context-specific, and can be quite complex, for example:

- The English word or term may not have an equivalent in the country's language – this is often the case for medical terminology.
- Local community members might be more familiar with the English words (for example, 'diabetes' or 'stroke') than their translated version.
- In some languages, there might not be the equivalent of absolute 'yes' or 'no' responses, but the response will vary with the question asked.
- While the VA questionnaire has been written in an informal language to facilitate easy and clear communication with community members, translation can become difficult as some languages only have a formal written language (with many informal spoken dialects).

VA interviewers might also be required to paraphrase or give additional explanation for words or phrases on the VA questionnaire that remain unclear to the respondent. This has implications for the standardisation of the VA interview, where different interviewers might use different methods to explain symptoms or conditions.

Also, although English is widely spoken in many non-English speaking countries, especially within the medical community or among ministry of health officials at the national level, this is not necessarily the case for staff located at local health facilities (for example, community-based midwives and public health supervisors). Often, it is these local staff who are responsible for conducting the VA interview.

Training materials on VA should be translated and regularly updated

Training of the VA master trainers, therefore, might require the use of an experienced interpreter to ensure that all aspects and content of the automated VA training are fully comprehended. Moreover, the VA questionnaire, automated VA manuals, training slides and materials will need to be translated via a forward and back-translation process (**Box 1**), with revisions required when there are changes to those materials due to updates to questionnaires or training methods.

Transcultural adaptation challenges

When introducing an automated VA information collection process into a new country, region or district, adaptation challenges are likely to arise.⁹ A number of these linguistic and technological adaptation challenges have already been raised so far in this paper. However, cross-cultural or transcultural adaptation challenges will very likely emerge, as the new automated VA instrument is adapted for use in a specific new environment.

The sensitive nature of the VA interview itself in different sociocultural settings needs to be acknowledged.¹⁰ This is because each country and culture has unique values, structures and belief systems. Bereaved respondents are also vulnerable to emotional distress, which the

9 Herdman M, Fox-Rushby J, Badia X. A model of equivalence in the cultural adaptation of HRQoL instruments: the universalist approach. *Quality of Life Research* 1998; 7: 323-335.

10 Gouda HN, Kelly-Hanku A, Wilson A, et al. "Whenever they cry, I cry with them": Reciprocal relationships and the role of ethics in a verbal autopsy study in Papua New Guinea. *Social Science and Medicine* 2016: 163; 1-9.

Local context and customs around death and bereavement should be taken into consideration when implementing VA

VA interview or the timing of that interview might exacerbate.¹¹ Other potentially sensitive factors that need to be borne in mind by the VA interviewer include the type or underlying cause of death (for example, if the death is perceived by the community as having stigma attached), gender-related and blame issues, and crime-related deaths.

Box 1: Forward translation and back translation and cognitive testing – process of translation and adaptation of instruments suggested by the World Health Organization

“The aim of this process is to achieve different language versions of the English instrument that are conceptually equivalent in each of the target countries/cultures. That is, the instrument should be equally natural and acceptable and should practically perform in the same way. The focus is on cross-cultural and conceptual, rather than on linguistic/literal equivalence. A well-established method to achieve this goal is to use forward translations and back translations”¹²

Forward translation

The translator should preferably be a health professional, or have much experience in translating medical or health-related documents. The translator’s mother tongue should be the primary language of the target product, but they also require a strong knowledge of English and English-speaking culture. Ideally, translators will be familiar with VA terminology and data collection processes. Emphasis in the forward translation should be on conceptual and cultural equivalence and not linguistic equivalence. Translators need to use natural and acceptable language when translating the VA questionnaire, aiming to engage the broadest public audience.

Back translation

Once translated, the VA questionnaire should be translated back to English by an independent translator. Preferably, the back translator’s mother tongue is English and he/she has no knowledge of the questionnaire. As in the forward translation, emphasis in the back translation should be on conceptual rather than literal translations. Discrepancies or problematic words or phrases that do not correctly or completely capture the concept should be brought to the attention of the appropriate organisation and further translation work done, until a satisfactory translated version is achieved.

Pre-testing and cognitive interviewing

It is necessary to pre-test the instrument on the target population. Each module or section should be fully tested, and there are a number of different methodologies that can be applied.



What action can be taken to support automated VA rollout?

Devices used for conducting and storing VA information should support local language scripts

Recommendation 1: Pre-empting issues with non-English language scripts

The ability of android devices to both read and respond in different scripts has implications for the script used in the translation of the VA questionnaire for uploading onto the tablet. The Unicode-supported versions of all scripts should be uploaded onto tablets during the tablet preparation phase, which will help ensure that digital tablets are able to display local scripts properly.

- Configuring tablets with **keyboards in the local language** is also best practice. When tablets are being prepared, IT staff should upload the Unicode keyboard of the script being used so that VA interviewers can type responses in the local language.
- Smartphones being used for automated VA should also be able to display **Unicode-supported scripts**. This means that VA interviewers need to be provided with newer models of smartphones that support Unicode. Governments should consider standardising a set of minimum specifications for smartphones (such as android version 2.0 and above).

Recommendation 2: Thorough translation process of the VA questionnaire

Countries planning to use automated VA would benefit from investing in a thorough translation process. This process should involve forward- and back-translation (**Box 1**). Cognitive pre-testing with different stakeholders, including local workers, should be done to ensure that the lay terms used are easily understood and acceptable to both VA interviewers and respondents. Pre-test respondents should include individuals representative of those to whom the questionnaire will be administered. The translation should be updated following field-test observations and discussions with the VA interviewers. The accuracy and quality of the translation should be reviewed and updated as needed in the early stages of automated VA implementation. Where appropriate, the English term for medical conditions or symptoms should be included side-by-side with the local translation of the term.

Recommendation 3: Comprehensive training of VA interviewers

Thorough training is essential to ensure that, where language issues exist, VA interviewers can provide adequate and standard explanations around medical terminology. This will entail a comprehensive session involving question-by-question review of the VA questionnaire, and an emphasis on areas of particular concern in each country that have arisen from previous trainings and practice. A medical dictionary of common terms and symptoms should be developed and used during the training. This dictionary should be updated as additional language issues come to light. VA interviewers should be encouraged to refer frequently to this dictionary as well as the VA interviewer manual (which explains how to ask each question) to ensure they are confident in explaining all questions in the VA questionnaire.

Implementing automated VA involves a comprehensive training package for interviewers, supervisors, and IT support staff

Comprehensive training on how to best explain difficult questions to respondents will increase standardisation among interviewers. Dialect differences also need to be taken into consideration. VA interviewers should receive cultural or context-specific training on potential transcultural adaptation challenges they may experience in administering the VA questionnaire to bereaved family members. VA interviewers should also be encouraged to be flexible and responsive – for instance, to recognise when it might be best practice to ensure a

female VA interviewer is interviewing a female respondent.

How the training and rollout of automated VA will occur will depend on context, including country, government policy, planning, guidance and overview. Some countries might prefer to utilise a 'training of trainers' approach, where a small group of health staff known as 'master trainers' (for example) are trained on automated VA by VA specialist technicians, with the master trainers then going on to train a cluster of in-country VA interviewers. Another training approach may involve training the VA interviewers directly. **Box 2** gives an overview of topics that should ideally be covered in automated VA interviewer training. Field testing is always recommended.

Box 2: Recommended topics covered in automated VA interviewer training¹³

- What is CRVS and why is it important?
- Why cause of death information is important and how it can be used in policy and planning
- What is VA, and what is automated VA?
- Ethics and sensitivity training
- Identifying deaths for VAs
- Roles of interviewers and supervisors
- Overview of the VA questionnaire
 - Interviewers' understanding of the translated questions
 - Interviewer techniques, such as interaction with respondents, including how to build relationships and rapport with respondents, handle potential issues and obtain adequate answers to questions.
- General instructions on automated VA digital tablet use (or mobile phone use) for administering the VA questionnaire, as well as basic troubleshooting solutions.
- Role-playing of scenarios to simulate interviews, including the use of tablets.
- Field practice sessions (with time for debriefing).

Recommendation 4: Community-level advocacy and awareness-raising

In addition to training VA master trainers and interviewers, it is important to inform communities of the purpose of VA, especially those unaware of the VA process. The objective is for community members to have confidence that VA is a routine process for each death: no family or death will be singled out, the information gathered will be confidential, and the purpose of VA is not to examine individual problems or apportion 'blame' for a death. It should be made clear that VA is to address the health of the community as a whole so that governments can efficiently allocate resources to improve community wellbeing. This awareness-raising step is essential to ease any community suspicion of VA interviewers' motives and how the VA data will be used.¹⁴

¹³ University of Melbourne. *SmartVA: Interviewer's manual*. CRVS resources and tools. Melbourne, Australia: Civil Registration and Vital Statistics Improvement, University of Melbourne, Bloomberg Philanthropies Data for Health Initiative; 2018.

¹⁴ Gouda HN, Flaxman AD, Brolan CE, et al. New challenges for verbal autopsy: Considering the ethical and social implications of verbal autopsy methods in routine health information systems. *Social Science and Medicine* 2017: 184; 65-74.



Recommendation 5: Supervision and monitoring of VA interviewers

VA is not new, but automated VA is. As such, interviewers need close supervision, monitoring and support in these initial stages. Countries would be wise to invest in routine supervision and reporting systems to ensure that VA interviewers receive guidance and feedback on how they conduct VA. This will also improve overall monitoring and evaluation efforts to ensure a quality VA program.

Recommendation 6: Research

To address the cultural and social barriers related to automated VA, as well as the content and timing of VA questionnaire implementation, countries should consider engaging in formative research activities on cultural sensitivity and community members' responses to certain questions. Relevant cultural, epidemiological and administrative considerations need to be considered by research teams.¹⁵ This research will likely be qualitative in nature, and can provide key insights into potential barriers to accurate data collection and ways VA interviewers could overcome these barriers. Findings from such studies could inform training programs. Community-based participatory research on VA could serve as an important vehicle for raising community awareness around VA.

Recommendation 7: Frequent follow-up from technical partners

In the early stages of automated VA training and rollout, many countries will likely need to collaborate with external technical partners that specialise in CRVS and VA. Without ongoing communication, in-country capacity building and follow-up among countries and their technical partners (especially local technical partners and stakeholders), it will be difficult to ascertain whether VA training efforts are fruitful. It will also be hard to tell whether technological and transcultural challenges relating to automated VA data collection have been identified and mitigated, and whether the resulting COD data are reliable and of sufficient quality.

¹⁵ Baiden F, Bawah A, Biai S, et al. Setting international standards for verbal autopsy. *Bulletin of the World Health Organization* 2017; 85: 570-571.



Summary

Cause of death information is critical for countries for effective health policy, planning, and resource allocation. An efficient health system requires accurate, reliable, timely and complete information about who dies (age, sex) from what (cause of death), and where. Ideally, information about deaths would be provided by a well-functioning civil registration and vital statistics system, where every death is given a medically certified cause by a medical practitioner. However, in many countries most deaths occur away from hospitals, in the home, in areas without physicians, or in health facilities with limited diagnostic capacity. When people die in these circumstances, it can be difficult to know what they died from. Many of these deaths, even if registered, will not have a medically certified cause, meaning policy-makers lack the essential information to help prevent the deaths.

Verbal autopsy is a method for collecting information about an individual's signs and symptoms prior to their death from their family or next of kin, and interpreting these to diagnose the likely or most probable cause of death. In the past, VA questionnaire data were generally analysed by expert medical practitioners who had knowledge of the local context. However this approach is often costly, slow, and took physicians away from the delivery of essential health services. In response, automated methods of analysing VA questionnaire data have been developed. Automated methods are as reliable as physicians in diagnosing COD from VA interviews, involve minimal costs once established, and can easily recognise symptom patterns in the data and correctly associate them with the most probable underlying COD.

The Bloomberg Philanthropies Data for Health Initiative has identified a number of potential challenges that may arise for countries in their training and rollout of automated VA. These range from broad governance-level issues, to those discussed here relating to the adaptation of VA questionnaires to the local context, and involve both language and translation issues, and transcultural adaptation.

There is a range of strategies to prevent and mitigate these challenges, including configuring tablets with keyboards in the local language, ensuring smartphones used for automated VA data collection can display Unicode-supported scripts, ensuring a thorough translation process of the VA questionnaire, comprehensive training of VA interviewers, and the supervision, support and monitoring of VA interviewers. Taken together as part of local capacity building, with the support of external partners, these strategies will help to ensure the successful implementation of automated VA.

Related resources and products

University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Library

<https://crvsgateway.info/library>

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

Integrating community-based verbal autopsy into CRVS: System level considerations. CRVS technical outcome series.

Intervention: Automated verbal autopsy. CRVS summaries.

SmartVA: Interviewer's manual. CRVS resources and tools.

SmartVA: Technical user guide (V1.0). CRVS resources and tools.

University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Learning Centre

<https://crvsgateway.info/learningcentre>

Topic 2: CRVS governance and architecture – CRVS stakeholder analysis.

Topic 4: Cause of death in CRVS – Automated verbal autopsy; Incorporating verbal autopsy into the civil registration and vital statistics system.

Topic 6: CRVS tools – Automated verbal autopsy tools.

University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Courses

<https://crvsgateway.info/courses>

SmartVA.

Verbal autopsy costing tool.

Further reading

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

Serina P, Riley I, Stewart A. et al. A shortened verbal autopsy instrument for use in routine mortality surveillance systems. *BMC Medicine* 2015: 13; 302.

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

Civil Registration and Vital Statistics partners:



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