Cause of death assignment by physicians from verbal autopsy data

Manual for Physician Reviewers

World Health Organization

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V1

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Contents

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Executive Summary

This manual serves as a comprehensive guide for physicians assigned to determine the cause of death from verbal autopsy (VA) data. VA methods are used to ascertain the cause of death when the event occurs in the absence of medical attention. It involves interviews with caregivers of a deceased to obtain information on symptoms and circumstances during the illness leading to death. This is followed by a review of the collected information, either by a physician or automated algorithm, leading to the assignment of a probable cause of death. Physician-certified VA (PCVA) is a widely accepted method of analysing VA data, aligning with international practice for assigning causes of death. Recent efforts have focused on developing automated methods for assigning cause of death for VA through computer coded VA (CCVA), which is critical for supporting the routine use of VA integrated with civil registration and vital statistics (CRVS) systems. Although it acknowledges the central role of automated methods, the manual highlights the continued importance and use of PCVA.

The manual describes the definitions, concepts, and guidance on certifying and coding causes of death from VA, based on the International Classification of Diseases for Mortality and Morbidity Statistics (ICD). It outlines the process of identifying underlying, immediate, and antecedent causes of death, as well as contributory causes. Specific considerations are given for the certification and coding of causes included in the World Health Organization (WHO) target list of causes of death for VA, including stillbirths, perinatal causes, infectious diseases, COVID-19, non-communicable diseases, and neoplasms.

It also provides information on the principles and applications of VA methods, including the structure of the VA questionnaire and the characteristics of the WHO VA instrument.

Additionally, the manual provides an overview of standards for statistical tabulations of causes of death, diagnostic guidance for all causes on the WHO target list for VA, and a broad training curriculum for medical practitioners in the assignment of cause of death from VA data.

1 Background

Mortality statistics form an integral part of vital statistics systems. They are one of the basic inputs for tracking population health and change. Further, cause-specific mortality rates are key indicators of population health trends and differentials. Statistics on causes of death are required by health planners, administrators, and medical professionals, and are useful to:

- explain trends and differentials in overall mortality
- identify and decide priorities for intervention programs
- prioritise resource allocation to and within the health sector
- monitor public health programs
- determine priorities for biomedical and sociomedical research
- provide pointers to needed epidemiological research.

Mortality statistics, as compared to morbidity, are particularly advantageous for these purposes, as they can be collected efficiently on a routine basis through vital registration systems. Also, statistical analysis of mortality data is facilitated by the fact that death is a unique, clearly defined and final event, resulting in one count per individual as compared to multiple episodes of morbidity. A complete health information system includes both mortality and morbidity data. By combining the insights from current health conditions with historical health exposures and outcomes, such a system provides a robust framework for epidemiological analysis and informed decision-making.

The most efficient way of collecting data on mortality and causes of death is through civil registration and vital statistics (CRVS) systems, in which every death is legally registered with information on age and sex, along with a medical determination of cause of death. A civil

registration system that captures all deaths and their causes in the resident population requires significant human and financial resources. Where civil registration is incomplete, a viable alternative for public health purposes is death enumeration in a nationally representative sample of population clusters. This approach has been shown to provide reliable information on mortality levels and trends in overall mortality in a population. However, the absence of medical attention at death impedes accurate medical certification as to cause. At a minimum, mortality surveillance should be established in selected sentinel sites, where data collection procedures and practices could be tested as a basis for further scale up.

To fill the existing data gap on causes of death, verbal autopsy (VA) methods hold promise as an interim measure while CRVS systems with medical certification of cause of death (MCCD) are built up to full efficiency. These methods have been developed to ascertain the cause of death when the event occurs at home and in the absence of medical attention. By definition, VA is an interview with relatives or caregivers of the deceased, to obtain information on the signs, symptoms and events experienced during the illness leading to death. The information collected is reviewed and analysed either by a medical practitioner or by an automated algorithm, leading to the assignment of a cause of death using standard diagnostic guidelines for specific conditions.

The accuracy of cause of death ascertainment from VA is highly dependent on the structure and content of the VA questionnaire, quality of the interview, and procedures used to assign causes of death. The quality of the interview alone can be affected by a range of factors related to interviewer, respondent, or both, including the time elapsed between the death and the interview. The method has been proved to work satisfactorily for ascertaining causes of death in infancy and children under five, or due to specific conditions such as injuries, HIV or maternal causes. Adult deaths tend to be characterised by the description of multiple symptom complexes, making it more difficult to clearly distinguish specific causes of death. For these, the added value of the information extracted from existing and available medical records collected during the VA interview as well as the narrative section, can be particularly important in aiding the diagnosis. In some instances, the family of the deceased may possess some medical evidence on the illness preceding death, either verbal or documentary, based on the decedent's visits to health facilities prior to death. For adult deaths especially, such information can include details about non-communicable diseases (NCDs) such as neoplasms, diabetes, and cardiovascular conditions. When available, this information can enhance the scope and applicability of the VA interview.

Pilot studies in Tanzania,[1] China,[2] India,[3] Indonesia,[4] and Viet Nam,[5] have successfully tested a combination of demographic and mortality surveillance using VA in a representative sample of population clusters, leading to the development of a framework for measuring population level cause-specific mortality using VA methods.

While mortality data by age and sex strictly adhere to the principle of one death-one count, the situation becomes more complex when extended to the recording of the cause of death. Frequently, there are multiple conditions that could have caused the death, which could be:

- sequential stages in the natural history of one disease
- complications arising from one of the intermediate conditions
- different diseases existing simultaneously at the time of death.

To overcome this problem, the World Health Organization (WHO) recommends the use of a standard 'Medical Certificate of Cause of Death', which enables the recording of several causes. However, to enable uniform statistical presentation and interpretation for international comparison, the WHO also developed the concept of the underlying cause of death, which is defined as the disease or condition that initiated the sequence of events or the circumstances of the injury that eventually resulted in death. There are specific instructions for recording all identified causes of death and their durations in specific sections of the death certificate, following which standard coding rules are applied to select and code the underlying cause for each death, for primary statistical analysis. The guidelines for MCCD and

[1] 'CRVS Strengthening With SAVVY Implementation — MEASURE Evaluation', Publication, accessed 7 February 2024, https://www.measureevaluation.org/resources/publications/ws-16-26.html.
[2] Lijun Wang et al., 'Evaluation of the Quality of Cause of Death Statistics in Rural China Using Verbal Autopsies', *Journal of Epidemiology and Community Health* 61, no. 6 (June 2007): 519–26, https://doi.org/10.1136/jech.2005.043927.
[3] Anand Krishnan et al., 'Mortality in India Established through Verbal Autopsies (MINErVA): Strengthening National Mortality Surveillance System in India', *Journal of Global Health* 10, no. 2: 020431, accessed 7 February 2024, https://doi.org/10.7189/jogh.10.020431.
[4] Yuslely Usman et al., 'Indonesia's Sample Registration System in 2018: A Work in Progress', *Journal of Population and Social Studies [JPSS]* 27, no. 1 (2019): 39–52, https://so03.tci-thaijo.org/index.php/jpss/article/view/142010.
[5] Nguyen Phuong Hoa et al., 'Mortality Measures from Sample-Based Surveillance: Evidence of the Epidemiological Transition in Viet Nam', *Bulletin of the World Health Organization* 90, no. 10 (1 October 2012): 764–72, https://doi.org/10.2471/BLT.11.100750.

coding of underlying causes have been essentially developed for deaths attended by physicians, either within hospitals or within the community.

Analysis of cause of death from verbal autopsy

The Physician-certified VA (PCVA) which is the use of physicians to review completed VA questionnaires and assign causes of death, is a widely accepted method of analysing VA data. To align this function with standard international practice for assigning causes of death, the WHO international VA standards published in 2007 recommended the use of the format of the international medical certificate of cause of death form for VA physician review.[6] This recommendation enables the assignment of a probable underlying cause of death from the multiple potential conditions identified by the physician from reviewing the VA questionnaire. This offers a level of detail in cause of death assignment akin to that provided by MCCD (that is detailed ICD coding). This recommendation remains for the most recent 2022 WHO VA instrument. However, it is important to be aware that the cause of death derived from VA data does not have the same legal status as that based on a completed MCCD and should not be used for legal purposes.

More recently, automated methods or algorithms have been developed to assign probable cause of death from VA, computer coded VA (CCVA). CCVA has emerged as an important supportive element in the integration of routine VA use in CRVS systems. CCVA may offer a more cost-effective, efficient solution for producing cause of death information for deaths that occur without medical attention. CCVA assigns probable causes of death based on a predetermined list of causes considered to have sufficient reliability for VA assignment and of public health importance. As new causes of death emerge and become relevant, such as COVID-19, CCVA may require time to adjust and incorporate these into its coding system.

Despite the growing use of CCVA, PCVA maintains a critical role in several capacities:

- to aid in the process of adapting and ensuring the acceptability of VA methods, as they are integrated routinely into local CRVS systems;
- for quality control and validation purposes;

[6] Here referred to as the VA cause of death form.

- to support disease-specific surveillance efforts;

- to support the ongoing development, improvement, and verification of automated cause assignment methods.

This manual provides guidance on standard practices for physicians designated to assign causes of death from VA data. It presents a broad overview of the principles of selection and coding of the underlying cause of death, as prescribed by the WHO. At the same time, it offers guidance on how these standard practices may be adapted for VA applications where resource constraints warrant the primary use of automated methods for cause of death assignment for VA.

Section 2 describes the principles and applications of VA methods, largely focusing on the technical aspects of the nature of interviews and design of questionnaires. It is important for physician reviewers to be aware of these principles and practices in using VA methods for ascertaining causes of death, particularly insofar as they differ from the principles underlying methods of enquiry to diagnose illness in their patients. **Section 3** describes the basic definitions, concepts, and guidelines for certifying causes of death using the standard international medical certificate or cause of death. The WHO recommends that all primary tabulations on causes of death should be based on the underlying cause of death. Therefore, a complete understanding of the concepts of underlying cause of death is critical for personnel responsible for coding causes of death according to the principles of the ICD, and these are described in Section 3.1. Section 3 emphasizes the importance of listing all identified causes (also commonly termed as multiple causes) on the death certificate, along with examples of specific coding rules that apply to the selection of the correct underlying cause where certain combinations of multiple causes are listed on the death certificate.

Section 4 describes issues related to the nature of information that could be available from VA for certain causes of death, and considerations that may be required in assigning these causes. While physician reviewers would be aware of the clinical significance of the details described here, it may be useful for them to consider the same within the context of VA diagnosis.

Section 5 provides a brief overview of standards for statistical tabulations of causes of death according to sex, age group and cause categories. It also includes the list of cause categories recommended by WHO for tabulation of VA data.

Section 6 provides diagnostic guidance for the causes/cause groups included in the WHO target list of causes of death for VA. These guidelines have been developed specifically for the VA context, considering the likelihood of obtaining relevant data for formulating a diagnosis.

The last chapter in this manual – **Section 7** - provides a broad training curriculum for medical practitioners in the assignment of cause of death, as well as for staff responsible for ICD coding and statistical tabulation of data.

In terms of implementation, physician reviewers would mostly be expected to complete a VA cause of death form, while selection of the underlying cause and ICD coding would be conducted by a cadre of well-trained specialist coders or by available automated methods (such as Iris). Coders who are deployed to support PCVA would therefore also benefit from this manual, in terms of understanding the manner in which causes of death are ascertained from information gathered through household interviews, and how these are listed on the cause of death certificate. As a third alternative if specialist coder teams or automated coding are not available, it is acceptable for physicians trained in cause of death assignment to also conduct the coding function as an interim solution, if necessary. A close collaboration and feedback system between physician reviewers, ICD coders, and VA interviewers would have a beneficial effect on the final quality of the cause of death data that derived from a national mortality and cause of death reporting system.

2 Principles of verbal autopsy

Since many deaths in the population where VA is applied occur outside health facilities in the absence of medical attention, the practice of VA methods has been adopted to obtain the best evidence available to identify the probable cause of death for such cases. By original definition, VA involves an interview of the relatives or caregivers of the deceased to elicit details of symptoms, signs, clinical events/circumstances during the illness preceding death, and an evaluation of the collected information by physician reviewers or automated algorithms, to reason out a probable cause of death.

Cause of death ascertainment using VA was principally developed to provide information where there was very limited access to health care and is based on the following two key assumptions.

- The symptom complex for each disease of interest is unique, such as neonatal tetanus or motor vehicle accidents.

- Respondents can accurately recall symptoms and their timing.

These assumptions have been successfully validated for causes of infant deaths and a few clearly demarcated causes of adult deaths such as injuries and pregnancy related deaths. Certain common causes of adult mortality could be easy to recognize by the community, based upon their cardinal symptoms e.g., cerebrovascular disease (VAs-04.02 Stroke) causing one-sided paralysis, chronic breathlessness, and cough in chronic obstructive pulmonary disease (COPD). However, other common communicable diseases (tuberculosis, malaria, HIV) and NCDs (neoplasms, diabetes, renal, digestive tract disorders etc.) have overlapping symptomatology, which makes it difficult to clearly distinguish one from another even for clinical diagnosis, let aside VA. Also, as described earlier, there could be multiple illnesses or conditions in an individual, either sequentially or simultaneously. This is particularly so in the case of adult deaths. All the same, it is now recognized that while many adult deaths still occur at home or outside registered health facilities, the deceased could have accessed some

health care in the period preceding death. For these reasons, the VA interview includes the collection of relevant health facility access and health care data from the family of the deceased. This could include details from available medical documents, or any opinion on the illness conveyed to the family by the consulted health professional. In some contexts, it might be possible for the health facility to be contacted to obtain more detailed information, if consent for this is obtained from family members.

2.1 Characteristics of the WHO verbal autopsy instrument

VA questionnaires are used to collect information on the history of illness, symptoms, and signs preceding death to ascertain the cause of death. The 2022 WHO VA instrument is designed for use with an electronic data collection platform (i.e., ODK Collect). Through the use of skip patterns driven by the age and sex of the deceased, the WHO VA questionnaire is structured for three age groups: under 4 weeks; 4 weeks to 11 years; and 12 years and above.

The principal causes of death in each of these age groups differ, and by developing a separate set of questions for each group, the scope and duration of the interview is effectively limited. The layout and question flow during the VA interview is structured using skip patterns which allow the recording of only pertinent data depending on the nature of the case.

2.1.1 General structure of the verbal autopsy questionnaire

The VA questionnaire is divided into several sections, containing both common sections and specific sections targeted to the age and sex of the deceased. The general structure of the 2022 VA questionnaire, includes the following sections:

1. Preset HIV-Malaria mortality and season (the project office may make this question hidden to the interviewers in the electronic format)
2. Information on the respondent and background about interview
3. Information about the deceased and vital registration
    a. Information on the deceased
4. Open narrative (text field)
    a. Check list of additional items to record in the narrative open space
5. Medical history associated with final illness

6. History of injury/accidents
7. Health history
    a. Duration of illness
    b. General signs and symptoms associated with final illness
    c. Signs and symptoms associated with pregnancy and women
    d. Neonatal and child history, signs and symptom
    e. Health service utilization
    f. Civil registration numbers
    g. Death certificate with cause of death.

In addition to the general questions, the questionnaire contains sections and questions that are specific to the circumstances of the death. For example, a section on the condition of a deceased child's mother during and after pregnancy; events during birth and immunization history is included only for perinatal and infant deaths. A checklist of symptoms and their duration specific to women of reproductive age (12 - 49 years) and older, covers symptoms and signs specific to women, and those associated with pregnancy. A section on injuries is common to all age groups. Sections on risk factors are also in the adult questionnaire, collecting data on socio-economic status, tobacco and alcohol use; and where possible, obesity, and other cardiovascular risk factors.

The key component of the VA interview is the symptom duration checklist, which includes questions intended to provide enough information to arrive at a valid cause of death, and to exclude differential diagnoses. It is pertinent here to point out several key aspects in assessing the quality of the information derived from these questions to construct a diagnosis, by distinguishing between clinical histories which medical practitioners are accustomed to using regularly, and VA interviews.

A VA interview relates to a clinical event that occurred prior to the interview. Furthermore, the respondent is not the person who experienced the symptoms/illness, but is the one who observed or knows about the symptoms /signs reported/described by the deceased. This explains the somewhat 'lay' design of the symptom duration checklist, in terms of use of terminology, and level of clinical detail sought. Medical practitioners are able to review information similar to a clinical history record, which include questions and specific details and characteristics of individual symptoms – for example, number of diarrhoeal episodes per day, specific variations of breathlessness, duration of cough and fever, etc. They consider these questions important to verify the diagnosis, since their treatment plans hinge on such

verification of the diagnosis. Physicians should interpret with caution questions on specific details and characteristics of individual symptoms as the recall bias is likely to be higher than for some major or grossly visible symptoms that respondents are more likely to remember (such as presence of diarrhoea, presence of blood in sputum). Table 1 highlights some conceptual differences between design characteristics of a clinical history and a VA interview, and it is useful for medical practitioners involved in VA studies to consider these aspects, while evaluating information from VAs to identify probable causes of death. More details of the actual process of cause of death assignment from VAs are provided in later sections.

Table 1. Differences between clinical histories and verbal autopsies

Design characteristic	Patient history	Verbal autopsy
Motive	Preliminary step in search for exact diagnosis to plan treatment	Retrospective questioning to identify underlying cause of death with reasonable certainty
Respondent	Patient in person	Primary caregiver (usually a family member),[7] who should not be expected to remember anything more than gross details
Procedure	Interview followed by physical examination, and possibly investigations etc.	One-off interview[8]
Recall period	Generally, a few days, since onset of symptoms	Weeks / months Recalls of more than 1 year should be interpreted with caution
Interviewer	Physicians / assistants whose notes are reviewed by examining physicians	Mostly non-physician interviewers
Instrument	Narrative written after completing interview, and composing thoughts, requires much training and practice to become skilled	Interview is guided by the recording of full verbatim account by the respondent of circumstances leading to death in the open narrative section followed by a structured questionnaire.
Disease classification	Any possible disease	Search for a limited number of causes, which are: • important causes of death in the population

[7] In the absence of family members, VA respondents can be friends, neighbours, health workers, public officials or anyone who was with the deceased in the period leading to death or a witness to a sudden death or accident.
[8] Follow up interviews can be conducted for quality control purposes or to correct/clarify any information according to supervisors' instructions.

Design characteristic	Patient history	Verbal autopsy
		• characterized by symptoms easily recognized and recalled by the community • uniquely identified from symptoms.

Given this background, VA can at best be considered an imperfect method to arrive at a probable cause of death (with the use of CCVA) or, at best, probable underlying cause of death (with the use of PCVA), applicable in situations where there is no reliable data on cause specific mortality, in the form of medical opinion on cause of death.

Although basic forms of VA have been in use for the past 5 decades, interest in VA has increased recently as a practical and cost-effective method to obtain data of public health importance. Despites its limitations, the usefulness and applicability of VA has broadened and VA can generate more data on some aspects of mortality than civil registration alone, including for example, population characteristics, risk factor profiles, access to health care facilities, health care seeking behaviour, etc. Such information is important to inform health system analysis, planning and policy.

As mentioned earlier, the VA questionnaire records several types of information related to the cause of death, in addition to the symptom duration checklist. It is likely that each completed VA questionnaire would contain information from at least some, if not all these diverse sources. However, this depends on the quality of interviews conducted, and VA interviewers play an important role in this respect. Since the information recorded from the VA questionnaire is used to assign the cause of death, high quality data collection is important. This document offers guidance on the selection of VA interviewers and WHO has developed training manuals to conduct specialised training programs for VA interviewers and supervisors.[9] Local implementers of VA should develop manuals that are based on and adapted from the existing WHO VA standard manuals, including the VA field interviewer manual and the training manuals for interviewers and supervisors; and provide field support through on-site supervision and training by experienced personnel.

[9] *https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool*

Despite this, there may be some shortcomings in the data collection. In this regard, physician reviewers have an important role to play in identifying problems in the data collection that render ascertainment of cause of death difficult and providing feedback to the field interviewers. To assist this process, it would be useful for medical practitioners to familiarise themselves with the field interviewer's manuals and training programs. Also, their participation in feedback sessions during field interviewer refresher training sessions conducted periodically will improve the quality of data collection over time.

Several other issues could also influence the quality of data collection and processing. Important factors include the respondent's age, sex, educational status, relationship to the deceased, and presence within the household during the illness or at the time of death. In general, the mother is considered the most appropriate respondent for child deaths, the sister for maternal deaths, and spouse for adult deaths. Interviewers are also trained in selection of the most appropriate respondent for the interview, and certain details of the respondent are also available from the questionnaire. However, the medical reviewer has to take these into account along with all the other information collected on the questionnaire. Recall periods could influence the responses to the symptom duration checklist, as well as possible information regarding visits to health facilities or information conveyed by health professionals. The VA interviews should be conducted as soon as practically possible after the report of the death is received, but after any culturally prescribed mourning period has passed. In general, shorter recall periods are preferable and recalls of more than one year should be interpreted with caution. Finally, standardised protocols for assigning and coding causes of death, and tabulating statistics are also critical in the development of mortality measures that are comparable between populations and across time. It is important for medical practitioners tasked to assign causes of death from VA questionnaires to be cognizant of these aspects and take them into account as necessary.

In conclusion, despite its limitations, VA can serve as an interim measure to derive such information at the population level, until adequate health care systems are set up to provide wider coverage of medical certification, leading to availability of expert opinion on the cause of death as part of vital registration.

3 Cause of death certification: definitions and guidelines

Causes of death encompass all those diseases, morbid conditions, injuries, and the circumstances surrounding accidents or violence that contribute to death. A death often results from the combined effect of two or more conditions, which may be unrelated coexisting conditions or a series of causally linked events in a pathophysiological sequence. Where there is a sequence, it is important to ascertain the underlying cause of death, which is the cause that is selected for the purpose of tabulation. The underlying cause is defined as either:

- The disease or injury that initiated the sequence of events leading directly to death; or
- The circumstances of the accident or violence which produced the fatal injury.[10]

When several conditions have been identified to have occurred in the deceased, it is the responsibility of the physician reviewer to construct a chain of events that place the various conditions in sequence, i.e., one leading to the second to the third etc. (see examples below). Once the chain has been constructed, then the reviewer or the coder can select the underlying cause, as defined above, and illustrated below.

[10] International Statistical Classification of Diseases and Related Health Problems, 10th revision, fifth edition, vol. 2 (World Health Organization (WHO), 2016), https://icd.who.int/browse10/Content/statichtml/ICD10Volume2_en_2019.pdf.

Example 1:

Massive upper gastrointestinal haemorrhage
Due to
Bleeding oesophageal varices
Due to
Cirrhosis of the liver
Duo to
Chronic Hepatitis B infection
(VAs-01.99 Unspecified infectious disease)

It is evident from this case that Chronic Hepatitis B infection initiated the chain of events that resulted in the upper gastrointestinal haemorrhage and death, and hence Chronic Hepatitis B infection is selected as the underlying cause. From VA however, such detailed information would not be available, and in this case, the potential evidence may comprise the following:

Example 1- VA information sequence:

Recent vomiting of blood before death
Associated with
Prolonged jaundice and loss of weight since at least 1-2 years
With
Positive test for previous Hepatitis B infection
Underlying cause: VAs-06.02 Liver cirrhosis

All the above could be obtained from combined evidence from structured questions and the open narrative section. In case information on previous Hepatitis B is not available, then a diagnosis of liver cirrhosis would be appropriate. As mentioned in the diagnostic guidelines (See Section 6), information on other signs such as ascites (abdominal swelling due to fluid), or loss of consciousness (coma), and chronic alcoholism that would contribute to certainty of diagnosis, may also be listed in the causal sequence.

Example 2:

Aspiration bronchopneumonia
D*ue to*
Prolonged coma
D*ue to*
Cerebrovascular infarction
(VAs-04.02 Stroke)

For example 2, cerebrovascular infarction is adjudged as the underlying cause. From VA, the sequence of events may be as follows:

Example 2 – VA information sequence:

Fever, breathlessness /rapid breathing before death (VAs-01-02 acute respiratory infection, including pneumonia)

Due to

Prolonged bedridden state (coma)

Due to

Previous one-sided paralysis (cerebrovascular stroke)

Underlying cause: VAs-04.02 Stroke

Example 3:

Pulmonary embolism

Due to

Pathological fracture of femur

Due to

Secondary carcinoma of femur

Due to

Neoplasm of breast (VAs-02.04 Breast neoplasm)

Example 3 – VA information sequence:

Sudden breathlessness and collapse (pulmonary embolism)

Due to

Previous fracture of leg from minor trauma (pathological fracture)

Due to

Breast lump with chronic weight loss

OR

Previous diagnosis of Breast neoplasm

Underlying cause: VAs-02.04 Breast neoplasm

Example 4:

Acute pulmonary oedema

Due to

Left ventricular failure

Due to

Myocardial infarction

(VAs-04.01 Acute cardiac disease)

Example 4 – VA information sequence:

Severe breathlessness

Preceded by

Fainting and collapse (circulatory failure)

Following

Acute bout of chest pain

Underlying cause: VAs04.01 Acute cardiac disease

Example 5:

Traumatic shock

Due to

Multiple fractures of lower limbs and hip

Due to

Pedestrian hit by truck (road traffic accident)

(VAs-12.01 Road traffic accident)

Example 5 – VA information sequence: MISSING

Underlying cause:

Example 6:

Acute respiratory failure
Due to
Bronchopneumonia
Due to
Chronic obstructive pulmonary disease (COPD)
(VAs-05.01 COPD)

Example 6 – VA information sequence:

Terminal severe breathing difficulty (rapid / effort)
Preceded by
Episode of cough, sputum, fever, breathing problem
Associated with
Long standing breathlessness, chronic cough with progressive restriction in activity
Underlying cause: VAs-05.01 COPD

In each of the above examples, there is a clear sequence of events that can be constructed from detailed information available for most hospital deaths or those occurring with medical attention. Although sufficient detail would not be available from VA to make specific diagnoses, the above examples also illustrate the likely information from VA to deduce the causal sequence of events and probable clinical conditions within this sequence. In many instances, only one cause can be identified from the history and symptom duration checklist. In that case, only the identified cause needs to be listed on the certificate. Where more than one cause is identified, they should be listed in such a pathophysiological sequence of events, on the standard medical certificate of cause of death, shown in Figure 1 (i.e., including all sections of the International Form of Medical Certificate of Cause of Death).[11]In case there are causes present which do not fall directly in the pathophysiological sequence, they are to be listed in Part II of the certificate.

In 2014 there were important modifications to the ICD that include the format of the death certificate and the renaming of definitions, changes on rules and procedures for selection and modification of the underlying cause of death, which must be considered by certifying

[11] 'International Form of Medical Certificate of Cause of Death', in *International Statistical Classification of Diseases and Health Related Problems*, 10th revision, Fifth edition (World Health Organization (WHO), 2016), 203, https://icd.who.int/browse10/Content/statichtml/ICD10Volume2_en_2019.pdf.

physicians and coders. These appear in the Fifth Version (2016) of the Tenth Revision of the ICD and are reflected in the Eleventh Revision of the ICD that came into effect in 2022. In addition to the international format, annexes are included with recommendations for the correct filling out of the causes that are not included here (Figure 1).

Figure 1. International form of the medical certificate of cause of death

[12]

Administrative Data (can be further specified by country)																
Sex	☐ Female				☐ Male				☐ Unknown							
Date of birth	D	D	M	M	Y	Y	Y	Y	Date of death	D	D	M	M	Y	Y	Y	Y

FRAME A: ▶ Medical data: Part 1 and 2												
			▶ Cause of death							▶ Time interval from onset to death		
1.	Report disease or condition directly leading to death on line a		a									
	Report chain of events in due to order (if applicable)		b	Due to:								
	State the underlying cause on the lowest used line		c	Due to:								
			d	Due to:								
2.	Other significant conditions contributing to death (time intervals can be included in brackets after the condition)											

FRAME B: ▶ Other medical data									
Was surgery performed within the last 4 weeks?	☐ Yes	☐ No	☐ Unknown						
If yes please specify date of surgery	D	D	M	M	Y	Y	Y	Y	
If yes please specify reason for surgery (disease or condition)									
Was an autopsy requested?	☐ Yes	☐ No	☐ Unknown						
If yes were the findings used in the certification?	☐ Yes	☐ No	☐ Unknown						
▶ Manner of death:									
☐ Disease	☐ Assault	☐ Could not be determined							

[12] Additional data that might be necessary for individual countries' specific reporting system can be added to the certificate, but it should not replace the information shown in Figure 1.

☐ Accident		☐ Legal intervention			☐ Pending investigation						
☐ Intentional self harm		☐ War			☐ Unknown						
If external cause or poisoning:					Date of injury	D	D	M	M	Y	Y	Y	Y
Please describe how external cause occurred (If poisoning please specify poisoning agent)											
▶ **Place of occurrence of the external cause:**											
☐ At home	☐ Residential institution	☐ School, other institution, public administrative area		☐ Sports and athletics area							
☐ Street and highway	☐ Trade and service area	☐ Industrial and construction area		☐ Farm							
☐ Other place (please specify):				☐ Unknown							
▶ **Fetal or infant Death**											
Multiple pregnancy	☐ Yes	☐ No		☐ Unknown							
Stillborn?	☐ Yes	☐ No		☐ Unknown							
If death within 24h specify number of hours survived				Birth weight (in grams)							
Number of completed weeks of pregnancy				Age of mother (years)							
If death was perinatal, please state conditions of mother that affected the fetus and newborn											
▶ **For women, was the deceased pregnant?**		☐ Yes	☐ No	☐ Unknown							
☐ At time of death		☐ Within 42 days before the death									
☐ Between 43 days up to 1 year before death		☐ Unknown									
Did the pregnancy contribute to the death?		☐ Yes	☐ No	☐ Unknown							

Where there is a clear-cut sequence of events on the certificate, the cause of death listed on **the lowermost line** of the sequence in Part I, which initiated the train of events leading to death, is now defined as the Tentative Staring Point (TSP) by Step SP3 and, if there are not notes or modification rules that must be applied during the coding procedure, this will be the underlying cause of death.

For practical purposes, the cause listed on the **topmost line** of the sequence is referred to as the **immediate cause of death**, since it is the terminal event that occurred, leading to the death. While constructing the chain of events, it is essential to note that modes of death such as respiratory failure, heart failure, or brain death etc. should not be considered as immediate causes of death.

All other causes listed on **lines in between** the underlying cause of death (on the lowermost line), and the immediate cause (on the topmost line) are referred to as **antecedent causes of death.**

Sometimes (notably among adults) there are other significant medical conditions present in the deceased, which do not fit into any defined sequence of events, but may contribute in an indirect manner to the final event of death. For instance, in the first example, if the deceased also happened to suffer from COPD, then during the VA, relatives of the deceased may also provide information about the symptoms and signs of COPD. Or, in the second example, the deceased may have been suffering from diabetes, which may be elicited in the history. In such situations, those diseases or conditions that are independent of the causal chain of events (which originated in the underlying cause and terminated in the immediate cause) are defined as **contributory causes of death** and must be noted in Part 2 of the death certificate and with the duration of each one in parentheses if it was available.

3.1 Coding and selection of the probable underlying cause of death

NOTE: This section describes standard procedures for coding and selecting the underlying cause of death in legal systems for MCCD; in PCVA, it is understood that this step involves assigning a probable underlying cause of death that should only be used for statistical purposes only, not for legal purposes.

The previous section describes the process to be followed in assigning the cause of death, including the meanings of terms used to identify different stages in the pathophysiological sequence of events leading to death. Of these, the most important is the underlying cause of death, since all primary tabulations of causes of death by age and sex are to be based on underlying causes. Most instances of correct death certification would lead to the condition entered on the lowermost line on Part I of the certificate to be the underlying cause of death.

While the concept of underlying cause of death appears relatively straightforward, it is not commonly implemented by physicians at the time of death certification. This could be due to several reasons, including insufficient training, presence of multiple independent conditions, or confusion as to the chronological sequence of events. However, there is a need to identify an appropriate underlying cause of death, and the WHO has developed a set of rules and

guidelines for this purpose. A cadre of well-trained ICD coders (usually medical records administrators), who may or may not be supported by the use of automated coding systems, is the ideal solution for a national mortality and cause of death reporting system, including for PCVA where relevant. However, as such cadres do not yet exist or are still being established in countries where VA is most likely to be used routinely, physicians who complete the VA cause of death forms can themselves apply the ICD rules for selecting and coding the probable underlying cause of death. Once selected, the (probable) underlying cause needs to be assigned a specific alphanumeric code. This section includes a basic description of the WHO system for selection and coding of the (probable) underlying cause of death, commonly referred to by the acronym ICD.

The current definition of the ICD is the International Statistical Classification of Diseases and Health Related Problems. Its original use was to classify causes of mortality as recorded at the registration of death. Later, its scope has been expanded to classify diseases and other health related problems recorded on many types of health and vital records. Although the ICD is primarily designed for the classification of diseases and injuries with a formal diagnosis (and hence the retention of the original acronym ICD, despite the expanded definition), the current version includes a wide variety of signs, symptoms, abnormal findings, complaints, and social circumstances that may appear in place of a diagnosis on health-related records and may be important for analysis. The ICD first originated in 1893. The tenth revision (ICD-10) was adopted in 1990 by the WHO and the last used version is of 2016 with updates until 2020. The eleventh revision (ICD-11) of the classification system, which replaced ICD-10 in 2022, reflects the latest scientific knowledge and best practices.[13,14]

The purpose of the ICD is to permit the systematic recording, analysis, interpretation and comparison of mortality and morbidity data collected in different countries or areas at different times. The ICD is used to translate diagnoses of diseases and other health problems from words into an alphanumeric code, which permits easy storage, retrieval, and analysis of data. In practice, the ICD has become the international standard diagnostic classification for all general, epidemiological, and many health management purposes. These include the analysis of the general health situation of population groups, and the monitoring and analysis

[13] 'List of Official ICD-10 Updates', accessed 10 May 2024, https://www.who.int/standards/classifications/classification-of-diseases/list-of-official-icd-10-updates.
[14] The eleventh revision (ICD-11) came into effect in 2022.

of mortality and morbidity (incidence/ prevalence) due to diseases in relation to other variables such as the characteristics and circumstances of the individuals affected.

Apart from the main classification of diseases and health related problems, the ICD also covers a conceptual framework of definitions, standards, and methods that have been closely linked and developed along with the classifications themselves. These include practical instructions and rules for reporting causes of death, coding of mortality and morbidity data, and guidelines for presentation and interpretation of data. Adherence to these guidelines enables standardized collection, analysis and presentation of data, which enables the effective comparison of observations between populations, and across time.

Compared to previous versions, ICD-11 is designed to be more user-friendly and flexible, offering a simpler and more intuitive coding process with an updated structure and improved indexing. As a fully digital system, ICD-11 integrates with local health information systems and can be used both online and offline. The main structural innovation of ICD-11 is its Foundation Component which is a comprehensive database that includes all ICD entities, such as diseases, disorders, injuries, and symptoms, ranging from broad categories to highly specific terms. The ICD-11 tabular list derived from this Foundation Component is equivalent to the Tabular List (Volume 1) and Alphabetic Index (Volume 3) in ICD-10. This digital infrastructure ensures that ICD-11 is compatible with traditional use cases and maintains continuity with previous versions, allowing for older data to be linked and compared with new data.

ICD-11 tools and software, including a browser tool, coding tool and Application Programming Interface (API), allow for direct generation and recording of codes, eliminating the need to memorize codes or transcribe information from paper records. Clinicians can search for diagnoses using natural language, and the system automatically identifies the correct code, which streamlines the coding process and reduces training time and costs.

ICD–11 codes are alphanumeric and range from 1A00.00 to ZZ9Z.ZZ. The first character shows the chapter number and can be a letter or a number. Codes starting with ‘X’ are extension codes. The second character is always a letter to set ICD-11 codes apart from ICD–10 (e.g., Pulmonary tuberculosis, ICD-11: 1B10; ICD-10: A15-A16). A number is always in the third position to avoid spelling unwanted words. The letters ‘O’ and ‘I’ are not used to prevent confusion with the numbers ‘0’ and ‘1’. The last letter ‘Y’ means ‘other specified’ and ‘Z’ means ‘unspecified’. In chapters with more than 240 blocks, ‘F’ (other specified) and ‘G’ (unspecified) are also used for these categories because of space limits. The ICD has

developed as a practical, rather than a purely theoretical classification. It has been based on the principle that for practical, epidemiological purposes, statistical data on diseases should be grouped in the following way:

- epidemic diseases
- constitutional or general diseases
- local diseases arranged by system
- developmental diseases
- injuries.

As per the above-defined grouping pattern, the ICD classification has grouped the detailed code categories into a total of 26 chapters in the Eleventh Revision (hereafter referred to ICD-11).[15] As can be seen, this type of grouping of infectious diseases, neoplasms, injuries etc. brings together conditions that are epidemiologically related and would be inconvenient for analysis if they were scattered in a classification arranged primarily by body site. The distinction between these 'special group' chapters and the 'body system' chapters, has practical implications for understanding the structure of the classification, for coding, and interpreting statistics that are based on it.

[15] There are 21 chapters in the Tenth Revision (ICD-10).

ICD-10 Chapters and Codes		ICD-11 Chapters and Codes	
Chapter I: Certain infectious and parasitic diseases	A00-B99	01 Certain infectious or parasitic diseases	1A00-1H0Z
Chapter II: Neoplasms	C00-D48	02 Neoplasms	2A00-2F9Z
Chapter III: Diseases of the blood and blood forming organs	D50-D89	03 Diseases of the blood or blood-forming organs	3A00-3C0Z
		04 Diseases of the immune system	4A00-4B4Z
Chapter IV: Endocrine, nutritional and metabolic diseases	E00-E90	05 Endocrine, nutritional or metabolic diseases	5A00-5D46
Chapter V: Mental and behavioural disorders	F00-F99	06 Mental, behavioural or neurodevelopmental disorders	6A00-6E8Z
		07 Sleep-wake disorders	7A00-7B2Z
Chapter VI: Diseases of the nervous system	G00-G99	08 Diseases of the nervous system	8A00-8E7Z
Chapter VII: Diseases of the eye and adnexa	H00-H59	09 Diseases of the visual system	9A00-9E1Z
Chapter VIII: Diseases of the ear and mastoid process	H60-H95	10 Diseases of the ear or mastoid process	AA00-AC0Z
Chapter IX: Diseases of the circulatory system	I00-I99	11 Diseases of the circulatory system	BA00-BE2Z
Chapter X: Diseases of the respiratory system	J00-J99	12 Diseases of the respiratory system	CA00-CB7Z
Chapter XI: Diseases of the digestive system	K00-K93	13 Diseases of the digestive system	DA00-DE2Z
Chapter XII: Diseases of the skin and subcutaneous tissue	L00-L99	14 Diseases of the skin	EA00-EM0Z
Chapter XIII: Diseases of the musculoskeletal system	M00-M99	15 Diseases of the musculoskeletal system or connective tissue	FA00-FC0Z
Chapter XIV: Diseases of the genitourinary system	N00-N99	16 Diseases of the genitourinary system	GA00-GC8Z
		17 Conditions related to sexual health	HA00-HA8Z
Chapter XV: Pregnancy, childbirth and the puerperium	O00-O99	18 Pregnancy, childbirth or the puerperium	JA00- JB6Z
Chapter XVI: Certain conditions originating in the perinatal period	P00-P96	19 Certain conditions originating in the perinatal period	KA00-KD5Z
Chapter XVII: Congenital malformations and chromosomal abnormalities	Q00-Q99	20 Developmental anomalies	LA00-LD0Z
Chapter XVIII: Symptoms, signs and abnormalities not elsewhere classified	R00-R99	21 Symptoms, signs or clinical findings, not elsewhere classified	MA00-MH2Y
Chapter XIX: Injury, poisoning and other consequences of external causes	S00-T98	22 Injury, poisoning or certain other consequences of external causes	NA00-NF2Z

Chapter XX: External causes of morbidity and mortality	V01-Y98	23 External causes of morbidity or mortality	PA00-PL2Z
Chapter XXI: Factors influencing health status and contact with health services	Z00-Z99	24 Factors influencing health status or contact with health services	QA00-QF4Z
Chapter XXII: Codes for special purposes		25 Codes for special purposes	RA00-RA26
		26 Supplementary Chapter Traditional Medicine Conditions	SA00-SJ1Z
		V Supplementary section for functioning assessment	VD00-VW8Z
		X Extension Codes	[16]

The chapters are divided into homogenous 'blocks' of cause categories, to enable easy identification of specific disease groups or conditions that are closely related to each other within a chapter. Within the disease specific codes, there are usually listed a number of other diagnostics terms, which are either to be included or excluded from classification under the code. Further, ICD employs some special conventions relating to the use of parentheses, square brackets, the abbreviation 'NOS' (not otherwise specified) or 'NEC' (not elsewhere classified), among others. These need to be clearly understood by coders and should be covered in detail during training programs on death certification and mortality coding. Coders are required to search for the core ICD code for the underlying cause, which is then used for statistical tabulation of the data. There are specific principles that guide the use of the Alphabetical Index in searching for the ICD code for a specific disease or condition, and these are described in detail in the ICD-11 Reference Guide (Volume 2).[17] More importantly, however, the Reference Guide prescribes detailed procedures for selection of the underlying cause of death, and its coding for mortality tabulation.

In general, although the ICD-11 has introduced changes in the structure, organization and characteristics of ICD codes for specific diseases and conditions, the coding rules for selection of the underlying cause of death remain the same across the two versions. These rules are described below.

[16] Extension codes should never be used in primary classification coding or tabulation.

[17] https://icdcdn.who.int/icd11referenceguide/en/html/index.html

Firstly, if there is only one cause of death reported on the certificate, then it is deemed as the underlying cause, and used for tabulation. When there are multiple causes of death recorded on the death certificate, the first step lies in determining whether there is a coherent pathophysiological sequence of events. In other words, the question asked is *'Does the condition listed on the lowermost line on Part 1 of the certificate give rise to all the conditions listed above it (now called rule Step SP3)?'* If the answer to this question is yes, then this lowermost listed condition is considered the Tentative Starting Point and very often the underlying cause of death (if no other rule or note applies that modifies the coding) and therefore selected for tabulation. This rule is frequently applicable in all properly completed medical certificates of cause of death.

Sometimes, even if the certificate has not been properly completed, this rule applies provided the condition entered alone on the lowermost line could have given rise to all the conditions listed above it, even though they may not have been entered in the correct causal order.

For certificates in which this rule is not applicable, there are other selection and modification rules of the underlying cause, as listed in Table 2. However, it is recommended by the WHO that where the lowermost listed condition cannot be selected, clarification of the certificate should be sought from the certifier whenever possible, since the selection rules are somewhat arbitrary and may not always lead to a satisfactory selection of the underlying cause. Also, it should be borne in mind that the medical certifier's statement reflects an informed opinion about the conditions leading to death and about their inter relationships and should not be disregarded lightly.

In some circumstances, the ICD allows the underlying cause selected according to the General Principle to be superseded by one more suitable among those listed on the certificate, for expressing the underlying cause in tabulation. For example, there are some categories for combinations of conditions (e.g., HIV and TB; rheumatic mitral stenosis, etc), or there may be epidemiological reasons for giving precedence to another specific condition on the certificate (e.g., hypertension with cerebral infarction – code to cerebral infarction).

Starting with the 2016 edition of ICD-10 and continuing into ICD-11, the numeric Modification Steps (M1–M4) replaced the lettered Modification Rules (A–F) of previous editions. These updated mortality coding instructions, introduced in 2016 and maintained in ICD-11, not only changed the naming convention but improved the rules and notes for obtaining the better underlying cause of death, as shown in the comparative Table 2.

Table 2. List of rules and terms for selecting the underlying cause of death equivalent between the previous and current editions of ICD

ICD-10, previous editions	ICD-11 & ICD-10, 2016 edition
Originating antecedent cause	Starting point
Originating cause	Starting point
Rules for selection of the originating antecedent cause	Find the starting point
Single cause on certificate	Step SP1 single cause on certificate
No equivalence	Step SP2 Only one line used in Part 1
General principle	Step SP3 – More than one line used in Part 1, first cause on lowest line explains all entries above
Rule 1	Step SP4 – First cause on lowest used line does not explain all entries above, but a sequence ends with the terminal condition
Rule 2	Step SP5 – No sequence in Part
Rule 3	Step SP6 – Obvious cause
Rule A. Senility and other ill-defied conditions	Step SP7 – Ill-defined conditions
Rule B. Trivial conditions	Step SP8 – Conditions unlikely to cause death
Modification rules	Check for modifications of the starting point
Rule C. Linkage	Step M1 – Special instructions
Rule D. Specificity	Step M2 – Specificity
No equivalence	Step M3 Re-check Step SP6, M1 and M2
Notes for several specific causes but not grouped into a rule	Step M4 Instructions on medical procedures, poisoning, main injury, and maternal deaths
'When reported as the originating antecedent cause of'	'When reported as the cause of'
Nature of injury	Main injury [18]

The ICD process for selection of the underlying cause is implemented through specific rules (Step SP1 to Step SP8) to obtain the Tentative Starting Point (TSP) and modification rules (Step M1 to Step M4) to obtain the Tentative Underlying Cause (TUC) in addition to the notes that may apply to obtain the final Underlying Cause of Death (UCOD).

ICD-11 also includes two new selection rules called Step SP1 and Step SP2 for specific situations, and two modification rules Step M3 and Step M4 where instructions are grouped for specific cases:

- **Step SP1 – Single cause on certificate:** If there is only a single condition reported on the certificate, in either Part 1 or Part 2, this is the Tentative Starting Point.

[18] Modified from the original: Annex 7.9 List of revised terms in the coding instructions for mortality. ICD-10, Pag. 235; Fifth Ed. 2016.

Subsequently, the coder goes to Step M1 or Step M4 to confirm it or to do a final modification to obtain the Underlying Cause of Death.

- **Step SP2 – First condition on the only line used:** Is applied when only one line in Part 1 is used. a) If that line lists a single condition and more conditions are listed in Part 2, the single condition in Part 1 is the tentative starting point. b) If that same line lists two or more conditions, the first listed condition is used as the Tentative Starting Point (independently of other conditions in Part 2).

- **Step M3 - Recheck Steps SP6, M1 and M2:** It is used if, at this point, the tentative underlying cause is not the same as the starting point you selected using Steps SP1–SP8, then go back to Step SP6. Repeat the procedures described in Step SP6 and M1–M2.

- **Step M4 – Instructions on medical procedures, main injury, poisoning and maternal deaths:** Contains specific coding instructions for these situations. After applying Step M4, the tentative underlying cause, modified or not, becomes the underlying cause of death.

These modification rules are intended to improve the usefulness and precision of cause of death data and should be applied after selection of the TSP using one of the selection rules. A complete description of the selection rules (SP1-SP8) and modification rules (M1-M4) is available in the ICD-11 Reference Guide (Sections 2.17.3 - 2.18) and may be studied to get a clear understanding of the process of selection and coding the underlying cause of death.[19]

While cause of death certification is to be performed by medical practitioners, coding of underlying causes of death can be done by trained medical records staff, who have a basic knowledge of medical terminology and hold responsibilities for classification, archiving, retrieval and possibly analysis of health-related data. Such distinct separation of the tasks is widely practised and is intended to enable medical practitioners to conduct their part of the process efficiently: without getting involved in the complex and what could be confusing

[19] https://icdcdn.who.int/icd11referenceguide/en/html/index.html#find-the-starting-point-steps-sp1-to-sp8

process of applying the various rules for selection and coding of the underlying cause and interacting with extensive digital classification system for assigning specific ICD-11 codes.

It is important to note also that medical practitioners should be adequately trained in the process of cause of death certification, and should understand the structure of the death certificate, and what needs to be entered in its different parts. They should also receive an overview of the purpose, process and rules involved in selection and coding of the underlying cause of death. They should also know that a well written cause of death certificate would almost always result in the easy and correct selection of the underlying cause, and this function can be readily performed by trained medical records staff. On the other hand, where this does not occur, trained coders could get in touch with the certifier to verify and if necessary, correct the cause of death certificate, or deal with the same using the ICD prescribed procedures. In particular, the application of the modification rule of linkage is more common than the others. A comprehensive set of notes on for use in underlying cause mortality coding as well as a detailed linkage table are available on the ICD-11 Reference Guide Sections 2.18.1 and 2.19.3.[20] These notes and tables need to be consulted and implemented wherever necessary and are best left to be used by trained medical coders, rather than medical practitioners.

For efficient coding in ICD-11, the browser and coding tool are essential resources. These tools provide an extensive collection of synonyms, abbreviations, and alternative terms that correspond to official disease entities in the Foundation Component of ICD-11 (equivalent to Volume 1 in ICD-10). Synonyms are important because medical certifiers commonly use different terminology for the same condition across populations, clinical settings, or across time. For example, the terms “cardiac angina”, “anginal syndrome”, “ischaemic chest pain”, and “angina” could be used by different physicians to identify the same disease and are mapped to the same ICD code (ICD-11: BA40; ICD-10: I20.9). The ICD-11 browser indexes matching terms, allowing coders to quickly search and identify the correct code for any given term. Before attempting to code, coders must also receive proper training to understand the

[20] https://icdcdn.who.int/icd11referenceguide/en/html/index.html#step-m1-special-instructions https://icdcdn.who.int/icd11referenceguide/en/html/index.html#special-instructions-on-linkages-and-other-provisions-step-m1

principles of classification, the selection of the underlying cause of death, and to gain practical experience through coding exercises.

Detailed coding guidelines are provided in Reference Guide (Volume 2) of the ICD, along with specific instructions relevant for accurate coding of individual medical conditions. A comprehensive training program to cover the essential theoretical and practical aspects of ICD coding is essential. When a national team of ICD coders is being established, it is useful to have a few staff with medical background also trained in these coding procedures, so that they could serve in an advisory capacity whenever required to do so by the non-medical coders who will conduct the bulk of the coding process.

As referred, coders may be supported by the use of automated coding systems. The National Centre for Health Statistics (USA) developed an automated ICD coding software program that processes individual electronic cause of death certificates, to select an underlying cause of death in each case and assign its appropriate ICD code.[21] Specific care was taken to program the different selection and modification rules as laid down in Volume 2 of ICD-10. However, there is a need for accurate data entry of the cause of death in text, for the automated coding program to function efficiently. Currently, the program is being implemented in several countries, which also cross check a proportion of the codes by manual procedures. In recent years, two new programs have been developed and are in use for automated mortality coding: Iris (Iris Institute; BfArM)[22] and DORIS "WHO Digital Open Rule Integrated Cause of Death Selection Tool").[23] Iris is an automated software-tool that codes death certificates using ICD-10 rules and standards. The Iris Institute has developed a strategic plan to align the tool with ICD-11, ensuring continued accuracy and compliance with the latest international coding guidelines. DORIS is a WHO multilingual software tool that analyses information from death certificates and assists in automatically selecting the underlying cause according to the fully digitalized ICD-11 mortality rules. DORIS is available through web application for individual death certificates for cause of death selection, or as a standalone application that can be installed on computers for batch processing of large volumes of death certificates. In summary, this automated process offers promise to hasten the development of national

[21] https://www.cdc.gov/nchs/nvss/mmds/about_mmds.htm
[22] https://www.bfarm.de/EN/Code-systems/Collaboration-and-projects/Iris-Institute/Iris-software/_node.html
[23] https://icd.who.int/doris/en

cause-specific mortality statistics programs, but this will continue to rely on a sound and efficient MCCD.

Multiple causes of death

As mentioned previously, there are several instances where the selection of the underlying cause of death would require a consideration among the multiple causes of death on the death certificate, which would overrule the cause selected. These are outlined as follows:

1. The mention of conditions that could either be causes of death or risk factors (e.g., prematurity/low birth weight, or hypertension).

2. The location and/or sequence of causes listed on the death certificate (as in the case of diabetes and cardiovascular disease).

3. The mention of specific combination of medical conditions on the certificate that will result in applying a specific code for the combination, rather than the code for either individual cause. E.g., HIV and Tuberculosis; malaria in pregnancy; Insulin dependent diabetes mellitus with renal failure; liver disease due to alcohol; among others.

4. For injuries, dual codes are applied, one each for the external cause and internal cause (nature of injury), respectively (see below for details).

It is a recognized fact that it is not possible for physician certifiers to know and recall all these specific instances where multiple cause rules are applied for selection and coding of the underlying cause. Under these circumstances, physician certifiers should ensure that they carefully identify and list all potential clinical conditions/events/risk factors on the death certificate. This will provide all the required information for the coders/automated coding programs to apply the most appropriate coding rules for selection and coding of the underlying cause of death. Further, availability of multiple causes of death enhances the utility of data for epidemiological analysis.

Special note on injury

For all deaths due to injuries, the code for the external cause of the injury from Chapter 23 in ICD-11 (Chapter XX in ICD-10) is to be used as the underlying cause code. That is, only codes with the first letters PA-PL in ICD-11 (V-Y in ICD-10) are acceptable as underlying cause codes

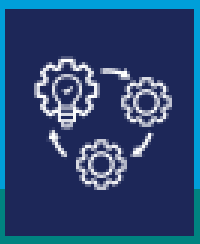
for deaths due to injuries. A note from the ICD Reference Guide indicates that specific codes for injury, poisoning and certain other consequences of external causes (Chapter 22 In ICD-11; Chapter XIX in ICD-10) can only be used as "optional additional" codes to those of the external cause that will always be the underlying cause of death. This would add information about injuries caused by external causes. WHO recommends that from a public health perspective, external codes should be used as underlying causes of death, as they are useful for developing prevention programmes.

For example, a case of burns could be classified based on intent into one of the following categories:

- Accidental - Exposure to smoke, fire and flames (ICD-11: PB10-PB11; ICD-10: X00-X09)
- Intentional self-harm (Suicidal) - Intentional self-harm by smoke, fire, and flames (ICD-11: PC80-PC81; ICD-10: X76)
- Assault (Domestic violence etc) - Assault by smoke, fire, and flames (ICD-11: PE70-PE71; ICD-10: X97)
- Event of undetermined intent (ICD-11: PF40-PH8Z; ICD-10: Y10-Y34)
- Legal intervention and operations of war (ICD-11: PJ40-PK6Z; ICD-10: Y35-Y36)
- Complications of medical and surgical care (ICD-11: PK80-PL14.Z; ICD-10: Y40-Y84)
- Sequelae of external causes of morbidity and mortality (ICD-11: PL2Y-PL2Z; ICD-10: Y85-Y89)

Sometimes, difficulties may be experienced to separate suicide – homicide – accidental deaths (such as in the absence of sufficient information, burn injuries can fit into any category). However, careful capture of respondents' narratives in VA can help in differentiating these injuries. In these cases, the information obtained from the forensic doctor and the police investigation can be useful to determine the intentionality of the action that led to the death, but if the result of the investigation is not conclusive or there is none, the underlying cause can be coded as undetermined intent.

4 Guidelines for completing the verbal autopsy cause of death form



NOTE: While it is considered acceptable for physicians reviewing VA data to complete a form that follows the format of the international medical certificate of cause of death to assist in the assignment of a probable underlying cause of death, this form is not equivalent to a legal death certificate, and its contents should only be used for statistical, not legal, purposes.

Before assigning causes of death, the physician reviewer should do the following:

- Carefully screen all modules and responses of the completed instrument for relevant information, including the open narrative section.

- To streamline the physician review process, a structured Excel sheet may be used to organize responses to all relevant VA questions required for determining causes of death. In this format, each row corresponds to a questionnaire variable (including the VA question Id), ordered as in the original instrument, and each column represents an individual case. At the end of the sheet, dedicated rows are included for physicians to assign immediate, intermediate, and underlying causes of death, as well as contributing causes. See an example mock-up of such a sheet in Annex 2.

- A learned suggestion from the field, includes changing the font colour of 'YES' responses to red in the Excel sheet to facilitate quick identification by reviewers.

- Additionally, software can be used to further facilitate the physician review process. For instance, a program can be developed to automate interview responses to be populated from the database into the Excel sheet for physician review. The software VMan3 (Verbal Autopsy Manager Software tool version 3) provides an all-in solution to streamline the management and visualisation of VA data collected using the

standardized WHO VA instrument. The tool offers online PCVA with a standard MCCD form, as well as additional functionalities such as monitoring data collection progress and performing advanced data quality checks based on a predefined set of validation rules.[24] Where available, VMan3 or similar software can further support efficient physician review.

- The open narrative is an important questionnaire component for PCVA. It allows respondents to describe the final illness trajectory in their own words, can provide clinical context, more detail into timelines and insights into the health-seeking behaviours. The narrative can help clarify ambiguities or inconsistencies found in structured data and may capture information that can't be captured in any of the other sections of the questionnaire.

- Make a separate record of all the positive evidence, keeping in mind that negative responses for exclusionary signs and symptoms are also of value in making a diagnosis.[25]

- Use clinical judgement and diagnostic guidelines (Section 6) to identify specific causes of death.

- In some instances, the absence of a particular symptom/sign etc. might be indicative or helpful in judging a cause.

- In general, precedence should be given to available medical opinion on the cause of illness/death, if it can be corroborated with the details of symptoms and events described by the VA respondent.

- Make a note of all identified clinical conditions that should be listed in a sequence on the VA cause of death form.

[24] https://www.medrxiv.org/content/10.1101/2025.05.28.25328220v1

[25] Example of an exclusionary symptom includes "no H/O injury to head up to one week before death" for the diagnosis of epilepsy. See Section 6 for the complete diagnostic guidance for epilepsy and other causes included in the WHO target list of causes of death for VA.

- Identify any biological (obesity, hypertension) or behavioural (tobacco/alcohol) risk factors.

- In case of injury, identify as far as possible the injured body parts and/or mechanism of injury, as well as the external cause (accident, intentional self-harm, or assault).

- Place identified clinical conditions/events/circumstances of injury into chronological and pathophysiological sequence.

- Do not conjure sequential events which are not documented in the VA questionnaire. Remain restricted to the words/sentences/facts provided in the VA questionnaire only.

- After assessing all the available information, the physician reviewer can attempt to record the identified sequence of causes as immediate, antecedent, underlying, and contributory causes, in the VA cause of death form described above.

Common do's in assigning cause of death

- Use common sense and best clinical judgement. There is no substitute.
- Read the narrative, history, responses to specific symptom questions and all other information very carefully. You can avoid going down blind alleys and false diagnosis by a careful read.
- Corroborate what a health care provider is reported to have said on the form with some other symptoms or signs in the VA questionnaire.
- Do look for important negatives in the history. These can narrow down several possible causes to one or two.
- Do think from a public health perspective - common causes are common.
- Do not be afraid to state that no cause can be assigned. This is reality.
- Write only one cause of death on each line of the VA cause of death form.
- Ensure you list all identified causes or conditions, since there are special ICD rules that need to be applied in some cases, and multiple causes of death facilitate more detailed epidemiological analyses.
- Write legibly, and do not use any abbreviations or acronyms.

Common dont's in assigning cause of death

- Do not make a random diagnosis if no evidence to back one up is found in the VA questionnaire.
- Do not try to make a pathological diagnosis. It is very difficult from the VA report to make a pathological diagnosis (e.g., various types of myocardial infarction). Moreover, while such pathological diagnosis is appropriate for clinical and hospital care, getting right the overall categories of causes of death is far more important for public health.

- Do not rely on the respondent's education level, or other characteristics, only use them as supporting information. Misconceptions abound across education or income levels of respondents.
- Do not rely on the **risk factors** alone for making a diagnosis. For example, cirrhosis occurs not only among alcohol drinkers but also among non-drinkers. Similarly, lung neoplasm can happen among smokers and non-smokers. Although all the above information is common clinical and epidemiological knowledge which would be known to all physician reviewers, the mention of these examples here is merely to serve as a reminder for physicians at the time of assigning cause of death.

4.1 Considerations on cause of death assignment from verbal autopsy data

Reliability and validity of cause of death assignment from VA data are key elements in determining their usefulness. PCVA has become a widely accepted method of analysing VA data, being often used as a reference against which other methods for cause of death assignment from VA data are compared.

A standard approach to PCVA is essential to reduce inter observer variation. This can be achieved through adequate training on VA data review and cause of death assignment. Also, the use of standard disease/condition specific diagnostic guidelines will increase reliability and reduce inter observer bias.

Section 5 provides a set of standard disease descriptions and diagnostic guidance for the causes of deaths included in the WHO target list of causes for VA, based on previous epidemiological observations and experience. It is important to rely on presence of key words or cardinal symptoms of the disease (for example sudden onset chest pain for diagnosing myocardial infarction (VAs-04.01 acute cardiac disease), or recurrent bouts of cough with breathlessness for COPD), as well as associated symptoms (such as radiation of pain, associated sweating etc for myocardial infarction, clinical features of cor pulmonale for COPD), as is usually done while making a clinical diagnosis. This is mentioned because, from past experience, relatives may not be able to recall minute details, especially when they are mostly subjective in nature.

It is very important that reviewers use these descriptions and criteria as general guidelines and for reference, and to apply clinical diagnostic knowledge and skills to judge whether the information from individual VAs is sufficient to assign a specific condition as a probable

underlying cause of death. It may also be noted here that reviewers are expected to provide an opinion on the cause to the best of their knowledge and belief, based on the information available to them, and with the assurance that these data are collected purely for the purpose of generating health statistics for policy formulation and program evaluation, and not for any legal purposes.

Reviewers are encouraged to attempt assigning, wherever possible, specific disease or condition causes and codes, rather than ill-defined conditions such as senility, painful abdomen, fevers etc. In case it is not possible to arrive at a diagnosis, symptoms can be written. To enable such assignment, these disease descriptions and criteria are provided, to assist and guide the selection of specific disease entities. Also, wherever available, information on the illness before death from medical documents available at the home of the deceased, or as told to the relatives by health personnel should be considered, and corroborated with the evidence provided in the symptom duration section by the respondents.

In summary, if there is only one cause identified, it should be entered on line I (a) of the certificate. If there is more than one cause, the immediate (or terminal) cause is entered at (a) and the underlying cause is entered last, with any intervening (or antecedent) causes listed in between. Any other significant condition that contributed to the fatal outcome, but was not related to the sequence of events causing death should be listed in part II as a contributory cause.

Some important considerations for coding are addressed below for key groupings within the WHO VA target list of causes of death. Note that not all causes included in the WHO list of COD for VA are discussed here; for diagnostic guidance for all the WHO VA causes of death see Section 5.

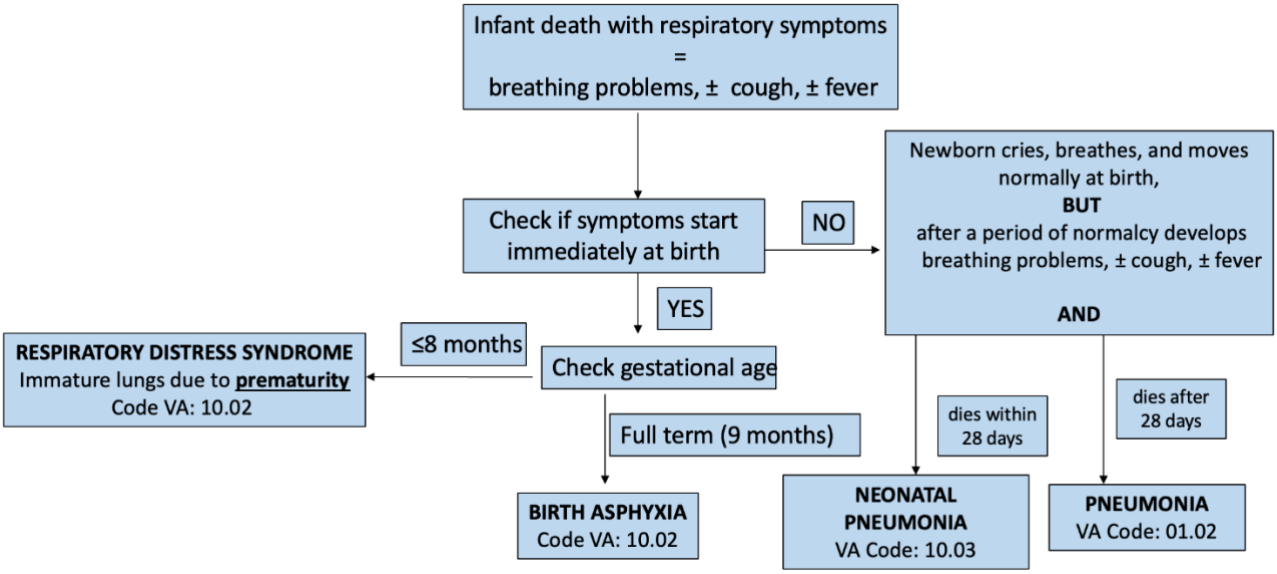
4.1.1 Stillbirths and perinatal causes of death

Distinguishing between a live birth and stillbirth is crucial to accurately measure early age mortality using indicators, such as perinatal, neonatal, and infant mortality rates. In many VA settings, identifying signs of life at birth is challenging, largely stemming from the occurrence of birth without skilled attendance. While a gold standard assessment of life at birth would be based on an Apgar score measured by a trained clinician, the best a VA could use to differentiate live births from stillbirths would be the observation by the mother or birth attendant of a cry, or breathing, or voluntary muscle movement at birth. Other signs such as presence of heartbeat, or umbilical cord pulsation are too technical for traditional birth

attendants to observe, record and finally report the same to the bereaved mother. Also, the mother (the most likely respondent for such events) may have not been able to observe such specific details at the end of labour, and would rely on what is conveyed to her by those present at childbirth. Finally, in many societies, deaths occurring within a few hours of birth are not reported or are reported as stillbirths to avoid any legal implications of registration, and also potential mental stress to the mother. There are specific questions as to whether the newborn breathed, moved or cried after birth, to make the distinction between live births and stillbirths. There is also a final question to confirm a stillbirth, if the responses to previous questions were negative. Interviewer training programs stress on the need for careful investigation and recording of responses to these questions. Careful attention is required from physician reviewers in interpreting these responses and distinguishing to the best extent possible live births from stillbirths. In some instances, the open narrative may report a stillbirth, but this should be cross checked and confirmed from negative responses to the specific stillbirth questions. Accurate diagnoses of stillbirths will be required to develop measures of stillbirth, perinatal, neonatal, and infant mortality rates, as these are critical indicators to develop health policy and monitor the impact of interventions to improve maternal and child health.

For those confirmed live births that do not survive the first week of life, the duration of gestation and weight or size at birth are important to assess the cause of death. The questionnaire contains several items to identify the common causes of neonatal death, details of which are provided in Section 6. Among these, there are several closely related disorders of the respiratory system, and these need to be carefully distinguished, as far as possible, from the VA data. Fig. 2 illustrates a broad decision algorithm that could be used to differentiate some of these conditions and assign the appropriate code for the underlying cause of death in CRVS settings. Fig. 3 illustrates a more granular algorithm, developed to be more useful for research purposes. The key issues that need to be considered are the duration of gestation at birth and the timing of onset of respiratory symptoms. The timing of symptom onset can be verified from the symptom-specific questions, the open narrative, and the specific questions for identifying stillbirth (e.g., did the baby breathe or cry immediately after birth). Also, while meconium aspiration syndrome is an important perinatal respiratory condition, it is rather difficult to identify specific clinical history or signs, which would largely require inputs from expert clinical attendance. Hence, the principal respiratory causes of infant death from VA are birth asphyxia, respiratory distress syndrome (RDS) (VAs-10.01 prematurity or low birth weight), neonatal pneumonia and infant pneumonia (VAs-01-02 acute respiratory infection, including pneumonia).

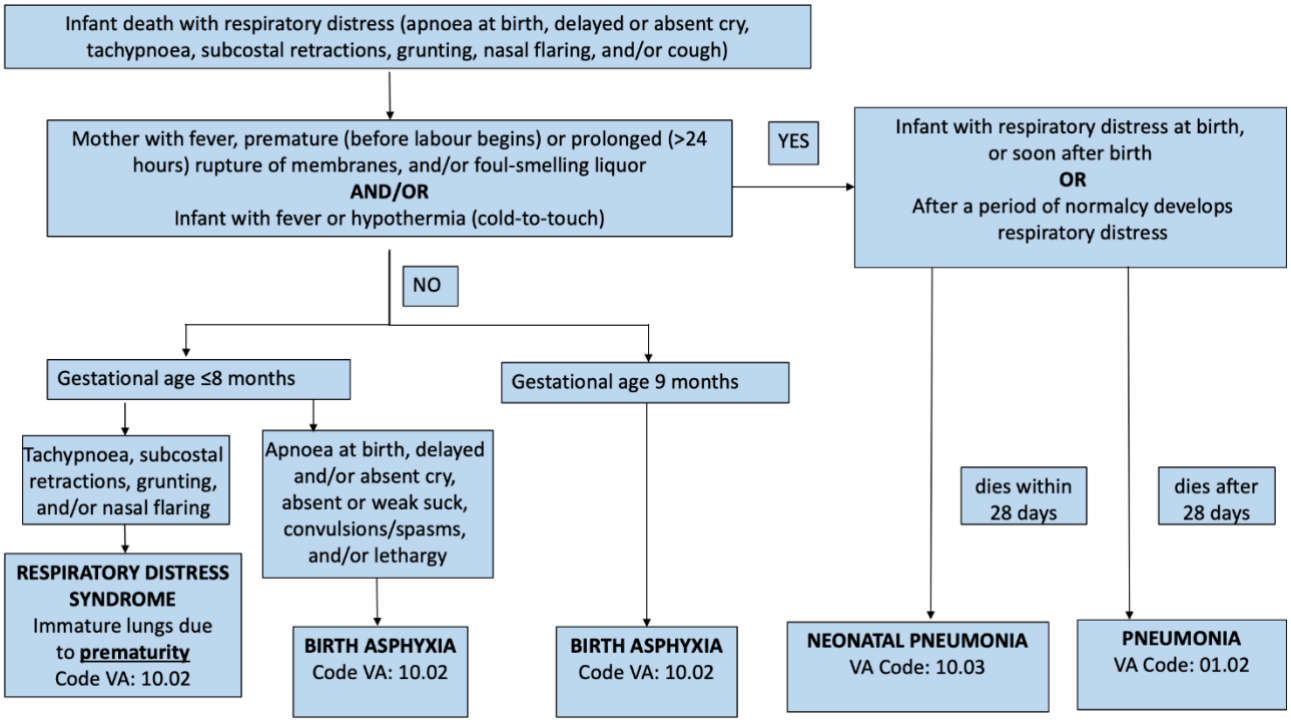
Figure 2. Broad algorithm for assigning and coding respiratory causes of infant deaths from VA



26

[26] Although prematurity could be the underlying cause of respiratory distress syndrome, ICD rules consider it to be a risk factor, hence RDS (VAs-10.02 birth asphyxia) is to be coded as the underlying cause of death.

Figure 3. Granular algorithm for assigning and coding respiratory causes of infant deaths from VA



Information on different symptoms, signs and their chronology can be available from either the structured questions or the open narrative sections, so physician reviewers should carefully collate the information and arrive at the correct underlying cause of death.

There are specific instructions for prematurity and low birth weight, in that they should be assigned as the underlying cause of death only when either of these is the single mentioned cause of death. However, if these conditions are mentioned along with any other specific condition (e.g., sepsis, hypothermia, respiratory cause, birth trauma, congenital malformation etc), then the specific condition is to be selected as the underlying cause of death, even if prematurity or low birth weight are listed below the specific condition. In the perinatal death certificate, prematurity in this circumstance is referred to as the "other disease or condition" of the fetus or infant, and the specific condition is called the "main disease or condition" of the fetus or infant. The perinatal certificate also includes lines for the "main" and "other" maternal disease or condition affecting the fetus or infant. Physician reviewers should always write a complete VA cause of death form mentioning all the identified conditions, as this will facilitate more detailed analysis beyond the primary analysis based on underlying/main causes. This is particularly important for prematurity and low birth weight, which are of considerable importance as preventable conditions from both public health and clinical perspectives. The perinatal death certificate provides the opportunity to

also specify the contributing maternal causes, which enables an even more in-depth analysis of causal conditions of public health importance.

4.1.2 Maternal causes of death

Death of a woman in the reproductive age group (approximately 12 to 50 years) should prompt a detailed investigation into whether or not it was associated with pregnancy, or within at least six weeks of childbirth (some definitions extend this period to one year after delivery). To ascertain this accurately, previous experience suggests that the respondent for the VA interview should be a female relative of the deceased, and wherever possible, a sister. The VA questionnaire has relatively straightforward questions in the 'maternal' module to identify pregnancy status, and conditions such as ante-/post-partum haemorrhage (VAs-09.04 obstetric haemorrhage), obstructed labour, and abortion-related death. To identify eclampsia and other hypertensive disorders of pregnancy (VA-09.03 pregnancy-induced hypertension), the reviewer would have to integrate responses to the 'maternal' module with responses to other items in the questionnaire such as history of hypertension, presence of ankle swelling, dimness or blurring of vision, and presence and nature of convulsions. Similarly, a diagnosis of puerperal sepsis (VAs-09.06 pregnancy-related sepsis) would need some positive responses to questions on fever, foul vaginal discharge, and lower abdominal pain, located in other sections of the questionnaire. Finally, occurrence of other medical conditions (e.g. hepatitis, rheumatic heart disease, malaria, diabetes etc) while the deceased is pregnant requires their mention on the VA cause of death form, which will lead to their coding as indirect maternal causes of death. Hence, a death from hepatitis in a pregnant female would be assigned to 'hepatitis in pregnancy' as the underlying cause, and there is a specific ICD code available for this combination. Similar codes are available for all known combinations of medical conditions complicating pregnancy. Hence, as far as possible, note in detail all the multiple causes of death that can be identified from the questionnaire, and select the detailed direct or indirect maternal cause of death as the underlying cause of death.

4.1.3 Infectious diseases

4.1.3.1 Childhood infectious diseases

Acute febrile illnesses among children pose a particular problem with reference to identifying a specific disease as the underlying cause of death, because of the common presence of multiple conditions at the time of death. Also, the relatively short interval between onset of symptoms and passage into a stage of severity marked by lethargy, drowsiness and even

unconsciousness compounds the problem of trying to identify which symptom appeared first, which could be a pointer to the underlying cause. For instance, children with either malaria or measles are prone to develop pneumonia at some stage in their illness. Similarly, meningitis and encephalitis could be confused with malaria, and convulsions could be a common symptom in both, and meningitis could also be preceded by pneumonia.

Nevertheless, a careful interview could possibly reveal the chronology of occurrence or presence of at least one cardinal symptom apart from fever, which could aid in the diagnoses of the underlying condition. Therefore, the presence of fast breathing early in the illness could indicate pneumonia (VAs-01-02 acute respiratory infection, including pneumonia) as the underlying condition, especially in a region which carries a low risk of malaria. On the other hand, presence of fever with convulsions or loss of consciousness in the absence of (or before) respiratory symptoms would suggest malaria, in an endemic / epidemic situation. The occurrence of fever with rashes anytime within about a month before death is suggestive of measles being the underlying condition, irrespective of the development of other organ specific symptoms later on in the course of the illness. In the case of history of diarrhoea, it is important to establish the presence of features of dehydration before death, to identify diarrheal diseases as the underlying cause. Finally, the presence of fever with neck stiffness (a particularly difficult sign to pick up the presence of in a VA interview) and / or bulging fontanelle could guide the selection of meningitis and encephalitis as the underlying cause in children and infants.

Given all these uncertainties in identifying specific underlying causes, reviewers could exercise judgement in applying these diagnostic guidelines, and assign multiple causes on the VA cause of death form, noting their choice of the underlying cause on the lowermost line on Part I. On Part II, it is important to note the presence of malnutrition or anaemia, as significant contributory conditions co-existing with any of the above infectious diseases.

4.1.3.2 Infectious diseases in adulthood

HIV/AIDS is a condition that requires careful attention, both for inclusion as well as exclusion as an underlying cause of death. The availability of serological evidence on HIV status could be sufficient for labelling it as the underlying cause, but provided it is possible to identify any specific coexisting infections (TB, fungal infections, diarrhoeal diseases, or opportunistic pneumonia), which should be listed as the immediate cause of death.

In the absence of serological evidence, availability of a clinical record of presence of Kaposi's sarcoma, cryptococcal meningitis, or pneumocystis carinii pneumonia could be used to make a presumptive diagnosis of HIV/AIDS.

Several epidemiological studies which employ VA methods to measure HIV/AIDS mortality have adapted clinical features and signs from the WHO guidelines for the provisional clinical case definition for AIDS where diagnostic resources are limited, and either used them to construct specific diagnostic algorithms for the same, or categorise them into major and minor signs that help identify the diagnosis. For instance, major signs include chronic diarrhoea for more than one-month, prolonged fever for more than one month, and weight loss of more than 10% body weight (inferred from a history of weight loss over one month). Minor signs that assist diagnosis include the presence of prolonged cough with difficulty in breathing, oral candidiasis, generalized swellings in groin, neck, armpits (suggestive of lymphadenopathy), and recurrent skin infections (herpes zoster). In general, the use of clinical judgement on the part of the physician reviewer should be judiciously applied to ascertaining the diagnosis, using these major and minor signs to guide their judgement.

Tuberculosis is another infectious disease that may co-exist with HIV/AIDS, or manifest by itself. Wherever possible, the above criteria could be used to identify the associated HIV/AIDS, which could also be inferred from a relatively short interval between onset of TB-like symptoms and death (less than 3 months). A positive sputum smear is confirmatory of tuberculosis, either by itself or as co-existing with HIV/AIDS. In the absence of such evidence, a prolonged duration of symptoms of tuberculosis (fever, cough, bloody sputum, long term weight loss etc) punctuated by periods of treatment and relapses with terminal respiratory symptoms could guide clinical judgement of TB.

In more recent times, the introduction and maintenance of HAART therapy for HIV patients has led to much improved survival, and potential to develop other conditions such as non-communicable diseases, which are un-related to an immune-compromised status. Hence, a history of being seropositive for HIV may not be relevant in the presence of clinical features and evidence of treatment for conditions such as diabetes, cardiovascular disease or neoplasms, and this should be borne in mind when assigning underlying causes of death for individuals with HIV+ status.

Pneumonia is a common cause of death among children, and the variations in its presentation and symptomatology during infancy and childhood have been discussed above.

In the elderly, the clinical features of pneumonia are more subtle, often masked by frailty and other debilitating signs. In such situations, VA reports of symptoms of shallow rapid breathing during the terminal illness may be the only information available to diagnose pneumonia (VAs-01-02 acute respiratory infection, including pneumonia). More profound signs such as cough with sputum, or fever may not have been present/observed/reported by caregivers. However, it is important to identify other signs that may be suggestive of co-existent heart disease, stroke, COPD, neoplasms, or diabetes, which would then be considered as the underlying cause of death, rather than the pneumonia. In all situations, it is essential that all suspected multiple causes of death are listed on the VA cause of death form; with the duration of symptoms or signs being a major criterion for deciding the chronology of conditions, and assigning the underlying cause of death.

4.1.3.3 COVID-19

The WHO VA instrument has been updated to include questions to help identify mortality associated with the Severe Acute Respiratory Syndrome 2 Coronavirus (SARS-CoV-2), as there is likelihood of community deaths from this condition in settings with limited access to tertiary health care. Referred to as COVID-19, the clinical picture associated with COVID-19 deaths is described in Table 3 below.

Table 3. Clinical picture associated with COVID-19

Initial and persistent: fever, fatigue, cough (with or without sputum production), anorexia, malaise, muscle pain, dyspnoea. Loss or change of smell/taste preceding onset of respiratory signs reported. Other non-specific symptoms cans include nasal congestion, headache, sore throat, diarrhoea, nausea, and vomiting.
Children, more severe: cough or difficulty breathing + fast breathing and chest indrawing + fast breathing grunting, very severe chest indrawing); inability to breastfeed or drink, lethargy or unconsciousness, or convulsions.
Adolescents or Adults, more severe: fast breathing, respiratory distress.
Critical: onset of acute respiratory distress syndrome within 1 week of a known clinical syndrome or new or worsening respiratory symptoms; characterized by need of respirator.
Signs of sepsis: altered mental status, difficult or fast breathing, low oxygen saturation, reduced urine output, fast heart rate, weak pulse, cold extremities or low blood pressure, skin mottling, or cool skin or petechial or purpuric rash; or laboratory evidence of coagulopathy, thrombocytopenia, acidosis, high lactate, or hyperbilirubinemia.

A positive laboratory test confirms the diagnosis. Relatives of cases that were treated and died in hospitals may have been informed of the diagnosis or may be aware of some treatment details including admission to ICUs, and use of ventilators. On the other hand, there is likelihood of community deaths without any medical attention, for whom additional evidence suggestive of the diagnosis would be required, in the form of positive contact history along with pre-existing disease(s). Close contact with a person known to have been diagnosed with SARS-CoV-2 is a positive indication of likely COVID-19 disease, in the presence of the clinical picture described above (Table 3).

Finally, COVID-19 mortality has been associated with males, higher age (>70 years), and history of pre-existing medical conditions including chronic lung disease, diabetes, cardiovascular disease, and malignancies, among others.

From the 2022 WHO VA questionnaire, information on symptoms and signs, including fever, cough, dyspnoea, extreme fatigue, loss or change of smell/taste and headache, as well as pre-existing disease is available from the structured questions. More detailed information on contact history and contact with the health services can be recorded in the open narrative.

It is important for physician VA cause of death assignment to carefully consider and list all probable clinical conditions on the cause of death statement, including likely COVID-19 infection, complications such as terminal respiratory distress and/or failure; as well as all pre-existing clinical diseases; AND information on testing done for COVID-19 and contact history, WHETHER positive, negative, or unknown. This will enable appropriate selection of the underlying cause of death, as well as permit analysis of other conditions that predispose to mortality from COVID-19.

4.1.4 Non-communicable diseases

NCDs are prominent causes of death in the middle-aged and elderly and are often associated with considerable co-morbidities. Hence, multiple causes of death have special relevance in the case of adult deaths from chronic diseases. From one aspect, it is possible that the one underlying cause of death e.g., cerebrovascular disease (VAs-04.02 Stroke) could pass through different pathophysiological sequences of events to terminate in several different immediate causes of death such as bronchopneumonia, or infected bed sores, or a urinary tract infection. On the other hand, bronchopneumonia could be an immediate cause of death secondary to cerebrovascular disease, several neoplasms, or COPD, among other underlying causes of death. In general, infectious diseases are common terminal complications of NCDs. Therefore,

the identification of such infectious causes, especially among adults, should stimulate a careful examination of the data from the questionnaire to identify any possible non-communicable underlying causes of death. Also, due to the long-standing nature of non-communicable diseases, individuals may have a history of visiting multiple health care facilities, with varying accounts of diagnostic / treatment services that were availed during the course of their illness. These may be recalled at varying level of detail by respondents, and such potentially partial accounts in the VA responses could also pose challenges to the accurate ascertainment and assignment of multiple causes of death, as a preliminary step to selection of the underlying cause of death.

In general, information on signs and symptoms from VA should always be considered in conjunction with reported durations, to establish the pathophysiological pathway and chronological sequence of events, which would have to be determined on a case-by-case evaluation of available information. Details about past history, previous hospitalizations, or information conveyed by health professionals would also need to be considered, and some of these details could be available from the open narrative section. The following considerations need to be taken into account to diagnose certain NCDs as the underlying cause of death from VA.

4.1.4.1 Diseases of the circulatory system

Vascular diseases such as acute myocardial infarction (AMI) (VAs-04.01 acute cardiac disease) or acute cerebrovascular accident (VAs-04.02 Stroke) have specific 'cardinal' clinical features such as onset of acute chest pain, or of unilateral limb paralysis during the terminal period preceding death. However, these conditions may sometimes result in 'sudden death' and accompanied by very few suggestive symptoms or signs that could be recognizable to lay persons. For VA, sudden death is defined as 'death occurring in a person with no obvious illness up to 24 hours prior to death'. In some instances, there is a positive response to 'sudden death' along with a positive response to the main clinical feature of AMI or stroke, in which case the diagnosis is straightforward. However, in some cases of sudden death, there is no information on chest pain either in response to the structured question on this symptom or in the open narrative section. To aid the diagnosis, a positive response to a medical history of hypertension, or previous history of IHD, or mention of these conditions in the open narrative should also be noted, as they are commonly associated with AMI. In some instances, the diagnosis of AMI is further supported by a report of terminal breathlessness, which could be a feature of acute left ventricular failure secondary to AMI. Also, mention of 'heart disease' as the cause of death reported by a health worker (either in the open narrative or in response

to the specific question) should also raise AMI as a potential cause of death, and trigger a careful review of past history, symptoms and terminal events from responses and notes recorded in the questionnaire.

Sudden death is also associated with cerebrovascular stroke (VAs-04.02 Stroke), for which sudden onset of unilateral paralysis is often present. On occasions, the clinical picture is one of sudden loss of consciousness accompanied by a fall, and ensuing coma leading to death. In such cases too, the cardinal sign of paralysis may not be reported in the structured responses or in the open narrative. In these cases, the diagnosis of stroke may need to be based on some of several associated features such as sudden death, or a terminal illness precipitated by sudden loss of consciousness accompanied by fall, and/or a previous history of stroke, or history of hypertension without features of heart disease. Reports of stroke as the cause of death as told by health staff to respondents should be considered in the light of evidence from past medical history, symptoms, and history from all sections of the questionnaire.

Hypertension

This is a common co-existing condition with ischaemic heart disease (IHD) (VAs-04.01 acute cardiac disease) and cerebrovascular disease (VAs-04.02 Stroke) but is also an independent cause of death in the form of hypertensive heart disease, or hypertensive renal disease. Where co-existent with IHD or stroke, the ICD coding rules consider hypertension as a risk factor, rather than an underlying cause of death. In such circumstances, the underlying cause is selected as IHD or stroke. Since it is not possible for physician reviewers to remember all the specific ICD coding rules, the recommended best practice is to always document hypertension on the VA cause of death form along with the other/ multiple clinical conditions recognised in the deceased, so as to allow correct selection of underlying cause, as well as facilitate more detailed analysis of cause attribution from risk factors.

4.1.4.2 Diabetes mellitus

The rising burden from diabetes mellitus across the world results in its frequent reporting as a medical condition in adult verbal autopsies, either in the medical history or the open narrative. When diabetes is reported, the questionnaire should be carefully screened for all other diseases or conditions, and these multiple causes should then be listed on the VA cause of death form. For instance, diabetes complications leading to death can include severe infections such as infected foot ulcers or pneumonia with uncontrolled sepsis, peripheral vascular disease with gangrene and amputations, metabolic complications and coma, or

renal disease. In all these situations, diabetes should be nominated as the underlying cause of death, with the multiple causes listed in the sequence in Part I of the VA cause of death form, to enable more accurate attribution of underlying cause. For instance, a history of dialysis treatment could be suggestive of renal failure in a diabetic individual, and documentation of renal failure would enable coding of the underlying cause to 'diabetic renal disease'. Similarly, metabolic and infectious complications of diabetes also have specific underlying cause codes.

However, there is ambiguity in the ICD coding rules for deaths from diabetes where there is association with cardiovascular causes such as ischemic heart disease or stroke. In case the physician reviewer lists ischemic heart disease or stroke as a consequence of diabetes in Part I of the form, then diabetes is selected as the underlying cause. However, if the reviewer lists the cardiovascular condition in Part I and diabetes as a contributory cause in Part II, then the cardiovascular condition is selected as the underlying cause. Variations in cause of death assignment practice by physicians, results in inconsistent mortality statistics. Hence, it is recommended that in such cases, the cardiovascular condition and its complications/sequelae should be listed in sequence of conditions in Part I of the VA cause of death form, which will enable selection of the cardiovascular condition as the underlying cause. Diabetes should be listed in Part II of the VA cause of death form, to be considered as a contributory cause of death. This will enable uniform and consistent statistics on mortality from cardiovascular diseases.

4.1.4.3 Neoplasms

The diagnosis of neoplasm as an underlying cause of death is particularly challenging from symptoms and signs alone. Quite often, neoplasms may present only at the terminal stages of the condition where there are metastases, and with symptoms and signs related to an organ (liver, lung) which is not the primary site. However, neoplasm of the breast can be recognized from the local lesion, and symptoms of bleeding from the genital tract, upper and lower gastro-intestinal tract, and in sputum may be reported by relatives of the deceased, suggestive of neoplasms in these sites. Another important sign is rapid loss of weight which may be recognized and reported by some respondents. Nevertheless, a purely symptom-based diagnosis cannot be achieved with confidence. Hence, information from access to health services and treatment records available with the household form important elements for a reliable diagnosis of neoplasms. In addition to diagnostic reports from pathology and imaging, even a health worker statement mentioning a site-specific neoplasm can be helpful. Wherever feasible, the diagnoses recorded from available health service documents or hearsay reports should be corroborated with responses in the questionnaire, to confirm the

neoplasm as the underlying cause. For instance, a health service report of prostate neoplasm should be corroborated by positive responses to difficulties with passage of urine over a reasonable period of time. Conditions such as blood neoplasms, brain neoplasms, or pancreatic neoplasms cannot be diagnosed from signs and symptoms and would necessarily require information from health service records. All these aspects underscore the importance of careful attention to VA interviewing skills and data collection, which could benefit from feedback on data quality provided by physician reviewers to VA interviewers.

4.1.4.4 Respiratory disorders

Diagnoses of two common respiratory causes of death – pneumonia (VAs-01-02 acute respiratory infection, including pneumonia) and COPD should be carefully considered when being assigned as underlying causes, taking into consideration the evidence potentially available from VA data. Following pneumonia, the second major respiratory condition is COPD, which is characterized by chronic cough with long standing progressive breathlessness accompanied by frequent infective exacerbations with acute breathlessness, cough, sputum, and fever. Often, there would be a history of smoking, but this may not be so when other occupational exposures or indoor air pollution serve as risk factors. In some instances, long standing breathlessness and signs of congestion from right heart failure (pedal oedema and breathlessness while lying flat or interfering with sleep) may resemble congestive heart failure. In some cultures, there is a practice of referring to all such breathlessness as ‘asthma’. By convention, a diagnosis of asthma is based on complete reversibility of airway narrowing, and such reversibility is not present in cases of long-standing breathlessness in adults. A persistent background breathlessness that restricts physical activity, along with recurrent infective episodes with aggravated breathlessness is a characteristic feature of COPD, which should be assigned as the underlying cause. Where there is information specific to breathlessness occurring at night or interfering with sleep, and possibly along with swelling of the feet, and without recurrent infective exacerbations, a diagnosis of congestive heart failure (VAs-04.99 other and unspecified cardiac disease) could be considered. Any co-existing hypertension or previous history of ischemic heart disease should also be recorded on the VA cause of death form, along with duration.

4.1.4.5 Other non-communicable diseases

Other important non-communicable causes of death are liver cirrhosis and renal failure, both of which are relatively difficult to diagnose solely on the basis of clinical signs and symptoms. Liver cirrhosis can present with a wide range of clinical features, of which a report of jaundice,

enlarged protuberant abdomen (suggestive of ascites), and terminal vomiting of blood (due to oesophageal varices) may be the common signs recalled and reported by respondents. There may be a prolonged history of alcoholism, to support the diagnosis of alcoholic liver disease. A diagnosis of renal failure from VA may need to rely on information obtained from health records, or reports of accessing renal dialysis services.

Similarly, diagnosis of deaths from musculoskeletal disorders such as rheumatoid arthritis or immune-mediated conditions would essentially require evidence from health records and are usually noted in the open narrative section of the questionnaire.

The mention in the open narrative section of behavioral and mood changes, memory loss, lack of motor coordination, apathy, anxiety, inappropriate disinhibited behaviors, and significant dependence on a caregiver, of several months' duration and no mention of a physician-diagnosed disease affecting brain functioning, could be suggestive of nervous system disorders, mental disorders and dementias as basic causes of death.

To enhance the utility of such information, VA interviewers are trained to record as much detail as available from previous contact with health services or treatment accessed during the terminal illness. This could include the name(s) of treating institutions, nature of diagnostic evidence available, and any details of treatment provided, and information on diagnosis of illness as conveyed by medical staff (preferably with medical designation/ qualification), all of which would improve the reliability of assigned causes of death.

4.1.5 External causes of death

Intuitively, external causes of death should be readily identified in VA settings, given the relatively straightforward circumstances and events of the injury or violence resulting in death. However, in the absence of an adequate medico-legal system that requires accurate identification and registration of these details, a range of sociological factors come into play that could mask the true cause of death in many cases. While these may not be that significant for transport accidents or falls, they could be so in the case of suicides, assault, and poisoning.

Even in scenarios that might appear straightforward, such as a road traffic accident, it is crucial to record the actual and specific circumstances on the VA cause instrument (e.g., motorcycle rider hit by car or pedestrian struck by tram). This enables detailed coding of the underlying cause in accordance with the ICD (see Section 3.1). The VA instrument includes an

open narrative section that permits the recording of these details, and interviewers should be adequately trained to capture these critical details. Recording precise detailed information is essential for all external causes of death. Physician reviewers can play a vital role in enhancing this process by providing constructive feedback to VA supervisors and interviewers on the quality of the recorded details pertaining to external causes of death.

In the case of medicolegal deaths—such as those involving homicide, suicide, accidents under investigation, or deaths in custody — coding of the underlying cause of death presents particular challenges. These cases often involve incomplete or restricted information due to pending legal investigations, which may create uncertainties not only about the exact cause of death but also the manner or intentionality of the event, making timely and accurate coding of the underlying cause difficult. Without formal forensic autopsies or medicolegal reporting systems, VA data may lack the specificity needed to assign accurate ICD codes. In such cases, it is appropriate for physician reviewers to exercise caution, and if uncertainty remains high, to assign the cause of death as undetermined rather than speculate.

In summary, all deaths from injuries should be assigned an internal cause (body part(s) affected) as well as an external cause (the circumstances of how the injury occurred), with as much detail as possible for both causes. For example, a death caused by a fall (external cause) should also mention whether the fall was from a height or at the same level, and if from a height, whether from a building or a tree. The external cause must also mention whether the injury was from an assault, or intentional self-harm, or from an accident. The internal cause for the same death could be a head injury; or multiple fractures. Similarly, a road traffic accident death should mention whether the victim was a vehicle driver, an occupant, or a pedestrian, along with details of the body parts that were injured. Also, a case of poisoning should specify the intent, as well as the nature of the poison. Care should be taken to mention if the external cause was related to occupation. Careful assignment of causes of injury deaths taking into account details of both external and internal causes would be very useful for epidemiology and public health prevention.

5 Tabulation and statistical presentation

The ICD prescribes a set of guidelines on data presentation of ICD coded causes of death by age groups and gender to facilitate statistical and epidemiological interpretation. In principle, the degree of detail in cross-classification by cause, age, sex, and geographical area will depend on the purpose(s) for developing the statistics, as well as the practical limits to their tabulation. This section discusses some relevant aspects of age groupings, and more importantly, aggregations of deaths by cause for statistical tabulation.

The determination of age at death is important in communities where VA procedures are implemented, as people may not be aware about birth dates. Furthermore, the Gregorian calendar may not be implemented locally. It is recommended that VA interviewers are appropriately trained in recording as accurately as possible the age at death. From both demographic and epidemiological perspectives, age reporting is important, and the compilation of statistics is recommended according to standard age-groupings as follows:

- For deaths below the one year, reporting should be according to the following categories:
    - Deaths under 7 days
    - 7-27 days
    - 28 days but under 1 year
- Single years to 4 years
- Five year groups from 5 to 84 years (i.e., 5-9, 10-14,…..80-84, 85+).

The ICD recommends several broader age groupings which may be used when reporting smaller data sets.

In terms of tabulations by cause, the ICD recommends that primary tabulations should be according to the detailed list of disease or condition specific ICD categories. In general, the hierarchical structure of the ICD allows considerable flexibility for possible groupings of the

specific categories, to produce a tabulation which is epidemiologically meaningful, at the same time with as few empty cells as possible. ICD-11 provides several special tabulation and linearization lists for mortality statistics, which are accessible via the digital browser. These lists can be used for preparing statistics to monitor and analyse population health and mortality-related health concerns at both national and international levels. For example, the "List 1 Mortality tabulation list"

includes 159 cause categories in ICD-11 and 103 categories in ICD-10, and is practical and convenient for most publication purposes, especially as it provides for residual elements within each ICD chapter, which enables the derivation of chapter specific subtotals for comparisons across populations and over time. The use of numerical prefixes helps prevent confusion between the different special tabulation lists, as in ICD-11 the four-character codes include a letter in the second position. When an adapted list is used for national or sub-national purposes, an alternative identifying prefix should be applied.[27]

The use of these ICD lists implies that the source of data on causes of death is from medical certificates issued by the attending physician. The ICD also stipulates that deaths that are not medically certified should be published separately. For these reasons, it allows the preparation of locally designed lists, using an appropriate identifying prefix for each cause category item number, for the presentation and usage of statistics derived from alternate sources of cause of death data. Where such a local list is constructed, the key to the condensed categories should contain the four-character codes (three-character codes for ICD-10) of the ICD-11 core classification. More details regarding these guidelines and recommendations on tabulation are available in the ICD-11 Reference Guide Section 2.25 "Recommendations in relation to statistical tables for international comparison".[28]

Based on these guiding principles in tabulation, there is potential to use a special selected mortality list for the purpose of tabulating cause of death statistics derived through VA methods. The WHO target list of causes of death for VA (see Annex 1) has been designed in accordance with the principles outlined below.

- Structured according to the ICD chapters.

[27] https://icd.who.int/browse/2025-01/mms/en
[28] https://icdcdn.who.int/icd11referenceguide/en/html/index.html#recommendations-in-relation-to-statistical-tables-for-international-comparison

- Includes causes of epidemiological and public health relevance for developing countries.
- Of these, specific causes that have clearly distinguishable symptom complexes have been listed separately (expert algorithms for diagnosing these causes are available).
- Some specific symptoms, which may be the only information gleaned from the VA, have been listed as individual causes, to serve as clues to the possible underlying pathology.
- Residual cause categories have been provided for some of the chapters where it is considered necessary to have a chapter total such as maternal causes, perinatal causes, infectious and parasitic diseases etc.
- The cause categories enable evaluation of individual health programs for specific infectious diseases, IMCI, maternal health, injury prevention, chronic disease control etc.
- An overall residual category has been provided, to complete the tabulation of all possible causes.

The list consists of 65 cause categories and provides information about many important diseases and external causes of death that can be identified by VA methods, as well as some other significant conditions of public health importance that require supporting diagnostic information (such as neoplasms). Primary tabulation of deaths by age and sex and cause according to this list are recommended, for comparability of data collected by these VA methods in different populations. Such tabulations facilitate comparison over time and observation of shifts in relative frequencies of individual causes as local health programs take effect. It also permits comparisons between subnational areas and population subgroups. Further, it enables the comparison between statistics derived from VA methods with statistics from vital registration systems or health facilities, where causes of death are medically certified.

Tabulations according to this list can be collapsed into broader cause categories, depending on further research/policy interests. Collapsing results to broader cause groups is also useful for assessing validity of data. For specific purposes like research and surveillance, the target cause list may be expanded, and specific ICD codes used for individual deaths. For example, for researchers interested in deaths due to HIV versus pulmonary tuberculosis, the VA instrument can code to HIV/AIDS related deaths (VAs-01.03) or pulmonary tuberculosis (VAs-01.09). However, where PCVA is available and the VAs contain sufficient information, physicians may be able to a complete the VA cause of death form with sufficient detail that

the cause can be coded to disease specific codes in ICD, which provide more detail about the specific relationship between HIV and TB for each individual death, e.g., (select list for demonstration purposes). PCVA physicians should write complete diagnoses and include all identified conditions on the VA COD form, which will enable mortality coders to accurately select the underlying cause of death as per ICD coding rules, and assign the correct corresponding ICD code from either the Eleventh or Tenth Revisions of the ICD, as applicable. Tabulations based on such codes would be amenable to different ICD code groupings, based on specific research interests. In all situations, coded data from VA should be specifically labelled according to the data source and the type of coding approach used, and separately tabulated for each data source/coding method. The WHO VA tabulation list is available on Annex 1 of this guide as well as in Section 3.14.14. within Annex C of the ICD-11 Reference Guide - where column 1 contains the code for the verbal autopsy entity; and column 2 lists the related titles hyperlinked to the ICD-11 codes that would be used if the condition labelled by column 2 were coded to ICD-11.[29]

NOTE: In addition to software that assist with the automated assignment and coding of causes of death, physicians and mortality surveillance teams can use analytical tools to assess the quality and patterns of mortality data. One such tool is the ANACoD3 (Analysing Mortality and Causes of Death 3), developed by WHO.[30] ANACoD3 enables users to systematically analyse mortality and cause-of-death data. It tabulates data, presents basic mortality measures, checks for inconsistencies and errors, and estimates data completeness for reporting. It also generates indicators such as age- and sex-specific mortality rates, crude death rates, life expectancy at birth, leading causes of death, and the proportion of ill-defined causes.

[29] https://icdcdn.who.int/icd11referenceguide/en/html/index.html#target-list-of-causes-of-death-for-verbal-autopsy

[30] https://www.who.int/standards/classifications/classification-of-diseases/services/analysing-mortality-levels-and-causes-of-death

6 Diagnostic guidance for the WHO target list of causes of death for verbal autopsy

Section 3 provides detailed instructions and guidelines on the certification of cause of death, using the standard international certificate. While this is adequately accomplished when detailed medical records are available that provide documented empirical evidence as to the medical diagnosis of the illness(es) present at the time of death, the same is not the case from a VA questionnaire. Several critical issues that govern data quality from VA questionnaires have been discussed in Section 4, and these could sometimes result in the recording of a multitude of symptoms, signs, and other evidence as to the cause, which could create some uncertainty as to the cause(s) operating at the time of death.

For these reasons, this section has been included in the manual to provide a set of general diagnostic guidelines for specific causes of death that could be identified from VA data. As stated in Section 4, these guidelines are not specific diagnostic algorithms or criteria for selection of the individual causes that have been described here, but more for the purpose of differentiation of one cause from other competing causes, in case of overlapping symptomatology or any confusion arising from the VA data. Also, these guidelines are to be used to support clinical judgement in the adjudication of cause of death and should be used in conjunction with the 'do's' and 'don'ts' listed in Section 4.

For interpreting these guidelines, note that more than one "symptom pathway" can lead to assigning a cause of death (for example, HIV/AID related death has two pathways). Each "pathway" is numbered, and if more than one pathway is possible, they are distinguished with an "**OR**". Also note that within a pathway, symptoms are combined with "**AND/OR**".

VA code	VA title	Guidelines
		VAs-01 Infectious and parasitic diseases
VAs-01.01	**Sepsis**	1. Fever **AND** mental confusion for less than 1 week **AND** one of the following: • Inability to stand up *(information needs to come from the open narrative*) • Lethargy *(information needs to come from the open narrative*). **NOTE:** If there is a more specific cause, like pneumonia, that would be the underlying cause. Sepsis in those cases would be considered the direct cause.
VAs-01.02	**Acute respiratory infection, including pneumonia**	1. Acute cough (dry or productive) **AND** fever **AND** any of the following: • Fast breathing/breathlessness • Chest pain • Cough up blood (i.e., blood in sputum) • Wheezing. **AND** none of the following: • Swelling of legs • Distension of abdomen.

VAs-01.03	**HIV/AIDS related death**	1. H/O severe weight loss in less than 3 months *(information on duration needs to come from the open narrative*) **AND** HIV +ve serology. **OR** 2. H/O severe weight loss in less than 3 months *(information on duration needs to come from the open narrative*) **AND** any two of the following: • History of prolonged unexplained fever • Persistent diarrhoea • Persistent cough for more than 1 month (intermittent or continuous) • Mouth sores/white patches in mouth • Skin rash for prolonged periods of time • Generalised swelling of nodes (i.e., lumps) in armpits, neck, groin • History of spouse/partner with similar illness/death of spouse partner from similar illness *(information needs to come from the open narrative*).
VAs-01.04	**Diarrheal diseases**	1. Three or more loose/liquid/watery stools per day over < 2 weeks **AND** any two of the following: • Eyes sunken/depressed fontanelle • Low/nil urine output • Vomiting • Intravenous fluid intake/ORS • *Mental confusion **OR** dizziness (information needs to come from the open narrative*) • Unconsciousness/lethargy (*information needs to come from the open narrative)* • Decreased fluid intake *(information needs to come from the open narrative*). **OR** 2. Three or more loose/liquid/watery stools per day over < 2 weeks **AND** blood in stool.

VAs-01.05	**Malaria**	1. Acute onset of severe fever (may be intermittent) **AND** NO stiff neck **AND** NO bulging of fontanelle (for children under 12 months old) **AND** any three of the following: • Convulsions • Unconscious • Breathlessness • Pallor (pale palms, eyes, nail beds) • Jaundice • Severe headache • Chills/rigor *(information needs to come from the open narrative*). **OR** 2. Acute onset of severe fever (may be intermittent) **AND** recent test positive for malaria **AND** any two of the following: • Convulsions • Unconscious • Breathlessness • Pallor (pale palms, eyes, nail beds) • Jaundice • Severe headache • Chills/rigor *(information needs to come from the open narrative*). **NOTE:** Presence of symptoms of ARI, diarrhoea or burning during micturition could be suggestive of immediate or contributory causes.
VAs-01.06	**Measles**	1. Age ≥ 4 months **AND** rash all over body ≥ 3 days **AND** fever ≥ 3 days **AND** any of the following: • Rash started on the face (measles rash) • Cough • Red or watery eyes *(information needs to come from the open narrative)* • Running nose *(information needs to come from the open narrative).*

VAs-01.07	**Meningitis and encephalitis**	1. (Continuous fever **OR** hypothermia in children < 3 months old (*information needs to come from the open narrative)*) **AND** any two of the following: • Neck stiffness • Convulsions • Bulging fontanelle • Severe headache • Prolonged loss of consciousness • Vomiting/ Poor feeding (children) • Mental confusion • Irritability or lethargy *(information needs to come from the open narrative*) • Ear discharge *(information needs to come from the open narrative).*
VAs-01.08	**Tetanus**[31]	1. (Stiffness of the whole body **AND/OR** unable to open the mouth) **AND** any of the following: • Arching of the back/whole body • History of injury (cut or pierced) • Difficulty breathing.
VAs-01.09	**Pulmonary tuberculosis**	1. Chronic cough of ≥ 2 weeks **AND** fever **AND** any two of the following: • Cough up blood (i.e., blood in sputum) • Chest pain • Breathlessness • Diagnosis and/or treatment history of TB • Known HIV positive serology (especially if not on ART) • Loss of appetite *(information needs to come from the open narrative)* • Chronic weight loss *(information on duration needs to come from the open narrative).*

[31] Excludes: Neonatal tetanus VAs-10.05

VAs-01.10	**Pertussis**	**1.** Severe cough **AND** any of the following: • "whooping" sound when coughing • Stridor • Vomiting after coughing *(information needs to come from the open narrative)* • Breathlessness in the neonate *(information needs to come from the open narrative).*
VAs-01.11	**Haemorrhagic fever**[32]	**1.** Fever > 3 days **AND** bleeding from nose, mouth or anus **AND** blood test for dengue fever negative (*information needs to come from the open narrative)*.
VAs-01.12	**Dengue fever**	**1.** Sudden onset of severe fever **AND** any 2 of the following: • Vomiting • Bleeding from nose, mouth, or anus • Severe pain in muscles, bones, forehead and behind eyeballs *(information needs to come from the open narrative).* **OR** **2.** Diagnosis of dengue fever by a health professional.
VAs-01.13	**COVID-19**	**1.** Severe difficulty breathing or breathlessness (i.e., shortness of breath) until death **AND** positive test for COVID-19.[33] **OR** **2.** Severe difficulty breathing or breathlessness until death **AND** not vaccinated against COVID-19 **AND** any three of the following: • Fever/chills • Loss or change of smell/taste • Extreme fatigue • Cough • Known exposure to COVID-19 • Diarrhoea/vomiting • Sore throat *(information needs to come from the open narrative)* • Muscle or body aches *(information needs to come from the open narrative).* **NOTE:** The open narrative is very important to elicit the necessary details to make a correct diagnosis for COVID-19.

VAs-01.99	**Unspecified infectious disease**	1. Fever with no other specific signs or symptoms.

Non-communicable diseases

NOTE: This group covers all non-communicable conditions. Any infection of the systems that are listed in this section should be assigned to the suitable infectious disease category. Any maternal and perinatal condition should be assigned to the maternal and perinatal causes below.

VAs-98	**Other and unspecified non-communicable disease**	No specific guidelines. **NOTE:** This group covers all non-communicable conditions that could not be assigned to another category in this section. There is a separate category for cases where the cause of death is unknown.

VAs-02 Neoplasms

VAs-02.01	**Oral neoplasms**	1. (Lump or sores **OR** mass **OR** swelling on tongue/ cheek/ mouth cavity/ gum/ palate, usually progressive *(information on swelling needs to come from the open narrative)*) **AND** any of the following: • H/O chewing tobacco • Weight loss • Non-healing sore or ulcer (*information needs to come from the narrative)* • Restriction/difficulty in opening mouth (*information needs to come from the open narrative)* • Bleeding on touch from the lump/mass/swelling *(information needs to come from the open narrative).* **OR** 2. Diagnosed as oral cancer.

[32] Excludes: Dengue VAs-01.12.
[33] Only test for COVID-19 conducted in health professionals are acceptable.

VAs-02.02 **Digestive neoplasms**

Oesophageal cancer

1. Progressive difficulty in taking foods **AND** weight loss over several months *(information on duration needs to come from the open narrative*).

OR

2. Diagnosed as oesophageal cancer.

Stomach cancer

1. Vomiting **AND** mass in upper abdomen *(information on location needs to come from the open narrative)* **AND** any of the following:
   - Blood in vomit
   - Weight loss
   - Difficulty in swallowing
   - Black stools *(information needs to come from the open narrative)*
   - *Black vomit.*

OR

2. Diagnosed as stomach cancer.

Colorectal cancer

1. Bleeding from anal opening **AND** any of the following:
   - Chronic H/O constipation alternating with loose stools **OR** constipation alone *(information needs to come from the open narrative)*
   - Weight loss
   - Painful abdominal distension
   - Lump in lower part of abdomen *(information on location needs to come from the open narrative).*

OR

2. Diagnosed as colorectal cancer.

Liver cancer

1. Mass in the abdomen in the right upper quadrant *(information on location needs to come from the open narrative)* **AND** any two of the following:

		• Protrusion of abdomen developed slowly over months • Weight loss • Jaundice. **OR** **2.** Diagnosed as liver cancer.
VAs-02.03	**Respiratory neoplasms**	Throat cancer **1.** (Hoarseness of voice slowly developed over months *(information needs to come from the open narrative)* **OR** swelling inside the throat *(information needs to come from the open narrative))* **AND** weight loss over several months *(information on duration needs to come from the open narrative).* **OR** **2.** Diagnosed as throat cancer. Lung cancer **1.** Chronic cough **AND** coughing blood **AND** NO diagnosis of Tuberculosis during final illness **AND** any of the following: • H/O smoking daily over a long period • Noticeable loss of weight • Recurrent H/O Pneumonia *(information needs to come from the open narrative).* **OR** **2.** Diagnosed as lung cancer.
VAs-02.04	**Breast neoplasms**	**1.** Painless lump in one or both breasts *(information on pain needs to come from the open narrative)* **AND** any of the following: • Skin ulceration over breast • Enlarged glands (i.e., lumps) in the neck/axilla • Discharge from nipple *(information needs to come from the open narrative).* **OR** **2.** Diagnosed as breast cancer.

VAs-02.05	**Female reproductive neoplasms**	1. (Vaginal bleeding after menopause **OR** pre-menopausal foul smelling vaginal discharge with blood *(information needs to come from the open narrative)*) **AND** any of the following: • Weight loss • HIV positive/AIDS diagnosis • Bleeding after sex *(information needs to come from the open narrative)* • HPV positive *(information needs to come from the open narrative).* **OR** 2. Diagnosed as Carcinoma cervix, uterus, ovarian, vulva.
VAs-02.06	**Male reproductive neoplasms**	1. (Palpable lesion/Ulcer in the penis of prolonged duration *(information needs to come from the open narrative)* **OR** hard swelling/lump on the testicle(s) *(information needs to come from the open narrative)* **OR** difficulty in passing urine) **AND** chronic loss of weight *(information on duration needs to come from the open narrative).* **OR** 2. Diagnosed as prostate, penile, or testicular carcinoma.
VAs-02.99	**Other and unspecified neoplasms**	No specific guidelines.

VAs-03 Nutritional and endocrine disorders

VAs-03.01	**Severe anaemia**	1. Pallor (palms, eyes, oral mucous membranes) **AND** NO diagnosis of any cancer/malaria/sickle cell disease/ TB/HIV/AIDS/cardiac failure **AND** any three of the following: • Weight loss • Fatigue/weakness • Breathlessness on exertion • Swollen legs and feet • H/O bleeding anywhere • Dizziness (*information needs to come from the narrative).*

		OR 2. Diagnosed as Anaemia.
VAs-03.02	**Severe malnutrition**	1. (Not growing properly **OR** losing weight and becoming very thin over months (*information on duration needs to come from the open narrative*)) **AND** any 2 of the following: • Recurrent febrile illness • Reddish brown discoloration of hair • Flaking of skin • Pallor • Protruding abdomen • Swelling of feet • Night-blindness *(information needs to come from the open narrative).*
VAs-03.03	**Diabetes mellitus**	1. H/O diabetes **AND** any of the following: • Ulcer(s) in the foot over long period *(information on duration needs to come from the open narrative)* • Frequent urination *(information needs to come from the open narrative)* • Increased thirst/increased hunger *(information needs to come from the open narrative)* • Recurrent infection (particularly respiratory) *(information needs to come from the open narrative).* • Tingling or numbness of toes *(information needs to come from the open narrative)* • Fruity-scented breath *(information needs to come from the open narrative).* **OR** 2. H/O diabetes **AND** no other cause of death identified.

	VAs-04 Diseases of the circulatory system	
VAs-04.01	**Acute cardiac disease**[34]	**1.** Severe chest pain lasting for more than ½ hour but less than 24 hours **AND** any 2 of the following: • Breathlessness (i.e., shortness of breath) • Nausea/vomiting • Sudden death • Pain radiating to left arm back, jaw or shoulders *(information needs to come from the open narrative)* • Pain between the shoulder blades *(information needs to come from the open narrative)* • Sweating *(information needs to come from the open narrative).* **OR** **2.** Sudden death with acute breathlessness **AND** (previous H/O heart disease **OR** hypertension). **NOTE:** See Section 4.1.1.1 for definition of sudden death. **OR** **3.** Diagnosed heart attack/Myocardial infarction.
VAs-04.02	**Stroke**	**1.** Sudden onset of paralysis of one side of the body in the month preceding death *(information on onset and timing needs to come from the open narrative)* **AND** any of the following: • Unconsciousness • Headache • Loss of vision *(information needs to come from the open narrative)* • Urinary incontinence *(information needs to come from the open narrative)* • Loss of sensations on one side of the body *(information needs to come from the open narrative)*

[34] Includes: Ischaemic heart disease; Pulmonary embolism; Sudden cardiac death; Cardiac arrest, unspecified; Left ventricular failure; and Hypertensive heart disease with heart failure.

		• Altered speech *(information needs to come from the open narrative)* • Face pulled skew *(information needs to come from open narrative).* **NOTE:** In long standing cases, commonly leading to development of bed sores with septicaemia, or features of pneumonia as the immediate cause of death.
VAs-04.03	**Sickle cell with crisis**	1. Pallor **AND** fast breathing **AND** H/O joint and bone pain (*information needs to come from the narrative)* **AND** any of the following: • Fever • Jaundice • H/O sickle cell • H/O blood transfusion • Fainting (collapse) (*information needs to come from the open narrative)* • Dizziness (*information needs to come from the open narrative)*.
VAs-04.99	**Other and unspecified cardiac disease**	No specific guidelines for this category

VAs-05 Respiratory disorders

VAs-05.01	**Chronic obstructive pulmonary disease (COPD)**	1. Recurrent episodes of productive cough >2yrs **AND** breathlessness, initially episodic (more in winter) later progressive *(information on mode of onset needs to come from the open narrative)* **AND** no H/O TB **AND** any of the following: • Ankle swelling late in disease • Death is often preceded by signs of terminal pneumonia *(information needs to come from the open narrative)* • Wheezing. **NOTE:** respondents may suggest that a patient has asthma when referring to COPD, but narrative may indicate adult onset which would be more in keeping with COPD.

VAs-05.02	**Asthma**	**1.** Severe acute breathlessness **AND** H/O asthma **AND** any of the following: • Usually in children and young adults • Not responding to usual treatment for breathing problems *(information needs to come from the open narrative).*

VAs-06 Gastrointestinal disorders

VAs-06.01	**Acute abdomen**	**1.** Severe acute abdominal pain **AND** any of the following: • Vomiting • Fever • Abdominal distension • Jaundice • Constipation *(information needs to come from the open narrative)* • Rigidity of abdomen *(information needs to come from the open narrative)* • Back pain that radiates to the buttocks, groin, or legs *(information needs to come from the open narrative)* • Pallor/coldness in the legs *(information needs to come from the open narrative).*
VAs-06.02	**Liver cirrhosis**[35]	**1.** Abdominal distension (i.e., fluid in abdomen; ascites) **AND** jaundice **AND** swelling of lower limbs **AND** with or without any of the following: • Vomiting of blood • Passing of blood in stool • H/o chronic alcoholism • Drowsiness/coma *(information needs to come from the open narrative).*

[35] Includes Alcoholic fibrosis/ cirrhosis; Toxic liver cirrhosis; Fibrosis and cirrhosis of liver, excluding alcoholic and toxic, but including 'unspecified liver cirrhosis'

VAs-07 Renal disorders

VAs-07.01 **Renal failure**

1. H/O renal dialysis/renal failure from health records **AND** no other specific cause of death.

OR

2. (Passing small amount of urine over a long period *(information needs to come from the open narrative)* **OR** acute onset of decreasing urinary output for more than 1 day *(information needs to come from the open narrative)*) **AND** any two of the following:
   - H/O hypertension
   - H/O diabetes
   - Swelling of the eyelids/face
   - Swelling of the whole body
   - Lower abdominal pain
   - Confusion/drowsiness *(information needs to come from the open narrative)*
   - Hiccups *(information needs to come from the open narrative).*

VAs-08 Mental and nervous system disorders

VAs-08.01 **Epilepsy**

1. (H/O epilepsy **OR** H/O generalized convulsions over a long period *(information on duration needs to come from the open narrative)*) **AND** (general convulsions during final illness **AND** loss of consciousness after convulsions) **AND**:
   - No fever
   - No neck stiffness
   - No H/O injury to head up to one week before death *(information needs to come from the open narrative).*

OR

2. H/O epilepsy **AND** no other specific cause of death.

VAs-09 Pregnancy-, childbirth and puerperium-related disorders

VAs-09.01	**Ectopic pregnancy**	1. Female aged 12-49 years old **AND** sudden severe abdominal pain **AND** (vaginal bleeding **OR** fainted). **NOTE:** H/O pregnancy <2 months is supporting evidence but not essential.
VAs-09.02	**Abortion-related death**	1. Female aged 12-49 years old **AND** H/O abortion (i.e., termination before 28 weeks of pregnancy) **AND** died within 42 days of having an abortion **AND** any of the following: • Lower abdominal pain and abnormal vaginal discharge • Excessive vaginal bleeding • Fever until death.
VAs-09.03	**Pregnancy-induced hypertension**	1. (Pregnancy >20 weeks of gestation **OR** up to 6 weeks postpartum) **AND** (diagnosis of high blood pressure by a health professional at >20 weeks gestation **OR** up to 6 weeks postpartum *(information on timing needs to come from the open narrative)*). **OR** 2. (Pregnancy >20 weeks gestation **OR** up to 6 weeks postpartum) **AND** any of the following: • Convulsions for first time in pregnancy **OR** up to 6 weeks postpartum • Swelling of face • Blurred vision • Severe headache • Upper abdominal pain.
VAs-09.04	**Obstetric haemorrhage**	Antepartum haemorrhage 1. Abdominal/back pain after 28 weeks of gestation but before birth of baby *(information needs to come from the open narrative)* **AND** (excessive vaginal bleeding **OR** fainting attack *(information needs to come from the open narrative)*). **OR** 2. H/O painless vaginal bleeding during pregnancy *(information on pain needs to come from the open narrative)* **AND** excessive bleeding during labour and delivery.

		Postpartum haemorrhage **3.** Excessive bleeding after delivery of baby **OR** fainting attack **AND** no abdominal pain **AND** any one of the following: • Placenta was partially or fully retained • Abdominal pain had stopped after delivering the baby *(information on timing needs to come from the open narrative).*
VAs-09.05	**Obstructed labour**	**1.** Abnormal presentation (breech, shoulder, hand, or transverse) **AND** baby not delivered. **OR** **2.** (Difficulty in delivering baby **OR** forceps/vacuum/C-section delivery) **AND** prolonged labour >24 hours.
VAs-09.06	**Pregnancy-related sepsis**	**1.** H/O delivery/abortion within 42 days **AND** severe fever persisting till death **AND** any of the following: • Foul smelling vaginal discharge • Lower abdominal pain/distention.
VAs-09.07	**Anaemia of pregnancy**	**1.** Death during pregnancy, labour, delivery or occurring soon after birth of child **AND** no other specific cause of death was identified **AND** any of the following: • (Paleness of tongue, lips or palms **OR** fatigue) **AND** breathlessness prior to death • H/O need/given blood transfusion • H/O diagnosis of severe anaemia (HB < 5g/dl) *(information needs to come from the open narrative or medical records)* **NOTE:** Other symptoms that can be available from the open narrative include palpitations/tachycardia, irritability, dizziness, and restless legs.
VAs-09.08	**Ruptured uterus**	**1.** H/O prolonged labour **AND** sudden severe abdominal pain **AND** any of the following: • Vaginal bleeding • H/O c-section.

VAs-10 Neonatal causes of death

VAs-10.01	**Prematurity or low birth weight**	1. Born alive **AND** pregnancy duration less than 8 months (i.e., for 7 months and below) **AND** no other obvious cause of death. **OR** 2. If pregnancy duration not known: Smaller than average size baby (if weighted, birth weight below 2.5 kilograms) **AND** no other obvious cause of death.
VAs-10.02	**Birth asphyxia**[36]	1. (Delayed or no breathing at birth **OR** delayed or no crying at birth) **AND** any sign of life present at birth (i.e., exclude stillbirths) **AND** any of the following: • Died within 24 hours of birth • Convulsions in first 24 hours • Prolonged or difficult labour • Poor suckling • Respiratory distress after birth in a term infant.
VAs-10.03	**Neonatal pneumonia**[37]	1. Breathed immediately at birth, even if a little **AND** (fever **OR** cold to touch) **AND** any of the following: • Fast breathing • Nasal flaring/grunting • Chest in drawing.
VAs-10.04	**Neonatal sepsis**	1. (Fever **OR** cold to touch) **AND** no other obvious causes of death (e.g., acute respiratory infection, including pneumonia, meningitis, diarrhoea) **AND** any of the following: • Purulent cord • Skin sores/ulcers • Poor suckling • Lethargic • Unconscious • Convulsions.

[36] Includes: Hypoxia and respiratory distress
[37] Differs from "pneumonia", as this refers to a death within 28 days of life.

VAs-10.05	**Neonatal tetanus**	1. Baby able to suckle and cry after birth **AND** stopped suckling or crying after 2 days **AND** baby's body became rigid (stiff with the back arched backwards) **AND** any of the following: • Convulsions • Umbilical cord inflammation (pus draining from the cord or redness extending to the skin) • Mother not vaccinated against tetanus in pregnancy.
VAs-10.06	**Congenital malformation**	1. Any of the following: • Abnormally small head • Abnormally large head • Swelling or defect of the back • Open palate (cleft) *(information needs to come from the open narrative)* • No anal opening (i.e., not being able to defecate) *(information needs to come from the open narrative)* • Defect of the abdominal wall and visible internal organs *(information needs to come from the open narrative).*
VAs-10.99	**Other and unspecified perinatal cause of death**	Death within 7 days of birth; No specific guidelines for this category.

VAs-11 Stillbirths

VAs-11.01	**Fresh stillbirth**	1. Baby did not cry, move, or breathe at birth **AND** (stopped moving during labour **OR** no maceration).
VAs-11.02	**Macerated stillbirth**	1. Baby did not cry, move, or breathe at birth **AND** (stopped moving before the onset of labour **OR** baby's body was soft, discoloured and the skin peeling away).

VAS-12 External causes of death

NOTE: The list of questions contains sub questions that allow for more specificity for accidents. Diagnosis is evident from related information from questions and open narrative. Care should be taken to certify external cause as well as body part involved in injury, as applicable.

VAs-12.01	**Road traffic accident**

VAs-12.02	**Other transport accident**
VAs-12.03	**Accidental fall**
VAs-12.04	**Accidental drowning and submersion**
VAs-12.05	**Accidental exposure to smoke, fire and flames**
VAs-12.06	**Contact with venomous animals and plants**
VAs-12.07	**Accidental poisoning and exposure to noxious substance**
VAs-12.08	**Intentional self-harm**
VAs-12.09	**Assault**
VAs-12.10	**Exposure to force of nature**
VAs-12.99	**Other and unspecified external cause of death**
VAs-99	**Cause of death unknown**

7 Physician reviewer training

Cause of death certification is an important professional duty that medical practitioners are required to perform for every death event attended by them and is universally considered to be an ethical and social responsibility as well. Death certificates are essentially legal documents, and the ICD recommends that administrative procedures should ensure the confidentiality of data on causes of death. For these reasons, it is imperative that medical practitioners receive adequate training in performing this duty, and to exercise adequate care and judgement in certifying the cause(s) of death, given that this information is essentially used for health policy and evaluation purposes.

A national agency should be identified as a resource centre for providing training to physician reviewers and develop a curriculum which includes local material for the same. Experts from other countries which also conduct VA activities could be invited to share experiences, and further distil the process.

Training workshops for VA reviewers should include the following modules:

- Sources and uses of cause specific mortality statistics;
- Standard procedures for cause of death certification using the WHO certificate;
- ICD guidelines for selection of underlying cause of death;
- Basic principles of ICD coding;
- Overview of the causes of death data collection program, household VA data collection mechanisms, and the structure and content of the VA questionnaires;
- VA data review and cause of death assignment practices;
- Mortality tabulations, and secondary data analysis;
- Preparation of a qualitative report on standards of field data collection, problems, and recommendations for improvement.

Modules on standard procedures for death certification are included to enable physicians to understand the principle of the underlying cause of death. Such understanding is essential for later developing the ability to select the underlying cause of death from the information provided from the VA instruments. This training should include practical exercises using real case summaries from deaths that have occurred in hospitals which will help physician reviewers to understand the process of physician certification of cause of death in a hospital situation, with adequate clinical evidence on the illness preceding death.

Once reviewers have some practice in this aspect, a session which discusses the relevance of specific clinical guidelines for establishing diagnoses from VA questionnaires should be conducted, which highlights the special features of VA which distinguish it from a clinical history or record, but which could still provide information to identify a probable cause of death or pathophysiological sequence to be entered on the VA cause of death form. This should be followed by discussion of a series of examples using completed VA instruments, covering the practical realities regarding the quality of VA data, which in some cases may be incomplete or with some missing details. This degree of incompleteness of information in VA could be due to lack of respondent recall for certain details, or poor-quality interviewing, or true lack of medical / clinical evidence.

During subsequent sessions of the workshop, participants should review completed VA questionnaires and apply the principles of cause of death assignment as covered in the theory sessions. These could be done in small groups, with interaction and discussion with faculty members on the availability of evidence, and the applicability of the prescribed diagnostic guidelines for the identification of specific causes of death in the cases being dealt with. Case presentations could form another mode for wider discussion and reinforcement of the basic principles of cause of death assignment. In general, the workshops should be interactive and should use live VA data collected as part of the project.

Measures of reliability

The workshop should also include sessions to test inter rater reliability, by having two physicians independently review the same VA questionnaire and complete a VA cause of death form for the same. Following this, each VA cause of death form should be presented to trained coders, who will select and code the underlying cause of death. Measures of agreement between the two independently derived underlying causes for the same death will be computed, to assess reliability of physician review. Such assessments of reliability could be

regularly conducted to ensure high quality of cause of death assignment, and guide training programs.

In order to ensure reliable cause of death assignment during routine physician review of VA, two physicians should independently review each VA record and certify a cause of death. After coding, the data manager should identify any records where the underlying cause of death from the two reviews does not match. The reviewers for the records with different underlying causes of death should be informed and asked to try and reach consensus on the underlying cause of death. Where the two reviewers are unable to reach consensus, a third reviewer (or a panel where available) should provide an opinion on which cause of death is most likely.

Annex 1: 2022 WHO target list of cause of death for verbal autopsy

Table A1. WHO target list of causes of death for VA with correspondence for ICD-11 and ICD-10 codes

VA code	VA cause of death title	ICD-10 codes	ICD-11 codes
VAs-01 Infectious and parasitic diseases			
VAs-01.01	Sepsis	A40-A41	1G40-1G41
VAs-01.02	Acute respiratory infection, including pneumonia	J00-J22; J85	CA00-CA07.1; CA40-CA43; CA45; CA4Z; 1E30-1E32
VAs-01.03	HIV/AIDS related death	B20-B24	1C60-1C62
VAs-01.04	Diarrheal diseases	A00-A09	1A00-1A40.Z
VAs-01.05	Malaria	B50-B54	1F40-1F4Z
VAs-01.06	Measles	B05	1F03
VAs-01.07	Meningitis and encephalitis	A39; G00- G05	1B53-1B54; 1C1C; 1C80-1C8F; 1D00-1D02; 8B41
VAs-01.08	Tetanus[a]	A33-A35	1C13-1C14
VAs-01.09	Pulmonary tuberculosis	A15-A16	1B10
VAs-01.10	Pertussis	A37	1C12
VAs-01.11	Haemorrhagic fever[b]	A92-A96, A98-A99	1D40-1D4Z; 1D6Z; 1D60-1D6Z
VAs-01.12	Dengue fever	A97	1D20 - 1D2Z
VAs-01.13	Coronavirus disease (COVID-19)	U07.1; U07.2	RA01.0; RA01.1
VAs-01.99	Unspecified infectious disease	A17-A19; A20-A32; A36; A38; A42-A89; B00-B04; B06-B19; B25-B49; B55-B99	1A60-1A9Z; 1B11-1B51; 1B5Y-1B9Z; 1C10-1C11.Y; 1C16-1C1B; 1C1D-1C62; 1C8Y-1C8Z; 1D03-1D0Z; 1D80-1E1Z; 1E50-1E91.Z; 1F00-1F02; 1F04-1F2Z; 1F50-1G2Z; 1G60-1H0Z; AA00-AA0Z; AA3Y-AA3Z; DB90; EA00-EA6Y; EE12; EG61; FA90-FA91; FB30; GA00-GA02; GA05; GA07; GB02; GC08

[a] Excludes: Neonatal tetanus VAs-10.05

[b] Excludes: Dengue VAs-01.12

VA code	VA cause of death title	ICD-10 codes	ICD-11 codes
Non-communicable diseases			
VAs-98	Other and unspecified non-communicable disease *Note: This group covers all non- communicable conditions that could not be assigned to another category in this section. There is a separate category for cases where the cause of death is unknown.*	D65-D89; E00-E07; E15-E35; E50-E90; F00-F99; G06-G09; G10-G37; G43-G47; G50-G99; H00-H95; J30-J39; J47- J84; J86-J99; K00-K31; K35-K38; K40-K69; K70-K93 L00-L99; M00- M99; N00-N16; N20-N99	3A60; 3B10-3C0Z; 4A00-4B4Z; DB96; 5A00-5A0Z; 5A40-5B3Z; 5B55-5C3Z; 5C50-5C51;5C52.Y-5C52-Z; 5C55; 5C56.0-5C56.3;5C58; 5C5A; 5C61.6; 5C64; 5C70-5C77; 5C80-5D46; 6A20-6A8 Z;6B00-6E8Z; 7A00-7A6Z; 7A80-7A81; 7A83-7B2Z; 8A00-8A4Z; 8A80-8A8Z; 8B24; 8B40; 8B42-8D8Z; 8E00-8E2Z; 8E40-8E7Z; 9A01-9E1Z; AA10-AA1Z; AA40-AC0Z; CA08-CA0Z; CA24-CA2Z; CA60-CB7Z; DA00-DB7Z; DB91-DB92; DB96-DE2Z; EA80-EB9Y; EC90-ED00; ED02-ED9Y; EE01-EE11; EE13-EE20; EE40-EG60; EG62-EG9Z; EH40-EL50; EL60-EM0Z; FA00-FA8Z; FA92-FB1Z; FB31-FC0Z; GA03-GA04; GA06; GA0Z-GB01; GB03-GB5Z; GB70-GB80; GB8Y; GB90-GC07; GC0Y-GC8Z; HA00-HA8Z; MB43; MB50-MB5Z; MC10-MC20; MC2Y-MC6Y; ME82; ME84-ME85; ME93;MF3A; MF54; MF56; MF80-MF8Z
VAs-02 Neoplasms			
VAs-02.01	Oral neoplasms	C00-C06	2B60-2B66
VAs-02.02	Digestive neoplasms	C15-C26	2B56.3; 2B70-2B72; 2B80-2B81; 2B90-2B9Y; 2C00-2C1Z
VAs-02.03	Respiratory neoplasms	C30-C39	2C20-2C2Z
VAs-02.04	Breast neoplasms	C50	2C60-2C6Z
VAs-02.05	Female reproductive neoplasms	C51-C58	2C70-2C7Z
VAs-02.06	Male reproductive neoplasms	C60-C63	2C80-2C8Z
VAs-02.99	Other and unspecified neoplasms	C07-C14; C40-C49; C64-D48; C91-C95	2A00-2A0Z; 2A20-2A90; 2B00-2B56.2; 2B56.Y-2B5Z; 2B67-2B6Y; 2C30-2C5Z; 2C90-2E6Z; 2E80-2F9Z
VAs-03 Nutritional and endocrine disorders			
VAs-03.01	Severe anaemia	D50-D64	3A00-3A4.Z; 3A61-3A9Z
VAs-03.02	Severe malnutrition	E40-E46	5B50-5B54; 5B71-5B7Z
VAs-03.03	Diabetes mellitus	E10-E14	5A10-5A14
VAs-04 Diseases of the circulatory system			
VAs-04.01	Acute cardiac disease[c]	I11.0; I20-I26; I46.1; I46.9; I50.1	BA01; BA40-BA6Z; BB00; BD11; MC82

VA code	VA cause of death title	ICD-10 codes	ICD-11 codes
VAs-04.02	Stroke	I60-I69	8B00-8B23; 8B25-8B2Z
VAs-04.03	Sickle cell with crisis	D57	3A51
VAs-04.99	Other and unspecified cardiac disease	I00-I10; I11.9-I15; I27- I46.0; I47-I50.0; I50.9-I52; I70-I99	BA00; BA02-BA2Z; BA50-BA5Z; BA81-BA8Z; BB01-BC91; BC9Y-BC9Z; BD10; BD12-BE2Z; 1B40-1B42
[c] Includes: Ischaemic heart disease; Pulmonary embolism; Sudden cardiac death; Cardiac arrest, unspecified; Left ventricular failure; and Hypertensive heart disease with heart failure			
VAs-05 Respiratory disorders			
VAs-05.01	Chronic obstructive pulmonary disease (COPD)	J40-J44	CA20-CA22
VAs-05.02	Asthma	J45-J46	CA23
VAs-06 Gastrointestinal disorders			
VAs-06.01	Acute abdomen	R10	MD81
VAs-06.02	Liver cirrhosis[d]	K70.2; K70.3; K71.7; K74	DB93; DB94.2; DB94.3, DB95.5
[d] Includes Alcoholic fibrosis/ cirrhosis; Toxic liver cirrhosis; Fibrosis and cirrhosis of liver, excluding alcoholic and toxic, but including 'unspecified liver cirrhosis'			
VAs-07 Renal disorders			
VAs-07.01	Renal failure	N17-N19	GB60-GB6Z
VAs-08 Mental and nervous system disorders			
VAs-08.01	Epilepsy	G40-G41	8A60-8A6Z
VAs-09 Pregnancy-, childbirth- and puerperium-related disorders			
VAs-09.01	Ectopic pregnancy	O00	JA01
VAs-09.02	Abortion-related death	O03-O08	JA00; JA05-JA0Z
VAs-09.03	Pregnancy-induced hypertension	O10-O16	JA20-JA2Z
VAs-09.04	Obstetric haemorrhage	O46; O67; O72	JA40-JA4Z
VAs-09.05	Obstructed labour	O63-O66	JB03-JB06
VAs-09.06	Pregnancy-related sepsis	O75.3; O85	JB0D.2; JB40
VAs-09.07	Anaemia of pregnancy	O99.0	JB64.0
VAs-09.0	Ruptured uterus	O71.0-O71.1	JB0A.0; JB0A.1
VAs-09.99	Other and unspecified maternal cause	O01-O02; O20-O45; O47-O62; O68-O70;O71.3-O71.9;O73-O84; O86-O99	JA02-JA04; JA60-JA6Z; JA80-JA8Z; JB00-JB02; JB07-JB09; JB0A.2-JB0D.1; JB0D.3-JB0Z; JB20-JB2Z; JB41-JB4Z; JB60-JB63; JB64.1-JB6Z

VA code	VA cause of death title	ICD-10 codes	ICD-11 codes
VAs-10 Neonatal causes of death			
VAs-10.01	Prematurity or low birth weight	P05; P07	KA20-KA21
VAs-10.02	Birth asphyxia[e]	P20-P22	KB20-KB23; KD30.0; KD30.1
VAs-10.03	Neonatal pneumonia	P23-P24	KB24; KB26
VAs-10.04	Neonatal sepsis	P36	KA60
VAs-10.05	Neonatal tetanus	A33	1C15
VAs-10.06	Congenital malformation	Q00-Q99	9A00; EC10-EC7Y; GB81-GB82; GB8Z; LA00-LD9Z
VAs-10.99	Other and unspecified perinatal cause of death	P00-P04; P08-P15; P25-P35; P37-P94; P96; R95	EH10-EH3Y; KA00-KA0Z; KA22-KA4Z; KA61-KA8Z; KB00-KB0Z; KB25; KB27-KB8Z; KC00-KC9Z; KD10-KD1Z; KD30.2-KD5Z; MH11
[e] Includes: Hypoxia and respiratory distress			
VAs-11 Stillbirths			
VAs-11.01	Fresh stillbirth	P95	KD3B.1
VAs-11.02	Macerated stillbirth	P95	KD3B.0
VAs-12 External causes of death			
Note: The list of questions contains sub questions that allow for more specificity for accidents.			
VAs-12.01	Road traffic accident	[f]	PA00-PA5Z
VAs-12.02	Other transport accident		
VAs-12.03	Accidental fall	W00-W19	PA60-PA6Z
VAs-12.04	Accidental drowning and submersion	W65-W74	PA90-PA9Z
VAs-12.05	Accidental exposure to smoke, fire and flames	X00-X19	PB10-PB15; PB1Y-PB1Z; PB55
VAs-12.06	Contact with venomous animals and plants	X20-X29	PA78; PA79
VAs-12.07	Accidental poisoning and exposure to noxious substance	X40-X49	PB20-PB36
VAs-12.08	Intentional self-harm	X60-X84; Y87.0	PB80-PD3Z
VAs-12.09	Assault	X85-Y09; Y87.1	PD50-PF2Z; PJ20-PJ2Z
VAs-12.10	Exposure to force of nature	X30-X39	PJ00-PJ0Z

VA code	VA cause of death title	ICD-10 codes	ICD-11 codes
VAs-12.99	Other and unspecified external cause of death	S00-T99; W20-W64; W75-W99; X10-X19; X50-X59; Y10-Y84; Y86; Y87.2; Y88-Y89	EL51-EL54; NA00-NF2Z; PA70-PA77; PA7Y-PA8Z; PB00-PB0Z; PB16; PB50-PB54; PB56-PB6Z; PF40-PH8Z; PJ20-PJ2Z; PJ40-PL2Z
VAs-99	Unknown and ill-defined cause of death	R00-R09; R11-R94; R96-R99	MA00-MB42; MB44-MB4D; MB60-MB9Y; MC21; MC80-MD80; MD82-ME81; ME83; ME86-ME92; ME9Y-MF39; MF3Y-MF53; MF55; MF57-MF7Z; MF90-MH10; MH12-MH2Y

f Distinction on the codes between VAs-12.01 and VAs 12.02 is on the basis whether the death was a road traffic accident. V01.1;V02.1;V03.1;V04.1;V05.1;V06.1; V09.2;V09.3; V10.4-V10.9; V11.4-V11.9; V12.4-V12.9; V13.4-V13.9; V14.4-V14.9; V15.4-V15.9; V16.4-V16.9; V17.4-V17.9; V18.4-V18.9; V19.4-V19.9; V20.4-V20.9; V21.4-V21.9; V22.4-V22.9; V23.4-V23.9; V24.4-V24.9; V25.4-V25.9; V26.4-V26.9; V27.4-V27.9; V28.4-V28.9; V29.4-V29.9; V30.5-V30.9; V31.5-V31.9; V32.5-V32.9; V33.5-V33.9; V34.5-V34.9; V35.5-V35.9; V36.5-V36.9; V37.5-V37.9; V38.5-V38.9; V39.4-V39.9; V40.5-V40.9; V41.5-V41.9; V42.5-V42.9; V43.5-V43.9; V44.5-V44.9; V45.5-V45.9; V46.5-V46.9; V47.5-V47.9; V48.5-V48.9; V49.4-V49.9; V50.5-V50.9; V51.5-V51.9; V52.5-V52.9; V53.5-V53.9; V54.5-V54.9; V55.5-V55.9; V56.5-V56.9; V57.5-V57.9; V58.5-V58.9; V59.4-V59.9; V60.5-V60.9; V61.5-V61.9; V62.5-V62.9; V63.5-V63.9; V64.5-V64.9; V65.5-V65.9; V66.5-V66.9; V67.5-V67.9; V68.5-V68.9; V69.4-V69.9; V70.5-V70.9; V71.5-V71.9; V72.5-V72.9; V73.5-V73.9; V74.5-V74.9; V75.5-V75.9; V76.5-V76.9; V77.5-V77.9; V78.5-V78.9; V79.4-V79.9; V80.0-V80.9;V81.1-V81.9; V82.1-V82.9; V83.0-V83.3; V84.0-V84.3; V85.0-V85.3; V86.0-V86.3; V87.0-V87.9; V89.2-V89.3; Y85.0; V90-V99; Y85.9

Annex 2: Mock-up sheet for physician certified verbal autopsy

Table A2 is a simplified illustrative mock-up of the physician review sheet. Only a selection of VA variables is displayed to demonstrate the format. In practice, the sheet includes all relevant questions from the full WHO VA questionnaire.

Table A2. Illustrative mock up review sheet for physician review

Variable (VA question Id)	Case 001	Case 002	Case 003
[…Rows of other VA questions intentionally omitted to illustrate partial example…]			
(Id10207) Did (s)he have a severe headache?	Yes	No	No
(Id10208) Did s/he have a stiff or painful neck?	Yes	No	No
(Id10209_units) How long before death did s/he have a stiff or painful neck?			
(Id10209_a) [Enter how long before death did (s)he have stiff or painful neck in days]:	3		
(Id10209_b) [Enter how long before death did (s)he have stiff or painful neck in months]:			
(Id10209) For how many days before death did (s)he have stiff or painful neck?	3		
(Id10212) Did (s)he have mental confusion?	Yes	Yes	Yes
(Id10213_units) How long did (s)he have mental confusion?			
(Id10213_a) [Enter how long (s)he had mental confusion in days]:	2		
(Id10213_b) [Enter how long (s)he had mental confusion in months]:		6	12
(Id10213) For how many months did (s)he have mental confusion?		6	12
(Id10214) Was (s)he unconscious?	Yes	No	Yes
(Id10216_units) How long before death did unconsciousness start?			
(Id10216_a) [Enter how long before death unconsciousness started in hours]?	12		
(Id10216_b) [Enter how long before death unconsciousness started in days]?			3
(Id10216) How many hours before death did unconsciousness start?	12		
(Id10217) Did the unconsciousness start suddenly, quickly (at least within a single day)?	Yes	No	No
(Id10220) Did (s)he experience any generalized convulsions?	Yes		
(Id10222) Did (s)he become unconscious immediately after the convulsion?	Yes	No	DK
(Id10275) Did the baby have convulsions starting within the first 24 hours of life?	-	-	-
(Id10276) Did the baby have convulsions starting more than 24 hours after birth?	-	-	-

(Id10223) Did (s)he have any urine problems?	Yes	Yes	No
(Id10226) During the final illness did (s)he ever pass blood in the urine?	No	No	No
(Id10224) Did (s)he stop urinating?	No	Yes	No
(Id10230) Did (s)he have an ulcer on the foot?	DK	Yes	No
(Id10231) Did the ulcer on the foot have pus?	-	Yes	Yes
(Id10232_units) How long did the ulcer on the foot have pus?	-		
(Id10232_a) [Enter how long the ulcer on the foot had pus in days]:	-	-	10
(Id10232_b) [Enter how long the ulcer on the foot had pus in months]:	-	4	
(Id10232) For how many days did the ulcer on the foot ooze pus?	-	-	
(Id10227) Did (s)he have ulcers or sores anywhere else on the body?	DK	Yes	Yes
(Id10229) Did the ulcers or sores have pus?	-	Yes	No
[…Rows of other VA questions intentionally omitted to illustrate partial example…]			
Underlying cause of death	Malaria	Neoplasm (Lung cancer)	Dementia
Antecedent cause(s) of death	Cerebral malaria	Metastatic cancer	
Immediate cause of death	Seizures	Respiratory failure	Coma
Contributory Cause(s)		Cachexia	Hypertension

Annex 3: Schedule of training program for physicians

The training schedule below outlines a suggested timetable and key topics to be covered during PCVA training. For physicians, a training duration of at least two days and up to five days is recommended. Training teams should adapt this reference timetable according to the level of prior experience/knowledge of the physicians in-training and according/as relevant their setting context and needs. Training teams should tailor this timetable based on the physicians' prior experience, knowledge, and the specific context and needs of their setting. For example, teams may choose to extend the training period to allocate additional time for working groups to review and provide feedback on the proposed diagnostic guidance for the WHO target list of causes of death for VA, included in Section 6.

Table A3. Training schedule for physician reviewers

Suggested times		Topic
Day 1	9:00 am – 9:45 am	**Introduction to mortality statistics** • Uses of mortality and causes of death • Data sources & common measures of mortality
	9:45 am -10:30 am	**Principles of death certification** • Definitions • Concept of underlying cause of death • Examples and common pitfalls
	11:00 am – 12:30 pm	**Group exercises in medical certification of cause of death** • Case scenarios • Participant led discussion
	1:30 pm – 2:15 pm	**Special situations in death certification** • Perinatal causes of death • Diabetes & hypertension • Injuries
	2:15 pm – 3:00 pm	**Introduction to ICD coding** • ICD structure and content (Tabular list, Reference Guide, Index; Volumes 1-3) • Rules for mortality coding (General Principle, Special rules) • Examples
	3:30 pm – 5:00 pm	**Reliability test in medical certification** • 3-4 case scenarios to each participant • Measures of accuracy of certification

Suggested times	Topic
	• Measures of agreement between participants
Day 2	
9:00 am – 10:30 am	**Introduction to verbal autopsy** • Principles and practice of VA • Review of questionnaires, manuals
11:00 am – 12:00 am	**Group exercises in VA cause of death assignment (including review of diagnostic guidance for target VA causes of death)** Case scenarios • Participant led discussion
12:00 pm – 12:30 pm	**Practical exercises in VA cause of death assignment (including review of diagnostic guidance for target VA causes of death)** • 4-5 case scenarios per participant • Measures of accuracy and agreement
1:30 pm – 3:00 pm	**Practical exercises in PCVA (cont.) (including review of diagnostic guidance for target VA causes of death)** • Case presentation and discussions
3:30 pm - 5:00 pm	**Principles of quality assurance/quality control/validation of VA** • Independent review of VAs (dual coding) • Comparison of VA diagnoses with hospital records • Training programs for VA interviewers/supervisors to improve interviewing skills and quality of questionnaires
5:00 pm – 5:30 pm	**Group discussion and feedback**