

# **Verbal Autopsy Standards:**

The 2022 WHO Verbal Autopsy Instrument

V1.2



---

© World Health Organization 2023

Some rights reserved. This work is available under the Creative Commons Attribution-NoDerivatives 3.0 IGO license (CC BY-ND 3.0 IGO; <https://creativecommons.org/licenses/by-nd/3.0/igo/>).

Under the terms of this license, you may copy and redistribute the work, provided the work is appropriately cited, as indicated below. In any use of this work, there should be no suggestion that WHO endorses any specific organization, products or services. The use of the WHO logo is not permitted. This license does not allow you to produce adaptations of the work (including translations) without permission from WHO.

Any mediation relating to disputes arising under the license shall be conducted in accordance with the mediation rules of the World Intellectual Property Organization.

**Suggested citation.** Verbal autopsy standards: The 2022 WHO verbal autopsy instrument; Geneva; World Health Organization; 2023; License: CC BY-ND 3.0 IGO.

**Third-party materials.** If you wish to reuse material from this work that is attributed to a third party, such as tables, figures or images, it is your responsibility to determine whether permission is needed for that reuse and to obtain permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

**General disclaimers.** The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by WHO in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by WHO to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall WHO be liable for damages arising from its use.

## Acknowledgements

For the development of the 2022 WHO Verbal Autopsy (VA) instrument, we would like to acknowledge the comprehensive inputs of the WHO Verbal Autopsy Reference Group (VARG) Revision Task Group, including Aurelio Di Pasquale, Swiss Tropical and Public Health Institute (Swiss TPH); Carine Alsokhn, WHO; Daniel Chandramohan, London School of Hygiene & Tropical Medicine (LSHTM), UK; Samuel J. Clark, The Ohio State University, USA; Daniel Cobos, Swiss TPH; Don de Savigny, Swiss TPH; Erin Nichols, Centers for Disease Control and Prevention (CDC); Jordana Leita, Angola; Peter Byass, Umeå University Centre for Global Health; and Robert Mswia, Vital Strategies, Bloomberg Philanthropies Data for Health Initiative.

Acknowledgment is given to other members of the WHO VARG, including Chalapati Rao, Australian National University; Carla Abou-Zahr, Bloomberg Philanthropies Data for Health Initiative; Riley Hazard, CDC Foundation; Sonja Firth, CDC Foundation; Tita Rosita Wiguno, Indonesia Agency for Health Research and Development; Shams El Arifeen, International Centre for Diarrhoeal Disease Research (icddr), Bangladesh; Henry Kalter, Johns Hopkins Bloomberg School of Public Health, USA; Lalit Dandona, Public Health Foundation of India; Samuel Cheburet, Ministry of Health, Kenya; Arvind Pandey, National Institute of Medical Statistics, India; Vishnu Rao, National Institute of Medical Statistics, India; Soewarta Kosen, National Institute of Health Research Indonesia; Debbie Bradshaw, South African Medical Research Council (SAMRC); Pamela Groenewald, SAMRC; Edward Fottrell, UCL Centre for International Health and Development, UK; Martin Bratschi, Vital Strategies, Bloomberg Philanthropies Data for Health Initiative; Philip Setel, Vital Strategies, Bloomberg Philanthropies Data for Health Initiative; Azza Badr, WHO; Doris MaFat, WHO; and Robert Jakob, WHO.

The development of the 2022 WHO VA instrument would not have been possible without the collaboration and support of numerous organisations, institutions and individuals.

For the contribution to the WHO Global VA dataset, acknowledgement is given to Aaron Samuels, CDC; Abdul-Razak Nuhu, Kintampo Health Research Centre, Ghana; Agbessi Amouzou, Johns Hopkins University, USA; Anthony Ofosu, Ghana Health Service; Beth Barr, CDC; Bonfoh Bassirou, Centre Suisse de recherches Scientifiques en Cote d'Ivoire; David Schellenberg, WHO; David Obor, Kenya Medical Research Institute; Debbie Bradshaw, SAMRC; Dianna Blau, CDC; Dominic Atweam, WHO; Fidelia Dake, Data for Health Initiative; Gordon Okomo, Ministry of Health, Kenya; Grace Manu, Kintampo Health Research Centre, Ghana; Hicham Darfouf, Ministry of Health, Morocco; Jamila El Mendili, Ministry of Health, Morocco; Kanitta Bundhamcharoen, Thailand Ministry of Public Health; Kathleen Kahn, University of the Witwatersrand, South Africa; Karim Derra, Clinical Research Unit of Nanoro, Burkina Faso; Kwaku Poku Asante, Kintampo Health Research Centre, Ghana; Jeff Koplan, Emory University, USA; Martin Nyahoda, Ministry of Home Affairs, Zambia; Pamela

Groenewald, SAMRC; Papa Larbi-Debrah Patrick, Ghana Health Service; Patricia Njuguna, WHO Kenya Country Office; Rob Breiman, Emory University, USA; Sam Notzon, CDC; Siaka Kone, Centre Suisse de recherches Scientifiques en Cote d'Ivoire; Solomon Kagulura, WHO country office, Zambia; Steve B. O. Odhiambo, Kenya Medical Research Institute; Titus Kwambai, CDC. Acknowledgement is also given to the Bill & Melinda Gates Foundation and the Child Health and Mortality Prevention Surveillance (CHAMPS) and Countrywide Mortality Surveillance for Action (COMSA) Initiatives.

For inputs and contributions to data analysis and interpretation, acknowledgment is given to Afrin Iqbal, icddr, Bangladesh; Alicia Perez, University of the Basque Country; Ana Luisa Bierrenbach, Hospital S rio Liban s, Brazil; Arantza Casillas, University of the Basque Country; Asri Adisasmita, University of Indonesia; Brent Vickers, CDC; Brian Munkombwe, CDC; Chomba Mwango, Data for Health Initiative, Zambia; Clarissa Surek-Clark, The Ohio State University, USA; Dan Kajungu, Makerere University, Uganda; Diane Morof, CDC South Africa office; El Marnissi Abdelilah, Ministry of Health, Morocco; Eman Aly, EMRO; Francis Yeji, Data for Health Initiative; Frank Baiden, LSHTM; Geoffery Semu, Tanzania; Greg Kabadi, Data for Health Initiative; Hermon Gebrehiwet, Capella University, USA; Isaac Ilyatu, Ifakara Health Institute, Tanzania; Jason Thomas, The Ohio State University, USA; Joyce Mugasa, Muhimbili National Hospital, Tanzania; Kristen Pettrone, CDC; Morris Ndemwa, Kenya Medical Research Institute; Nana Akosua Ansah, Navrongo Health Research Centre, Ghana; Oluwatoyin Awotiwon, SAMRC; Owen Trigueros, University of the Basque Country; Patrick Ansah, Navrongo Health Research Centre, Ghana; Paul Scanlon, CDC; Patricia Soliz, PAHO; Peter Choi, The Ohio State University, USA; Sajid Soofi, The Aga Khan University, Pakistan; Sudhir Benara, Indian council of medical research; Tyler McCormick, University of Washington, USA; Vilma Gawryszewski, PAHO; Yue Chu, The Ohio State University, USA; and Zehang Li, University of California, USA. Support was provided by CDC Foundation through the Bloomberg Philanthropies Data for Health Initiative.

## **2012-2016 WHO Verbal Autopsy Instruments**

For past versions of the WHO VA instrument, we would like to additionally acknowledge Abraham Flaxman, IHME; Abraham Hodgson, Ghana Health Service; Alan Lopez, The University of Queensland, Australia; Anand Krishnan, All India Institute of Medical Sciences; Bedirhan Ustun, WHO; Bernardo Hernandez, IHME; Carlos Navarro-Colorado, CDC; Chanpen Choprapawon, Health Policy and Strategic Bureau, Thailand; Dean Yergens, University of Calgary, Canada; Derege Kebede, WHO; Doris Chou, WHO; Elizabeth Fran a, Federal University of Minas Gerais, Brazil; Enrique Loyola, WHO; Fatima Marinho, WHO; Frederik Fr en, Norwegian Institute of Public Health; Gihan Gewaifel, University of Alexandria; Giuseppe Annunziata, WHO; Ian Riley, The University of Queensland; Kathleen Kahn, University of the Witwatersrand; Lulu Muhe, WHO; Rafael Lozano, IHME; Honorati Masanja, Ifakara Health Institute; Lene Mikkelsen, University of Queensland; Jun Gao, WHO; J rn Ivar Klungs yr, University of Bergen; Jyotsna Chikersal, WHO; Kidist Bartolomeus, WHO; Mark Amexo, HMN; Matthews Mathai; Mohammad Hafiz; Mohamed Ali, WHO; Osman Sankoh, INDEPTH Network; Paul Spiegel, UNHCR; Rasooly, Afghanistan Ministry of Public Health; Rajiv Bahl, WHO; Sennen Hounton, UNFPA; Ties Boerma, WHO; Thorkild Tyllesk r, University of Bergen; Vishwajeet Kumar, Uttar Pradesh Center for Maternal, Neonatal and Child Health, India;

William Soumbey Alley, WHO. Other organisations contributing to this work the United Nations Population Fund (UNFPA) and Office of the United Nations High Commissioner for Refugees (UNHCR).

# Table of Contents

<b>1</b>	<b><i>Purpose and content</i></b>	<b>1</b>
<b>2</b>	<b><i>Introduction to verbal autopsy</i></b>	<b>3</b>
2.1	Historical background	3
2.2	Uses and users of VA data	5
<b>3</b>	<b><i>The development of the 2022 WHO verbal autopsy instrument</i></b>	<b>6</b>
3.1	2022 WHO list of causes of death for VA	6
3.2	List of indicators and their definitions, relevant age and sex groups and sample questions	7
<b>4</b>	<b><i>Application and implementation of the 2022 WHO verbal autopsy instrument</i></b>	<b>10</b>
4.1	Sections of the 2022 WHO VA instrument	11
4.2	Technical description of the Table of Indicators (ODK XLS)	12
4.3	Sample questionnaires	14
4.3.1	Sample VA questionnaire 1: death of a child aged under four weeks	14
4.3.2	Sample VA questionnaire 2: death of a child aged four weeks to 11 years	14
4.3.3	Sample VA questionnaire 3: death of a person aged 12 years and above	14
4.4	Guidelines on augmentation and local adaptation	14
4.5	Translation and local adaptation	15
4.6	Vital registration	16
4.7	Age categories of death	16
4.8	Infrastructure	17
4.8.1	Interviewers	17
4.8.2	Data collection software, database, technology and staff	18
4.8.3	Methods for determining causes of death	19
4.8.4	Legal requirements, privacy, confidentiality, informed consent	21
4.9	Appropriate respondents and recall period	21
4.10	Use of verbal autopsy-generated data	21
<b>5</b>	<b><i>Bibliography</i></b>	<b>23</b>
	<b><i>Appendix 1: 2022 WHO list of cause of death for verbal autopsy with correspondence with ICD</i></b>	<b>25</b>
	<b><i>Appendix 2: Considerations for the use of verbal autopsy in the identification of COVID-19 deaths</i></b>	<b>31</b>
	Background	31
	Questions to identify suspected COVID-19 deaths	31
	Considerations for VA implementation in the context of the COVID-19 pandemic	33

# 1 Purpose and content

The WHO has since the 1970s been developing continuously improved verbal autopsy (VA) instruments, with research bringing special adaptations or new developments over time. Based on accumulated users' feedback and evidence from the field with the 2016 WHO VA instrument, a major revision was conducted to revise the instrument and generate a 2022 version of the questionnaire that is as short, concise and efficient as possible based on currently available evidence, and that works well in the field with currently available algorithms and physician certified VA (PCVA).

**All materials (Table of Indicators with skip patterns, questionnaires and this manual) are available separately for download at:**

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

The questions allow for responses with a simple yes or no answer, multiple choice, or a duration in some instances. This approach makes the instrument usable with analytical software that assigns causes of death. Some very few free text fields are included to allow adding information that may be used in reviews, but they are not used by the analytical software.

The instrument is designed for all age groups, including maternal and perinatal deaths, and also deaths caused by injuries. Based on the electronic format of the published instrument, it is recommended that electronic data collection methods are used. However, a set of paper forms by age group are available to show the design of the instrument for training purposes.

Sets of questions address information relevant to vital registration and information relevant to assessment of the cause of death.

The 2022 instrument is based on the 2016 version of the WHO VA instrument that had been designed to become suitable for routine use. Compared to the 2016 instrument, the number of questions has been reduced and the interview process has been simplified.

This manual contains some references to the development of the 2022 instrument and informs users on how to use the 2022 WHO VA instrument. The components of this manual include:

- Background on VA;
- Introduction to the full matrix of questions, definitions and related skip patterns;
- Instructions on how to use the matrix of questions;
- ODK compatible form for all ages, including skip patterns and calculated fields;
- Information about available for publicly available analytical software for assigning cause of death: InterVA5, SmartVA (IHME), and InSilicoVA (openVA Team);<sup>1</sup>
- Criteria for setting up a data collection infrastructure and the related databases;
- Instructions on how to adapt questionnaires for local use;

---

<sup>1</sup> Analytical software for data conversion for use with InterVA and SmartVA are freely available within openVA.

## Purpose and content

- General cause of death certification and coding guidelines for applying the International Statistical Classification of Diseases and Related Health Problems, tenth revision (ICD-10) to VA;<sup>2</sup> and
- The simplified WHO cause of death list for VA with corresponding ICD-10 codes.<sup>1</sup>

This manual and its resources are the products of the first one-year effort by an expert group led by the World Health Organization (WHO), consisting of researchers, data users, and government agencies, for the 2012 VA instrument, and an additional year of work of the WHO Working Group on Verbal Autopsy (subgroup of the WHO Reference Group for Health Statistics).

By simplifying and resolving known issues with the 2016 instrument, the 2022 WHO VA instrument is intended to allow for simple and inexpensive identification of causes of death in places where no other routine system is in place and to better serve the needs of countries' civil registration and vital statistics (CRVS) systems. Independently, this instrument can also be used in research and disease specific programmes. All materials are easily and widely accessible on the WHO web site, in print, and will be incorporated into diverse resource kits, intended for strengthening national vital statistics systems. Additional language versions will be made available through similar channels.

The core of the development process of the WHO VA instrument has included:

- Systematic review of experience from the field and publications on the most widely used and validated VA instruments and procedures (WHO VA standards, InterVA and Population Health Metrics Research Consortium (PHMRC) VA instrument);<sup>1-3</sup> and also assessment against experience in using analytical software for cause of death assignment (InterVA and SmartVA).
- Discussion of each question's utility with VA users.
- Experiences from field testing and cognitive reviews.
- The results of a simplification of the PHMRC Tariff method also contributed to the development of the 2016 WHO VA instrument. Including the addition of questions to facilitate the use of publicly available analytical software for assigning the cause of death, including InterVA and SmartVA.

These reviews and assessments have resulted in a simplified instrument with a reduced number of questions and causes of death, compared to the 2007 version. The systematic application of the 2022 WHO VA instrument will facilitate the application of VA in routine surveillance of vital events and lead to more consistency and cross-comparability of VA-derived mortality data. The correspondence table (Appendix 1) allows for easy conversion to and from ICD-10.

The application of the 2022 instrument in routine use and research with its standardised international set of questions will facilitate the compilation of larger databases that provides evidence for stepwise improvement of VA questionnaires internationally; becoming a basis for continuous development of analytical methods.

---

<sup>2</sup> A future update to this manual will include ICD-11 code updates.



## 2 Introduction to verbal autopsy

Reliable data on the levels and causes of mortality are cornerstones for building a solid evidence base for health policy, planning, monitoring and evaluation.

The main objective of VA is to describe the causes of death at the community level or population level where civil registration and death certification systems are weak and where most people die at home without having had contact with the health system.

In settings where most deaths occur at home and where civil registration systems do not function, there is little chance that deaths occurring away from health facilities will be recorded and the cause of death certified. As a partial solution to this problem, VA has become a primary source of information about causes of death in populations lacking vital registration and medical certification. VA has become an essential public health tool for obtaining a reasonable direct estimation of the cause structure of mortality at population level, although it may not be an accurate method for attributing causes of death at the individual level.

VA is a method used to ascertain the cause of a death based on an interview with next of kin or other caregivers. The interview is done using a standardised questionnaire that elicits information on signs, symptoms, medical history and circumstances preceding death. The cause of death, or the sequence of causes that led to death, are assigned based on the data collected using the VA questionnaire and any other available information. Rules and guidelines, algorithms or computer programs, may assist in interpreting the information collected using the VA questionnaire to determine the cause of death.<sup>11</sup>

A standard VA instrument comprises a VA questionnaire, a list of causes of death or mortality classification system and sets of diagnostic criteria (either expert or data derived algorithms) for assigning causes of death. The VA process consists of several steps, and many factors can influence the cause specific mortality fractions estimated through this process.<sup>4</sup>

### 2.1 Historical background

In Europe, before the 19<sup>th</sup> century when modern systems of death registration were implemented, designated death searchers visited the households of deceased people to assess the nature of deaths. The need for lay reporting of causes of death remained in low- and middle-income countries where there was a lack of medical capacity to produce death certificates for the population. As an alternative, in the 1950s and 60s in Asia and Africa, systematic interviews by physicians were used to determine causes of death. Workers at the Narangwal project in India labelled this new technique “verbal autopsy”.<sup>5,6</sup>

The interest of WHO in VA (formerly “lay reporting”) of health data was first demonstrated in a publication by Dr. Yves Biraud in 1956. During the 1970s, WHO encouraged the use of lay reporting of health information by people with no medical training, leading to development in 1975 of lay reporting forms (WHO 1978). Since the late 1970s and early 80s when the Reproductive Age Mortality Studies (RAMOS), Matlab (Bangladesh) and Niakhar (Senegal) questionnaires first emerged, several other questionnaires have been developed for use in research settings and in national or large-scale regional surveys.<sup>5</sup>

The past two decades have seen a proliferation of interest, research and development in all aspects of the VA process, including VA data-collection systems, VA questionnaires' content and format, cause of death assignment process, coding and tabulation of causes of death, and validation of VA instruments.

In 2007, needs and demands for standardisation led to the development and publication of the 2007 WHO VA standard tools, which comprised:<sup>8</sup>

- VA questionnaires for three age groups (under four weeks; four weeks to 14 years; and 15 years and above);
- Cause of death certification and coding resources consistent with the International Classification of Diseases and Related Health Problems, tenth revision (ICD-10);
- A cause-of-death list for VA mapped according to the ICD-10.

The WHO standard VA instrument published in 2007 has since then been successfully applied in many research settings. Following years saw a growing interest in the strengthening of countries' CRVS systems, which led to the demand for a more simplified and practical VA instrument that is associated with IT applications for data collection and analysis.<sup>7</sup>

In 2011, evidence from use of the WHO instrument and related VA instruments was reviewed to formulate the 2012 WHO VA tool. Besides elimination of unreported causes and focus on useful questions, it was designed to facilitate VA use in routine vital registration systems to improve national cause-specific mortality data.

In the development of the 2012 VA instrument, WHO carried out a systematic review of the use of VA and led an expert group of researchers, data users and other stakeholders, in collaboration with HMN, the University of Queensland (UQ) and the INDEPTH Network. Based on the compiled experience and evidence from the most widely-used and validated VA procedures (WHO VA standards, InterVA and PHMRC VA instrument),<sup>1-3,14</sup> consensus was reached on a VA instrument for routine use as part of civil registration and vital statistics systems in settings where many deaths are not medically certified.

Over the past years, efforts have been made to develop and implement software programs for automated interpretation of VA data to generate computer-based diagnosis of causes of death. Currently, the three most commonly used programs are the InterVA method developed by Peter Byass at Umea University (Sweden), InSilicoVA developed by the openVA Team<sup>3</sup> (USA) and the Tariff method (SmartVA) developed by the Institute of Health Metrics and Evaluation (USA). So far, it is not clear which of these methods performs better and whether they complement each other, despite several comparative studies.<sup>9-12</sup> In order to facilitate the application of these automated methods for interpreting VA and to allow comparison of the causes of death data determined by these methods, the WHO VA instrument was updated in 2016 to include all input variables required for the optimum performance of the software programs. Experience from the field in using the 2012 WHO VA tools and the interim 2014 WHO VA tools, and cognitive testing provided further inputs in the refinement of the 2016 WHO VA instrument.<sup>13</sup>

---

<sup>3</sup> <http://openva.net>

## 2.2 Uses and users of VA data

VA is used in three main ways. First, it has been primarily used as a research tool in the context of longitudinal population studies, intervention research or epidemiological studies. Second, it has become a source of cause of death statistics to meet the demand for population-level cause-specific mortality data to be used in policy, planning, priority setting and benchmarking. Third, VA data are gaining acceptance as a source of cause of death statistics to be used for monitoring progress and evaluating what works and what does not. Because vital registration coverage has not significantly improved in developing countries, VA methods have been mainly applied in the following data collection systems: clinical trials and large-scale epidemiological studies; demographic surveillance systems; national sample surveillance systems; and household surveys.<sup>6</sup>

Over the past decade, due to the growing demand for robust estimates of vital events and determinants of health, the primary objective of health and demographic surveillance system (HDSS) sites evolved to encompass: 1) the production of population-based health information to support evidence-based health policies and 2) the monitoring and evaluation of health interventions in settings where routine health information and vital registration systems are incomplete. Most HDSS sites collect VA data and provide population level cause specific mortality data. However, HDSS sites may not provide representative data for national estimates of cause-specific mortality. Application of VA in large cross-sectional surveys or in sample vital registration systems have been used to obtain national and sub-national level mortality estimates.

Potential users of data generated using VA include communities, health care planners and managers, researchers, global decision-makers and donors. While there is a degree of overlap, these users have different perspectives on the uses of mortality data, which have an impact on the desirable characteristics of VA instruments. Researchers, epidemiologists and global-level decision-makers want VA data to inform burden of disease estimation and program evaluation, implying that cause of death estimates must meet high accuracy standards and be comparable over time and across countries.<sup>7</sup> National and sub-national decision-makers and health system managers require cause of death data for planning, budgeting and resource allocation and for monitoring and reporting to donors, implying that VA data needs to be actionable and program relevant.

There have been a few instances where VA has been administered on a large scale as an explicit part of the development of national statistics.<sup>8</sup> Users of VA have identified the need for simpler data collection instruments coupled with convenient IT-based solutions (e.g., mobile phones or hand-held devices). These large scale users of VA have a perspective different from that of researchers, giving priority to the VA instrument's simplicity, feasibility and adaptability to local contexts, cost-effectiveness and program relevance.<sup>7</sup> A simplified VA instrument coupled with automated methods to ascertain causes of death can be a stepping-stone to increase the coverage of operational and representative civil and vital registration systems.

### **3 The development of the 2022 WHO verbal autopsy instrument**

The simplified 2022 WHO VA instrument comprises a short list of causes of death of public health importance that can be ascertained from a limited number of questions suitable for use in VA interviews and amenable to automated assignment of cause of death using analytical software.

The 2022 WHO VA instrument has been informed by field testing and cognitive reviews of the 2016 WHO instrument,<sup>13</sup> and the results of an item reduction process that used users' and experts' knowledge, response pattern analysis and significance analysis. For the analyses, a global VA dataset was comprised of 28,427 deaths collected with the 2016 WHO VA instrument from 13 countries. Of these, 10,822 deaths had reference causes included in the analyses.

An important part of the development process included the review and resolution of reported issues and feedback by users that have been compiled and managed by the VARG through the Public GitHub platform.<sup>4</sup> Exchanges between users, VA experts and clinicians with physician certified VA (PCVA) experience, on the reliability and diagnostic value of VA questions were coordinated through a series of workshops. For the item reduction component of the revision process, three complementary statistical methods were used: (1) the validity of responses from the full dataset, and (2) the importance of each question in identifying causes for the 'reference' dataset based on the Targeted maximum likelihood estimation (TMLE) and (3) the entropy scores. A report on development of the 2022 WHO VA instrument is available that provides details on the methods and revision process.<sup>5</sup>

Alterations made to the instrument are expected to provide a more parsimonious, concise, clear and efficient instrument. The 2022 WHO instrument is recommended for field implementation in conjunction with vital registration to enable use of automated VA interpretation programs as well as by physician coders of VAs.

#### **3.1 2022 WHO list of causes of death for VA**

VA cannot ascertain all causes of death and, as many validation studies have shown, VA does not perform equally well for all causes that it can ascertain. Taking these limitations into account, the 2007 list of causes of death for VA was revised to develop the 2016 list that includes all causes of death that could be ascertained with reasonable accuracy from a well-administered VA interview (Appendix 1). In developing the 2016 WHO VA instrument, a review was undertaken to compile evidence for the revision and simplification of the 2007 WHO VA standard cause of death list. The review included VA research studies that used either PCVA or automated analytical software to assign the cause of death.<sup>15</sup> In addition to research studies, a review of the materials and inputs from VA experts provided evidence on the feasibility and relevance of causes of death that can be reliably ascertained by VA.

---

<sup>4</sup> [https://github.com/SwissTPH/WHO\\_VA\\_2016](https://github.com/SwissTPH/WHO_VA_2016)

<sup>5</sup> <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>

The revision and simplification of the 2007 standard WHO VA cause of death list was based on:

- The frequency of a given cause of death being reported in VA; the importance and relevance of a given cause of death to global mortality levels;<sup>6</sup>
- The cause of death can be addressed by public health interventions; and
- The feasibility of the cause of death being ascertained through VA.

The list of causes of death resulting from the above process is presented in Appendix 1.

Using a minimum set of causes of death facilitates the merging and comparison of data from VA on an international scale. The mapping of the list of causes of death using ICD-10 codes shown in Appendix 1 allows comparison of mortality data determined by VA with ICD-10 coded causes of death data ascertained using the international certificate of causes of death.

### **3.2 List of indicators and their definitions, relevant age and sex groups and sample questions**

The 2022 WHO VA questionnaire has cause of death related indicators for all age groups in one sheet, but only subsets are used for the different age groups. The list of indicators is subdivided into 4 sections and 26 subgroups. Within sections and subgroups of the instrument, skip patterns are driven by the age and sex of the deceased and whether it, was a maternal or perinatal death.

From the 2012 to the present 2022 instrument, the list of indicators has been formulated through a review process that has included – removal of unused, uninformative and unreliable indicators based on field testing and experience, inputs from cause of death assignment analytical software (InterVA/InSilicoVA and Tariff), cognitive assessment, statistical analysis and expert review.

*The table shows the distribution of questions by age group and broad section of the questionnaire.*

*The levels refer to the skip questions. The 'entry level' questions always have to be asked.*

*Questions for CRVS are a set recommended by the UN Statistical Division. They may not be necessary in all settings.*

*The questions asking for content of a medical certificate of cause of death may provide helpful information in certain settings and in case such a certificate has been issued.*

---

<sup>6</sup> In the simplification of the list of diagnoses, attention has been given to the Global Burden of Disease (GBD) groupings. In view of the ongoing edits of the GBD, the correspondence table does not include GBD references. The mentioned ICD-10 codes may serve to distribute cases to the relevant GBD groups.

## The development of the 2022 WHO verbal autopsy instrument

Section	Neonate	Child	Adult (incl. maternal)
<b>Information on the interviewer</b>	5	5	5
<b>Presets</b>	3	3	3
<b>Information on the respondent and background about interview</b>	8	8	8
<b>Information on the Deceased and vital registration</b>	22	26	24
Entry Level	9	9	10
Level 2	13	17	14
<b>Open narrative</b>	2	2	2
<b>Verification of possible stillbirth</b>	14	0	0
Entry Level	5	0	0
Level 2	9	0	0
<b>Medical history associated with final illness</b>	0	20	24
Entry Level	0	18	18
Level 2	0	2	6
<b>History of injuries/accidents</b>	21	22	22
Entry Level	1	1	1
Level 2	20	21	21
<b>Health history</b>	87	125	155
Entry Level	45	44	45
Level 2	42	81	110
<b>Civil registration numbers</b>	6	6	6
Entry Level	1	1	1
Level 2	5	5	5
<b>Medical certificate of cause of death</b>	12	12	12
Entry Level	1	1	1
Level 2	11	11	11
<b>Grand Total</b>	<b>180</b>	<b>229</b>	<b>261</b>
<b>Entry Level</b>	<b>62</b>	<b>74</b>	<b>76</b>

The full set of indicators that were considered and the rationale for inclusion or exclusion of each indicator in the 2022 VA instrument have been documented and are available upon request. The list of 2022 WHO VA indicators is further described in Section 4.2.

The 2022 instrument is comprehensive for standard routine application and if correct cause of death certification and coding procedures are used, it should be possible to generate comparable data over time across populations. The instrument allows for the addition of

indicators of topical interest such as health system performance indicators and other social and risk factors that are not captured in the core 2022 WHO VA instrument. Adding additional questions directly to the 2022 instrument is not recommended, however, these can be added as an additional module. Any addition of indicators should be done in consultation with WHO in order to ensure operability of the analytical software for assigning cause of death and comparability of results. See Section 4.4 (“Guidelines on augmentation, and local adaptation”) for further guidance.

## 4 Application and implementation of the 2022 WHO verbal autopsy instrument

This section describes the application and implementation of the 2022 WHO VA instrument. The 2022 WHO VA instrument and supporting documentation for implementation, (available on WHO website at: <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>), include the following components:

- 2022 Cause of Death List with ICD Codes (Appendix 1, described in Section 3.1, identical with the 2016 v1.5.3)
- 2022 WHO VA instrument
  - Excel- and XML-files and references to data collection platforms
  - Excel file contains Table of Indicators: For each indicator, describes the variable ID and the data type, defines threshold values to categorise numeric values, defines skip patterns, and includes notes for translators (described in Section 4.5) and interviewers.
- Tools and guidance for remote data collection and storage in a database (described in Section 4.8.2)
- 2022 WHO VA instrument training materials – These include manuals, curriculums and respective accompanying PowerPoint slide sets for the training of VA interviewers and master trainers/supervisors.<sup>7</sup>
- Analytical tools for cause of death assignment are available at:
  - InterVA: <http://www.byass.uk/interva/>
  - Tariff: <http://www.healthdata.org/verbal-autopsy/tools>
  - openVA:<sup>8</sup> <https://openva.net>

Details for application and implementation described in this section include: a description of the structure and indicators included in the 2022 WHO VA instrument; guidelines for local adaptation and translation of the instrument; guidelines for data collection, management, and storage; and guidelines for cause of death assignment and use of VA data.

---

<sup>7</sup> <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>

<sup>8</sup> openVA is a software that runs automated VA coding algorithms and is available as a package for the R statistical software. Available algorithms include: InSilicoVA, InterVA4, InterVA5 and Naïve Bayes Classifier, and Tariff. Tariff2 will be available in the near future.



## 4.1 Sections of the 2022 WHO VA instrument

The 2022 VA instrument contains both common sections and specific sections appropriate to both the age and sex of the deceased.

**NOTE: Age, sex, information about the season, the local prevalence of HIV and malaria, section 3, 4, 6 and 7 are essential information for the analytical software that assigns causes of death. No questions must be removed from these sections. The numbering of the questions must remain unchanged. Questions added locally will not be used by the currently available analytical software.**

Other components of the personal information and the respondent can be adjusted to the local legal requirements.

The instrument consists of 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. History of injury/accidents
6. Medical history associated with final illness
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 symptoms
  - e) Health service utilization
  - f) Civil registration numbers
  - g) Death certificate with cause of death.

**Section 1** collects information about the prevalence of malaria and HIV in the area where the deceased lived and whether death occurred in the rainy or dry season. This information is essential for selecting the appropriate algorithm used by some software for assigning the cause of death. In most settings this information will be pre-completed by study staff or supervisors.

**Section 2** collects information about the respondent, consent if required in certain contexts and time the VA interview was started.

**Section 3** contains key identifying and socio-demographic information and data fields necessary for the management of completed forms.

**Section 4** is an open narrative text field that allows for comments from the interviewer and additional information from the respondent. This section is particularly useful for quality control and for providing important additional information for the cause of death assignment. To note, this section is also important in order to complete the checklist of some

indicators (section 6a) that are required for assigning causes of death using Tariff 2.0. Accordingly, it is highly recommended that this section be completed and responses recorded. Considering the time taken to manually enter information from the respondent and the challenges of including all relevant information relayed, it is best if the open narrative is audio recorded. To enable audio recording, the user should simply change the type of question from text to audio in the XLS form.

**Section 5** provides essential information on the history of known past or present diseases that would give clues to the causes of death

**Section 6** provides essential information for assigning the cause of death due to accidental and intentional injuries.

**Section 7** contains several sub-sections that collect information required for assigning causes of death. Section 7a) has questions to determine the duration of the final illness; 7b) contains symptoms and signs that are relevant for all deaths; 7c) contains symptoms and signs specific to maternal deaths; 7d) contains symptoms and signs relevant for neonatal and child deaths; and 7e) contains questions about the utilisation of health services. Section 7f&g) have fields for recording information from the legal death certificate from civil registration authorities and from a medical certificate of cause of death if these are available.

## 4.2 Technical description of the Table of Indicators (ODK XLS)

The Table of Indicators of the 2022 WHO VA instrument<sup>9</sup> consists of one table containing all indicators for all age groups with relevant details describing each indicator. The questions are grouped by sections, as is described above. Relevant skip patterns by age and sex are defined for each indicator.

Questions, hints and skip instructions are listed in the sheet “survey”. Selectable values are listed in the sheet “choices”.

Quick overview of the columns in the sheet “survey”:

type	The type column specifies the type of entry you are adding, e.g., yes/no, multiple choice, integer, or text
name No two	The name column specifies the unique variable name for that entry. entries can have the same name.
label::English	Question in a specified language: here English. You may add a column with the title “label::mylanguage” for the language of your choice. Having several language columns active allows to create multilingual forms.
hint::English	Hint for the question in the specified language. You may add a column with the title “hint::mylanguage” for the language of your choice. Having several language columns active allows to create multilingual forms.

---

<sup>9</sup> Available at WHO VA standards webpage:  
<https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>

relevant question previous	Here you have the information for the skip patterns. Ability to skip a or make an additional question appear based on the response to a question.
required	Determines whether the question must be answered if asked.
appearance	Describes appearance of questions in the form.
calculation	Specifies calculations using the values of preceding questions. e.g., It is used to determine the age group.
default with an	Adding a default field means that a question will be pre-populated answer when the user first sees the question.
constraint	Add constraints to the data fields.
constraint message	Used to display a message why the entry is not accepted (constraints violated).

Details about the format are available online at <http://xlsform.org/> and more generally at <https://docs.getodk.org/xlsform/>.

### **4.3 Sample questionnaires**

The 2022 WHO VA instrument is designed for use with an electronic data collection platform. Excel- and XML-files with the required instructions are posted on the WHO website at: <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>.

A set of sample/paper questionnaires that demonstrate the layout of the questions, as described in the Table of Indicators, are also provided for training purposes, as a guide to the user. If using paper- based data collection, to facilitate 1) the use of automated analytical software for the assignment of cause of death, and 2) the comparison of the responses across VA studies, all data (regardless of data collection method) should be entered into a database following the instructions provided in Section 4.8.2. It is especially important to retain the variable IDs as defined in the Table of Indicators.

#### **4.3.1 Sample VA questionnaire 1: death of a child aged under four weeks**

Sample VA questionnaire 1 is designed to determine causes of early neonatal deaths, late neonatal deaths, perinatal deaths and stillbirths. In addition to a “signs and symptoms noted during the final illness” list, the questionnaire contains questions concerning the history of the pregnancy, delivery, the condition of the baby soon after birth and the mother’s health.

#### **4.3.2 Sample VA questionnaire 2: death of a child aged four weeks to 11 years**

Sample VA questionnaire 2 is designed to ascertain the major causes of post-neonatal child mortality (i.e., starting from the fourth week of life), as well as causes of death that may be seen through 11 years of age. Questionnaire 2 includes all the common sections and questions described above, as well as questions related to causes of death in children aged four weeks to 11 months. The skip pattern is indicated by references to the next question.

#### **4.3.3 Sample VA questionnaire 3: death of a person aged 12 years and above**

Sample VA questionnaire 3 is designed to identify all major causes of death among adolescents and adults (i.e., starting at age 12), including deaths related to pregnancy and childbirth. Questionnaire 3 includes a section for all female deaths, in addition to the above-mentioned common sections and questions.

### **4.4 Guidelines on augmentation and local adaptation**

The indicators contained in the 2022 WHO VA instrument address the most relevant causes of death in most populations where the use of VA is a necessary means to obtain cause of death information.

In general, only changes to the wording of existing variables for the purposes of enhancing local comprehension or ensuring cultural acceptability of questions are to be undertaken. The definitions in the 2022 WHO VA instrument may provide some guidance about the meaning that needs to be preserved in such changes. Any need for modification should be shared with WHO together with the rationale for modification. The reporting of modifications made to WHO will inform future revisions of this instrument.

The 2022 WHO VA instrument by design allows for evolution of the instrument. Users may add questions but under no circumstances should questions be removed from the list because of the resulting impact on the comparability of the causes of death information and the further data-based evolution of the instrument.

**NOTE: Age, sex, information about the season, the local prevalence of HIV and malaria, section 3, 5, 6 and 7 are essential information for the analytical software that assigns causes of death. No questions must be removed from these sections. The numbering of the questions must remain unchanged. Questions added locally will not be used by the analytical software.**

It is acknowledged that there may be a desire to expand the instrument to address locally relevant conditions. However, adding signs and symptoms to the 2022 WHO VA instrument needs to be carried out with much caution because alteration can compromise the comparability of VA data between populations. In particular, the addition of new questions about particular diseases of interest may bias results if a disproportionate amount of information about only one condition is available in the cause of death assignment process.

Modifications may be necessary if there are emerging or locally important causes of death for which there are no questions on the 2022 VA questionnaires. In these circumstances, advice may be sought from WHO for making such modifications. If modifications are necessary, they should be carefully documented and distinguished from the 2022 questionnaire sections and variables.

Examples of modifications that are unlikely to affect the comparability of results include:

- Adding questions or sections about household characteristics or environmental or behavioural risk factors;
- Adding or changing questions about usage of a particular health context.

Examples of modifications that may affect the comparability of results include:

- Changing or adding to response categories in the checklist of “signs and symptoms noted during the final illness”;
- Adding new questions about diseases of particular interest (e.g., malaria, HIV/AIDS, diarrhoeal disease).

Adding and removing questions will impact the comparability of the data **but also may compromise the usability of analytical software** for assigning cause of death. It may either not be possible to use the existing analytical software for assigning the newly added causes of death at all, or the outputs from the software become unreliable.

## 4.5 Translation and local adaptation

The specific terminology used for indicators and interviewer and translator notes (in the excel Table of Indicators) aims to convey the highest level of clarity about the intent of a question. Indicators, instructions and data collection tools need to be translated or adapted for local use (even if administered in English, as lay language differs across English speaking regions). The notes in the Table of Indicators together with the “Question by Question” descriptions in the “VA Field Interviewer Manual” are intended to guide translators in the translation process; both the questions in the instrument and the hints in the Table of

Indicators should be translated, as the notes will also provide guidance to interviewers. Translators may need to adapt the wording of the questions to the local terminology used in the locations where interviews will be conducted. For quality assurance, a second translator should carry out a back-translation to English.

It is very important for both interviewers and respondents to be able to understand the medical terminologies used in the VA questionnaire - care should be taken to ensure that medical terms do not lose their meaning when translated into the local languages. Experience has shown that it may be useful to develop a list of common terms locally used that capture the medical terminology in the VA questionnaire - to be used during training and for interviewers' use during the VA data collection.

For any translations, please use the XLS form for the 2022 WHO VA instrument that you can download at <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>. Fill in your translations in the sheets "survey" and "choices" adding columns and do it the same way it was done for the existing translations. The given identifiers and the resulting multilingual file will allow users to 1. re-use a translation as necessary for other projects, and 2. load translations into the WHO software for immediate use, if so desired.

#### **4.6 Vital registration**

For use of the 2022 WHO VA instrument in routine vital registration, two options are possible:

- 1) A death has been reported and notified, and an interviewer is sent to query the cause of death. In this case, the personal data are known and the interview will be conducted only to identify the cause of death. The "information on the deceased" section will be prefilled before the interview based on information from the death notification form, and a death registration number (or a similar identifier) will allow the user to link the VA outcome with the related entry in the death registration registry.
- 2) A death is reported and the certification and interview are conducted at the same time. In this case, the personal data are not known, or are known only in part, and need to be recorded at the time of the interview, using the "information on the deceased" section. A registration number will be required to ensure the vital registration linkage between the death registry and the VA data.

#### **4.7 Age categories of death**

Some projects may be interested only in particular age categories of death, such as perinatal, maternal, child or adult deaths. Where data are captured electronically, the embedded skip patterns will ensure that only the relevant subset of questions is applied.

The relevant subset of questions can be extracted from the list of indicators of the 2022 WHO VA instrument. The three age-group specific paper questionnaires for three age groups (under four weeks; 4weeks-11 years, 12 years and above) may also be used.

Where interviews are conducted for all age categories of deaths, ideally the interview data should be captured electronically using the embedded skip patterns. Otherwise (eventually

using paper if there is no other way), the interviewers should always be sure to have questionnaires available for all three age groups during house visits for VA interviews.

## **4.8 Infrastructure**

In routine surveillance contexts, information needs to be timely and linked to a response that involves effective dissemination mechanisms, appropriate use of data, and periodic evaluation of the surveillance system. The latter can trigger formulation of recommendations for a revision of the components of the 2022 WHO VA instrument to WHO and local workflows of the VA system in use. Thus, use of VA in routine surveillance involves monitoring, accountability, planning and programming.

To develop an adequate instrument for application in large-scale surveillance, the VA instrument needs to have a system that synergises with other national mechanisms that are already in place. A permanent team that conducts VAs on a representative sample of deaths is likely the most feasible way.

The infrastructure will depend largely on the given setting. Data should ideally be stored in a centralised location but at a level that facilitates necessary queries. Usually this is likely to be at the district level. All verified district data would then be forwarded to a central database at the national level.

Arrangements regarding collection, storage and handling of the vital registration and cause of death data should be made between the offices that are involved. Depending on the national infrastructure these offices are most frequently the Statistical Office, Ministry of Health, Ministry of Justice, and Ministry of Interior.

Different arrangements may be necessary where VA is conducted in another context, as for research or disease specific programmes.

### **4.8.1 Interviewers**

Interviewers should be trained on using the instrument and on conducting interviews with persons who may still be in mourning and may become upset during the interview. Interviewers should be given enough time to prepare and carry out VA interviews. It is proposed that at least one VA interview per month should be conducted by each VA interviewer to retain their proficiency in conducting VA interviews. Interviewers involved in the application of the VA should have the following minimum qualifications:

- Have completed at least secondary school and have good working knowledge in the relevant local language(s);
- Be acceptable to the local community; where possible, selected by the local community;
- Have good training in conducting VA interviews;
- Know very well the content and uses of the VA instrument.

Standard training manuals for the interviewers, master trainers and supervisors are available at the WHO VA website. Overall, the following procedure is recommended to train VA interviewers. First the trainee interviewer should review all elements and the flow of questions with the help of an expert VA trainer. For this purpose, it is recommended that the VA Field Interviewer Manual is used. The manual explains the meaning and importance of

each indicator and how to ask each question included in the 2022 WHO VA instrument<sup>10</sup>. After discussing any questions that need clarification with the VA trainer, the interviewer can role play VA interviews using the VA trainer as proxy VA respondent. Sample case scenarios are provided in the training manuals. Such used scenarios should include the different age groups of the deceased (maternal, neonatal, child, adult), thus varying the relationship of the respondent to the deceased and also the probable local behaviour on the interview per se, and on sensitive questions. In the next stage, the interviewer should conduct real VA interviews in the presence of the expert trainer. The number of VA interviews to be conducted in the presence of the VA trainer required to certify proficiency of individual trainee VA interviewers will vary depending on the skills and abilities. Nevertheless, typically it would take at least five VA interviews to become confident in doing VA interviews.

### 4.8.2 Data collection software, database, technology and staff

The 2022 WHO VA instrument is designed to be compatible with electronic data collection platforms and automated analytical software to assign cause of death.

The 2022 Instrument form is provided in a format that is fully compatible with the ODK (<https://getodk.org/>). This allows one to quickly start collecting data using Internet cloud-based services as well as local servers. Data is output in a table format and at any time ready for analysis. A link to a demo version for using is available at <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tools>. The electronic data collection form includes embedded skip patterns that automatically navigate the various combinations of age-, sex-, maternal- and perinatal-specific indicators within a single, comprehensive instrument.

The ODK-compatible instrument is defined using the XLSForm standard.<sup>11</sup> The XLSForm instrument definition file is a full and complete description of the instrument. It is possible to use that definition with any XLSForm-compatible electronic data capture system. Further using that definition, it is possible to replicate the instrument 'from scratch' using any software provided that the skip/flow patterns are fully implemented, all values adhere to the predetermined values, and the field/item names are replicated exactly. However, a note of caution, the skip/flow patterns in the instrument are complex and will require careful attention if the XLSForm definition is not used directly. If the skip/flow patterns are not implemented correctly, then the item response pattern will be affected - with the important consequence that *automated cause-coding algorithms may not work correctly*. Automated cause of death assignment methods compatible with the 2022 WHO VA instrument, are listed in the WHO VA website - see section 4.8.3 of this manual for more details.

The ODK format has been adopted by several data collection software systems. Software with wide implementation are OpenSRP and DHIS2. Both can handle ODK standard instruments and have the ability to conduct batch processing and output of results. For DHIS, this requires setting up a separate server that feeds the data into the DHIS server.

---

<sup>10</sup>Also available at the WHO VA standards website: <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>

<sup>11</sup> <https://xlsform.org/en/>, <https://docs.getodk.org/xlsform/>



Regardless of the data collection method (electronic or paper), answers to all questions and the cause of death assigned to each case should be recorded in a database. The database should retain the cause of death together with a variable that identifies the method of assigning the cause of death. The name of the interviewer and date, time and duration of the interview should also be retained in the database. If data are reported electronically this information can be generated automatically. If physician review is used to assign the cause or causes of death, then all assigned causes and the identity of the physician who assigned each should be recorded.

In order to facilitate the use of data collection and analytical software and to simplify the interviews, most questions follow a simple yes/no pattern. However, some questions address a time interval or a frequency. All continuous variables should be recorded as continuous variables in the database and will be categorised in a second step using a recommended threshold value. Categorisation depends on the analytical software that is used to identify the cause of death. The converter tool will include the necessary algorithms.

The compilation of the information above into a database will provide a tool for reviewing cases as well as enable sharing of results with WHO to facilitate further improvements to this instrument.

In addition to the questions, the narrative is helpful if physician assessment is a possibility, for quality assurance, and for later review. The full *verbatim* narrative should be stored in the database as well. Note also that the instrument has the option to audio record the narrative section.

In order to use the existing analytical software, the data collected with the WHO VA instrument need to be converted into the formats that can be processed by the analytical software that determines the cause of death. WHO makes available conversion algorithms in collaboration with the openVA Team and the Swiss TPH. These include a simple conversion (programmed in R) and an all-in-one R package (openVA - <https://cran.r-project.org/web/packages/openVA/index.html>) that does the conversion and runs the analytical software and outputs the cause of death. Links to the packages are also available from the WHO website <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>.

VA, using preferably ODK, requires at a minimum a central server, and mobile devices for data collection. The data will be stored on the central server as soon as a mobile or wired internet connection to the server is available. Sufficient maintenance staff with IT administration skills is necessary in order to set up and maintain the technical infrastructure. Data and software staff will ensure that data collection is complete and workflows work. Statistical and epidemiological staff will use the outputs from the system for tabulation and analysis. A quick guide for ODK for VA is provided at the WHO VA website: <https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>.

### 4.8.3 Methods for determining causes of death

In the past decade, methodological developments in automated methods for assigning cause of death for VA have emerged with significant potential for future application in routine

national and research data collection platforms. These methods create new opportunities for reliable, timely, and useful cause-specific mortality measurement. These developments have created a shift away from limited individual-level and clinical paradigms towards population-based epidemiological thinking and public health.<sup>16</sup>

The 2022 WHO VA instrument contains information on diseases, signs and symptoms, the age and sex of the deceased as well as his or her medical history (if available). Additional information may be recorded in the open text field at the start of the interview. To facilitate application in routine surveillance systems, the 2022 WHO VA instrument was specifically developed to ascertain cause of death through automated methods. As a more cost-effective and feasible alternative to physician-coded VA, the WHO recommends the use of automated methods for cause of death identification. The use of automated VA cause of death assignment methods also ensures that causes of death are determined in a standard fashion, removing the variability inherent with physician coding of VA.

Analytical software tools for cause of death assignment without the use of physicians that are compatible with the WHO VA instrument structure are listed on the WHO VA website (<https://www.who.int/standards/classifications/other-classifications/verbal-autopsy-standards-ascertaining-and-attributing-causes-of-death-tool>). For full compatibility and optimal performance with the 2022 WHO VA instrument, the probability base that defines the relationship between the symptoms/questions in the VA questionnaire and the causes of death will need to be updated. At the time of publication, efforts are underway to update the probability base that is used with InterVA and InSilicoVA, and an updated version is expected to be ready for testing in late 2022. An updated version of SmartVA-Analyze compatible with the 2022 WHO VA instrument will also be available by the end of 2022.

In case physicians assess the cause of death, ideally two physicians will review the outcome of an interview and formulate a cause of death independently. If there were a discrepancy, a third physician would arbitrate the result. The opinion of each physician involved should be separately recorded in the database, as well as the consensus finding.

#### **4.8.4 Legal requirements, privacy, confidentiality, informed consent**

Ideally, informed consent should be sought from the respondent. Where the legislation or local regulations require that VA be conducted, informed consent may not always be necessary.

Personal data, in particular name, geographical information and contact information about the respondent, should be kept separate from the epidemiological data and ideally be encrypted to protect privacy and ensure confidentiality. Additional measures to anonymise the individual record may be subject to the legislation in force. A common case-ID in the person identifiable VA dataset and the diagnostic VA dataset will allow data linkage between personal and diagnostic data upon formal request in line with national and international regulations.

#### **4.9 Appropriate respondents and recall period**

The respondent who provides information about the deceased and allows the interviewer to complete the VA questionnaire should be the primary caregiver (usually a family member) who was with the deceased in the period leading to death or a witness to a sudden death or accident. This individual is likely to provide the most reliable and accurate account of the signs and symptoms of importance. It is not uncommon for a VA respondent to require assistance from other household or family members in answering the VA questions. However, the VA interviews should be conducted in privacy. The VA interviews should be conducted as soon as practically possible after the report of the event is received, but after any culturally prescribed mourning period has passed. Recalls of more than one year should be interpreted with caution. In general, shorter recall periods are preferable.

#### **4.10 Use of verbal autopsy-generated data**

The purpose of VA is to describe the causes of death at the community level or population level in instances where no better alternative sources of mortality data exist. Therefore, VA serves as a limited but essential substitute for medical certification. The quality of information of the assigned cause of death varies depending on the skills of the interviewer and the ability of the respondents to recognise, recall, and report key indicators.

The 2022 WHO VA cause of death list (Appendix 1) is a core mortality classification system, specifying the most important causes of death in low-income and middle-income countries where it is deemed feasible to certify cause of death using VA. Coding causes of death using the ICD coding system facilitates the comparison of data and the retention of as much detail as needed in local settings.

The context and method of information gathering to assign cause of death from VA is different from the medical certification of cause of deaths by a physician. The certainty of the cause of death is much lower in VA, and VA cannot reliably ascertain some causes of death. Thus, causes of death data obtained from these two systems should not be merged, as it would conceal differences that may result from these methods and lead to misinterpretation of the results.

ICD-10 provides tabulation lists for mortality and morbidity in volume 1. Other professional groups have made different lists for grouping diseases and presenting mortality statistics. Regardless of the list used, deaths should be classified by sex and into the following age

groups: aged < 1 year, aged 1–4 years, and then in 5-year groups from age 5 years to 84 years, followed by a group for those aged 85 years or older. Volume 2, section 5.6.1 of ICD-10, contains a full set of instructions for tabulation.

## 5 Bibliography

- 1 Verbal autopsy standards: ascertaining and attributing cause of death. (World Health Organization, 2007).
- 2 InterVA. *InterVA*, <<http://www.interva.net/>> (2011).
- 3 Murray, C. J. *et al.* Population Health Metrics Research Consortium gold standard verbal autopsy validation study: design, implementation, and development of analysis datasets. *Popul Health Metr* **9**, 27, doi:1478-7954-9-27 [pii] 10.1186/1478-7954-9-27 (2011).
- 4 Soleman, N., Chandramohan, D. & Shibuya, K. Verbal autopsy: current practices and challenges. *Bull World Health Organ* **84**, 239-245, doi:S0042-96862006000300020 [pii] /S0042-96862006000300020 (2006).
- 5 Biraud Y. Méthodes pour l'enregistrement par des non médecins des causes élémentaires de décès dans les zones sous-développées. Geneva: World Health Organization; 1956. WHO document HS/60
- 6 Murray, C. J., Lopez, A. D., Feehan, D. M., Peter, S. T. & Yang, G. Validation of the symptom pattern method for analyzing verbal autopsy data. *PLoS Med* **4**, e327, doi:07-PLME-RA-0521 [pii] 10.1371/journal.pmed.0040327 (2007).
- 7 Abouzahr, C. Verbal autopsy: who needs it? *Popul Health Metr* **9**, 19, doi:1478-7954-9-19 [pii] 10.1186/1478-7954-9-19 (2011).
- 8 Setel, P. W. Verbal autopsy and global mortality statistics: if not now, then when? *Popul Health Metr* **9**, 20, doi:1478-7954-9-20 [pii] 10.1186/1478-7954-9-20 (2011).
- 9 Leitaio, J. *et al.* Comparison of physician-certified verbal autopsy with computer-coded verbal autopsy for cause of death assignment in hospitalized patients in low- and middle-income countries: systematic review. *BMC medicine* **12**, 22, doi:10.1186/1741-7015-12-22 (2014).
- 10 Desai, N. *et al.* Performance of four computer-coded verbal autopsy methods for cause of death assignment compared with physician coding on 24,000 deaths in low- and middle-income countries. *BMC medicine* **12**, 20, doi:10.1186/1741-7015-12-20 (2014).
- 11 Lozano, R. *et al.* Performance of InterVA for assigning causes of death to verbal autopsies: multisite validation study using clinical diagnostic gold standards. *Popul Health Metr* **9**, 50, doi:10.1186/1478-7954-9-50 (2011).
- 12 Oti, S. O. & Kyobutungi, C. Verbal autopsy interpretation: a comparative analysis of the InterVA model versus physician review in determining causes of death in the Nairobi DSS. *Popul Health Metr* **8**, 21, doi:10.1186/1478-7954-8-21 (2010).
- 13 Scanlon, P., Nichols, E. (2014). National Center for Health Statistics. Hyattsville, MD Results of the Cognitive Interviewing Study of the 2012 WHO Verbal Autopsy Instrument in Nyanza Province, Kenya.
- 14 Bauni, E. *et al.* Validating physician-certified verbal autopsy and probabilistic modeling (InterVA) approaches to verbal autopsy interpretation using hospital causes of adult deaths. *Popul Health Metr* **9**, 49, doi:10.1186/1478-7954-9-49 (2011).
- 15 Leitaio, J. *et al.* Revising the WHO verbal autopsy instrument to facilitate routine cause-of-death monitoring. *Global health action* **6**, 21518, doi:10.3402/gha.v6i0.21518 (2013).

16. Fottrell, E. Advances in verbal autopsy: pragmatic optimism or optimistic theory? *Popul Health Metr* 9, 24, doi:1478-7954-9-24 [pii] 10.1186/1478-7954-9-24 (2011).
17. World Health Organization (WHO). International guidelines for certification and classification (coding) of COVID-19 as a cause of death. 2020, World Health Organization: Geneva. Available from: <https://www.who.int/publications/i/item/revealing-the-toll-of-covid-19> (Accessed 31 July 2020)
18. World Health Organization (WHO), Global surveillance for COVID-19 caused by human infection with COVID-19 virus - Interim guidance – 20 March 2020 WHO, Geneva. Available from: <https://www.who.int/docs/default-source/coronaviruse/global-surveillance-for-covid-v-19-final200321-rev.pdf> (accessed 31 July 2020)
19. Centers for Disease Control and Prevention (CDC). Coronavirus Disease 2019 in Children — United States, 12 February–2 April 2020. *MMWR Morb Mortal Wkly Rep.* ePub: 6 April 2020. Available from: <https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e4.htm> (Accessed 26 April 2020)
20. Hussain-Alkhateeb L, D’Ambruoso L, Tollman S, Kahn K, Van Der Merwe M, Twine R, Schiöler L, Petzold M, Byass P. Enhancing the value of mortality data for health systems: adding Circumstances Of Mortality CATegories (COMCATs) to deaths investigated by verbal autopsy. *Global Health Action.* 12:1. 25 October 2019. DOI: [10.1080/16549716.2019.1680068](https://doi.org/10.1080/16549716.2019.1680068)
21. Li LQ, Huang T, Wang YQ, Wang ZP, Liang Y, Huang TB, et al. COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis. *J Med Virol.* 12 March 2020.
22. Menni C, Valdes AM, Freidin MB, Sudre CH, Nguyen LH, Drew DA, et al. Real-time tracking of self-reported symptoms to predict potential COVID-19. *Nature Medicine.* 2020. DOI: 10.1038/s41591-020-0916-2
23. Sant Fruchtmann C, Kabadi G, Mwanza J, Mushi A, Matemba L, Msigwa G, et al. Telephone verbal autopsy (TeleVA) for cause of death estimation in CRVS systems where there is no doctor: A proof of concept study. Final Report v1.0. Aug 2019.
24. World Health Organization (WHO). Clinical management of COVID-19 disease. Geneva: World Health Organization; 27 May 2020. Available from <https://www.who.int/publications/i/item/clinical-management-of-covid-19> (accessed 31 July 2020)
25. WHO, Vital Strategies, (2020). Revealing the toll of COVID-19: A technical package for rapid mortality surveillance and epidemic response. NY: Vital Strategies; Geneva: WHO. <https://www.who.int/publications-detail-redirect/revealing-the-toll-of-covid-19>

## **Appendix 1: 2022 WHO list of cause of death for verbal autopsy with correspondence with ICD**

The use of this list is two-fold. For computer-coding VA (CCVA) algorithms that assign broad text labels for causes of death, this list could serve as a coding list, such that the CCVA program could directly code the death to one of these labels, and this table provides the related ICD codes. Alternatively, this list could serve as a tabulation list for other VA cause of death assignment methods such as physician coding or expert algorithms, which have the potential to directly assign specific text labels for causes of death with their individual ICD 3- or 4-character codes. In such situations, the detailed coded data from these methods could then be aggregated for tabulation according to the code groups in Column 3, to enable comparison with computer derived diagnosis. In other situations, the specifically coded data (3- or 4-character ICD codes) from physician coded VA or expert algorithms could be aggregated and analysed using other tabulation lists such as the WHO Mortality Lists or the Global Health Estimates/Global Burden of Disease categories. 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.

Column 1 contains the code for the verbal autopsy entity. Column 2 lists the related titles. Column 3 lists the ICD-10 codes that would be used if the condition labelled by column 2 were coded to ICD-10. Column 4 lists the ICD-11 codes that relate to the text label of the cause of death in Column 2.

VA code	VA cause of death title	ICD-10 codes	ICD-11 codes
<b>VAs-01 Infectious and parasitic diseases</b>			
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 <sup>12</sup>	A33-A35	1C13-1C14
VAs-01.09	Pulmonary tuberculosis	A15-A16	1B10
VAs-01.10	Pertussis	A37	1C12
VAs-01.11	Haemorrhagic fever <sup>13</sup>	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
<sup>12</sup> Excludes: Neonatal tetanus VAs-10.05			
<sup>13</sup> Excludes: Dengue VAs-01.12			



Non-communicable diseases			
VAs-98	Other and unspecified non-communicable disease  <i>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.</i>	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; 2B67-2B6Z; 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 <sup>14</sup>	I11.0; I20-I26; I46.1; I46.9; I50.1	BA01; BA40-BA6Z; BB00; MC82; BD11
VAs-04.02	Stroke	I60-I69	8B00-8B23; 8B25-8B2Z

## Application and implementation of the 2022 WHO VA instrument

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
<sup>14</sup> Includes: Ischaemic heart disease; Pulmonary embolism; Sudden cardiac death; Cardiac arrest, unspecified; Left ventricular failure; and Hypertensive heart disease with heart failure			
<b>VAs-05 Respiratory disorders</b>			
VAs-05.01	Chronic obstructive pulmonary disease (COPD)	J40-J44	CA20-CA22
VAs-05.02	Asthma	J45-J46	CA23
<b>VAs-06 Gastrointestinal disorders</b>			
VAs-06.01	Acute abdomen	R10	MD81
VAs-06.02	Liver cirrhosis <sup>15</sup>	K70.2; K70.3; K71.7; K74	DB93; DB94.2; DB94.3, DB95.5
<sup>15</sup> Includes Alcoholic fibrosis/ cirrhosis; Toxic liver cirrhosis; Fibrosis and cirrhosis of liver, excluding alcoholic and toxic, but including 'unspecified liver cirrhosis'			
<b>VAs-07 Renal disorders</b>			
VAs-07.01	Renal failure	N17-N19	GB60-GB6Z
<b>VAs-08 Mental and nervous system disorders</b>			
VAs-08.01	Epilepsy	G40-G41	8A60-8A6Z
<b>VAs-09 Pregnancy-, childbirth and puerperium-related disorders</b>			
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 28	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

VAs-10 Neonatal causes of death			
VAs-10.01	Prematurity or low birth weight	P05; P07	KA20-KA21
VAs-10.02	Birth asphyxia <sup>16</sup>	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	EH10-EH3Y; KA00-KA0Z; KA22-KA4Z; KA61-KA8Z; KB00-KB0Z; KB25; KB27-KB8Z; KC00-KC9Z; KD10-KD1Z; KD30.2-KD5Z
<sup>16</sup> 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	<sup>17</sup>	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

## Application and implementation of the 2022 WHO VA instrument

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; PN50- PB54; PB56-PB6Z; PF40-PH8Z; PJ20- PJ2Z; PJ40-PL2Z
VAs-99	Cause of death unknown	R95-R99	MH10-MH16

17 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

## **Appendix 2: Considerations for the use of verbal autopsy in the identification of COVID-19 deaths**

A set of questions to identify COVID-19 deaths has been introduced since version 1.5.3 of the 2016 WHO VA instrument. This brief technical note offers explanations for the use of VA to identify COVID-19 deaths.

### **Background**

Given the emergence of COVID-19 (coronavirus disease 2019), VA can complement information about causes of death, and also provide useful information on mortality profiles concerning COVID-19 where medical certification of cause of death is not available. This includes monitoring of excess deaths and potentially identifying individual COVID-19 cases.

The questions have been added to the WHO VA questionnaire upon request by countries and to standardise and align the set of questions proposed by different initiatives with the WHO definition of death due to COVID-19<sup>17</sup> and the underlying case definition for surveillance of COVID-19<sup>18</sup> and including the rapid mortality surveillance.

Evidence continues to evolve. Several studies have documented symptom patterns of COVID-19 patients,<sup>19-23</sup> and a core pattern of common symptoms has emerged. The WHO guidance “Clinical Management of COVID-19” summarises the current knowledge.<sup>24</sup>

The most common symptoms of COVID-19 infection are fever, cough, shortness of breath or dyspnoea, myalgia or muscle aching, fatigue, headache and change of smell/taste.

Note:

- Fever, cough, dyspnoea, and headache are already captured by the WHO VA questionnaire, before v1.5.3 of the 2016 WHO VA instrument.
- Questions added include:
  - Questions that complete the clinical presentation: loss or change of smell/taste, myalgia or fatigue.
  - Questions that may help identify a COVID-19 death or may provide information on comorbidities and other factors that are associated with increased risk of death or severe COVID-19 infection.
  - Questions relevant in the context of COVID-19 case definition<sup>17,18</sup>
- Using versions older than v1.5.3 of the 2016 WHO VA instrument (i.e., without the additional questions listed in Table 2), will NOT allow distinction between COVID-19 and other causes that share similar core symptoms (e.g., acute respiratory infection, including pneumonia).

### **Questions to identify suspected COVID-19 deaths**

New items added to the WHO VA instrument include core COVID-19 symptoms that were not included previous to v1.5.3 of the 2016 WHO VA questionnaire:

- Testing status
- Close contact with a potential case

In such a way, the criteria used in the WHO COVID-19 case definition are adequately reflected.<sup>17,18</sup>

These specific questions are aligned with the ones in rapid mortality surveillance (RMS).<sup>25</sup>

Table 2 presents the new questions (n=6; 5 root questions and one follow-up question) that have been identified as of particular relevance for the identification of suspected COVID-19 deaths.

**Table 2: List of the additional interim questions for the identification of possible COVID-19 deaths**

1. (Id10482) Was there any diagnosis by a health professional of COVID-19?

- Yes
- No
- Don't know
- Refused to answer

2. (Id10483) Did s(h)e have a recent test for COVID-19?

- Yes
- No
- Don't know
- Refused to answer

2.1. (Id10484) What was the result? (Hint for interviewer: Prompt for the result of the most recent test in case the deceased had more than one test performed)

- Positive
- Negative
- Unclear
- Don't know
- Refused to answer

3. (Id10485) Did s(h)e suffer from extreme fatigue? (Hint to interviewer: Probe whether the deceased felt so tired that (s)he found it hard to get out the bed and do the routine things like taking a shower or changing clothes)

- Yes
- No
- Don't know
- Refused to answer

Restriction: Only for adults.

4. (Id10486) Did (s)he experience a new loss, change or decreased sense of smell or taste?

- Yes
- No
- Don't know
- Refused to answer

Restriction: Only for adults

5. (Id10487) In the two weeks before death, did (s)he live with, visit, or care for someone who had any COVID-19 symptoms or a positive COVID-19 test? (Hint to the interviewer: COVID-19 symptoms include fever, difficulty breathing, cough, extreme fatigue, and changes in sense of smell or taste. In the case of neonates or young children, please omit "care for".)

- Yes
- No
- Don't know
- Refused to answer

Physician certified VA (PCVA), is the recommended method for assigning the cause of death for COVID-19 deaths identified through VA. Guidance for the identification of probably COVID-19 deaths from VA data using PCVA will be soon made available on the WHO VA standards webpage.

As evidence is compiled, the symptom-cause information used by the existing automated algorithms for assigning the cause of death using the 2022 WHO VA questionnaire (e.g., InterVA, InSilicoVA, and SmartVA) will also be updated to include COVID-19, if and as it is determined appropriate to do so, by the respective algorithm developers. The performance of the newly added COVID-19 questions will be evaluated, and a final set of questions will be included in the next major revision of the WHO VA questionnaire.

## **Considerations for VA implementation in the context of the COVID-19 pandemic**

The information described in this appendix has been compiled with consideration to three key caveats:

1. VA, as described by standard WHO guidance, is well accepted as a method for understanding population-level cause of death patterns. However, it should not be used to assign a cause of death for individuals for legal purposes.
2. The appropriate methods for compiling cause of death information depend on the information goals; proper selection and application of VA methods requires an understanding of the purpose and limitations of the various methods. The full VA questionnaire is required for teams needing cause-specific mortality fractions across multiple causes. Alternatively, for teams wishing to determine if a death was possibly due to COVID-19 quickly, a rapid screener questionnaire may be sufficient.<sup>25</sup>
3. In the face of an epidemic, there is great value in death counts even in the absence of cause of death information. Monitoring for excess death by comparing all-cause mortality to a historical baseline can serve as an early warning signal to detect an outbreak and inform decision-making as an epidemic progresses.<sup>25</sup> If resources are limited, efforts to track all-cause mortality should not be sacrificed to obtain the probable cause of death information from VA.