WHO VERBAL AUTOPSY REFERENCE GROUP

REVISION OF THE 2016 WHO VERBAL AUTOPSY INSTRUMENT

MARCH 2022

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EXECUTIVE SUMMARY

The overall objective of the revision of the 2016 WHO VA instrument was to improve the VA standard instrument by (a) reducing the duration of interview and the number of questions without degrading the performance of cause assignment, (b) improving the flow and logistics of the instrument, and (c) improving the questions that remain and the training tools associated with the instrument.

The 2016 version of the WHO VA instrument was developed to be fully compatible with publicly available automated algorithms (Tariff 2.0 – Smart VA, InterVA, and InSilicoVA) and has been subjected to training, testing and extensive field use. Breaking down complex questions for clarity has resulted in a considerable number of questions, and users have requested a shorter questionnaire. A considerable number of sites have conducted VA with the 2016 WHO VA questionnaire, allowing the assessment of the feasibility of questions.

The approach to the resolution of issues and identification of questions that can be dropped drew on a mixture of qualitative, quantitative, and expert knowledge. Collated evidence includes a review of response patterns, cognitive testing (available only for some issues), significance measures, as well as insights resulting from a coordinated exchange process between users, VA experts and clinicians with PCVA experience on the reliability and diagnostic value of VA questions.

The report briefly summarizes the methods and results of the revision. Additional documents where details on methodology and analysis can be found are referenced through the report.
The quantitative analysis starts with a dataset consisting of 28,427 deaths with VA using the 2016 WHO standard instrument from thirteen sites in low- and middle-income countries. Fifty percent of the deaths are female, 77 percent adult, 13 percent child, 10 percent neonate, and 8 percent maternal. These deaths come from many sources, and a reference cause was supplied along with the responses to the VA for 10,822 deaths.

The results also highlighted the value of the "mixed-methods" approach to identify and understand poor performing questions, and the importance of triangulating different methods to enable robust assessments over whether a VA item should be kept, removed or changed to address any clarity or redundancy issue(s). Alterations made to the WHO VA instrument are expected to provide a more parsimonious, concise, clear and efficient instrument that can be analyzed with currently available algorithms and by physicians. While testing is still underway, the changes made to the instrument are not expected to significantly influence the performance of the algorithms to assign CODs, but some adaptation of the software used will be required.

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BACKGROUND

Verbal autopsy (VA) is a method for estimating population-level cause of death patterns for mortality surveillance purposes; information is obtained from the caretaker of a deceased, whereby trained interviewers visit the relatives to conduct VA interviews using electronic data capture instruments or paper questionnaires. Information obtained during VA interviews include the circumstances, signs, and symptoms during the terminal stage to find out the likely cause of death, health care seeking in the period leading to death, and history of events leading to death as narrated by the respondent. Cause of death determination from VA can be done using physicians review or using automated computer algorithms.

Since the 1970s, the WHO has been developing continuously improved VA instruments. Research has seen special adaptations and new developments over time. A systematic analysis of causes identifiable with VA, and of questions relevant to identify these causes led to the development of the 2012 WHO VA instrument. The goal was also to have a VA instrument that was feasible in routine environments, parsimonious, and where the answers can be analyzed by automated analytical software for assigning causes of death. The current 2016 version was developed to be fully compatible with publicly available automated algorithms (Tariff 2.0 – Smart VA, InterVA, and InSilicoVA) and has been subjected to training, testing and extensive field use being implemented in over 20 countries.

Since the release of the 2016 version, issues reported with its use have been compiled (e.g., skip patterns, unreliable questions) and a major revision of the instrument planned based on users' feedback and evidence from the field. The WHO VA Reference Group (VARG) developed a protocol to revise the WHO VA instrument and generate a questionnaire that is as short, concise and efficient as possible, and that works well in the field with currently available algorithms and physician-certified VA (PCVA). The following encapsulate the two key aims of the revision process:

- To resolve known issues and improve and simplify the interview process with the WHO VA instrument; and
- To reduce the duration of the interview and the number of questions in the VA questionnaire without impairing the instrument's diagnostic performance.

It should be highlighted that the WHO VA target list of causes of death was not under review. Only the WHO VA questionnaire was reviewed in light of producing all the indicators of signs and symptoms that are sufficiently reliable to make the diagnosis of causes of deaths included in the target list of causes of death (Appendix A). To note, with the emergence of the COVID-19 pandemic, in a separate effort, COVID-19 was added to the cause list, and associated questions have been proposed for addition to the questionnaire. These questions were added in the v1.5.3 of the 2016 questionnaire update that was released in 2020. Validation testing is underway to inform the permanent addition of the proposed questions.

METHODOLOGY & DATASETS

The approach to the revision process drew on a mixture of qualitative, quantitative, and expert knowledge: mixed-methods analysis of secondary data collected using the 2016 WHO VA questionnaire; together with cognitive interviewing results; and a consultation process with VA users and experts in the field, including a panel with clinicians experienced in PCVA.

SECONDARY DATA

QUANTITATIVE ANALYSIS

For quantitative analysis, de-identified VA questionnaire data was provided from teams, including government or research teams that were known to have compiled VAs using the 2016 WHO VA questionnaire[1]. All data were collected electronically.

Except where noted, the results of analysis in this document refer to item response analysis conducted on a global VA dataset that comprises 28,427 deaths from 13 countries which include:

- Burkina Faso (Nanoro n = 1,511)
- Ivory Coast (n = 316)
- Ghana (Bongo = 782, Kintampo = 205, and maternal data set n = 2,122)
- Kenya (Western Kenya HDSS n = 4,230 and Homa Bay n = 816)
- Mozambique Countrywide Mortality Surveillance for Action (COMSA) Initiative (n = 5,615)
- the Child Health and Mortality Prevention Surveillance (CHAMPS) Initiative, that includes Bangladesh, Ethiopia, Kenya, Mali, Mozambique, Sierra Leone and South Africa (n=1,567)
- Morocco (n = 589)
- South Africa (n = 5,428)
- Zambia (n=2,746)
- Thailand (n = 2,500)

The demographic composition of these data are as follows: 50% female; 77% adults, 13% children, 10% neonates; and 8% maternal deaths.

Some analyses involve a reference death dataset from four sources: (1) the South Africa National Cause of Death Validation Study (n = 5,388); (2) CHAMPS (n = 1,567); (3) Ghana maternal data set (n = 1,367); and (4) Thailand (n = 2,500). There are a total of 10,822 deaths with reference causes included in these analyses. The demographic composition of these deaths are as follows: 52% female; 83% adults, 6% children, and 11% neonates; and 4% maternal deaths.

QUALITATIVE ANALYSIS

The qualitative information used in this activity was secondary analysis of results from cognitive interviews conducted in Zambia and Morocco in 2019, with support from the Collaborating Center for Questionnaire Design and Evaluation Research (CCQDER) at CDC's

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

National Center for Health Statistics (NCHS). The primary benefit of cognitive interviewing over non-qualitative evaluation methods is that it provides rich, contextual data into how respondents interpret questions, apply their lived experiences to their responses, and formulate responses to survey items based on those interpretations and experiences. Thus, cognitive interviewing data allows researchers and survey designers to understand whether or not a question is capturing the specific social constructs they originally wanted and gives insight into what design changes are needed to advance the survey's overall goal.

Information was collected from cognitive interviews with living respondents about deceased individuals; NCHS staff trained the local interviewers to conduct the cognitive interviews and compiled and analyzed the cognitive interviewing results. In the 2019 evaluation of the VA questionnaires, a purposive sample of 149 respondents across two sites—Lusaka, Zambia and Rabat, Morocco—was recruited to participate in cognitive interviews. An effort was made to create a sample with a range of decedent ages, so that all three questionnaires could be evaluated fully. Unfortunately, given the specifics of how respondents were recruited in Morocco, proportionally fewer respondents from that country received either the child or neonate questionnaire as compared to the Zambian sample. As a result, the final sample for this project is slightly skewed towards respondents who received the adult questionnaire, as shown in Table 1:

Table 1: Cognitive Interviewing Sample by Country and Questionnaire

	Adult	**Child**	**Neonate**	***Total***
Morocco	45	20	19	84
Zambia	23	23	19	65
Total	68	43	38	149

Respondents in Zambia were sampled at a morgue at a city hospital. With the support of the Zambian government, VAs were conducted for all brought-in-dead (i.e., decedents who did not die in a hospital) in Lusaka. Cognitive interviewers recruited respondents from the pool of VA respondents, and the cognitive interviews were conducted directly following the VA. In Morocco, VAs were conducted for non-hospital deaths at the Ministry of the Interior's Vital Registration Office when family members came to register a death and obtain a burial certificate. Just as in Zambia, cognitive interviewers recruited respondents from this pool of VA respondents and conducted the cognitive interview directly following the VA. Incentives were not provided to respondents in either location.

Cognitive interviewers entered their notes into CDC's Q-Notes software, which is a qualitative analysis program designed specifically for the storage and analysis of data from cognitive interviews. Following a week-long training course conducted by NCHS researchers, the local cognitive interviewers conducted the interviews over a period of four months (for Zambia) and one year (for Morocco). NCHS researchers were able to monitor the data collection and data quality via Q-Notes and communicated with the field teams when necessary to provide direction and assistance.

REVIEW OF ENUMERATED VA ISSUES

Reported issues and feedback by users have been compiled and managed by the VARG through the Public GitHub platform: https://github.com/SwissTPH/WHO_VA_2016.

For the review of the issues, frequency distributions and select cross tabulations of quantitative interview data were run to compare response patterns in related questions to flag potential redundancy and inconsistencies. Select comparisons were further evaluated by calculating prevalence ratios, 95% confidence intervals and *p*-values. The qualitative cognitive interviewing results were reviewed for additional understanding of 1) known issues with the questionnaire that have been reported by users and 2) issues that emerged from the quantitative analysis described above. The cognitive interviewing report was also reviewed to identify any new issues that were further explored in the quantitative data.

For some issues, it was also considered if/how the InterVA/InSilicoVA, SmartVA, and PCVA cause of death assignment methods utilize the questions. In some cases, the respective symptom-cause information was reviewed for the questions, including prior probabilities from the InterVA probbase, Tariff scores and PHMRC endorsement rates for SmartVA, and the PCVA diagnostic criteria. This information shows how the question is used in relation to a given cause of death and helps to evaluate which causes the symptoms/items were intended to target. Though the results sometimes reference specific symptom-cause associations, it is acknowledged that every indicator contributes to distinguishing between causes of death in the algorithms.

ITEM REDUCTION

For the item reduction component of the revision process, a number of analyses were conducted, but we will focus on two: (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 the entropy scores.

VALIDITY OF RESPONSE

All deaths in the global VA death dataset were used to quantify response patterns. Because the 2016 WHO instrument has complex skip patterns, each death was examined individually to determine which questions were asked in the VA interview. Only questions that were asked were included in the valid response analysis. A *valid response* was defined as a meaningful value that does not include "don't now", "missing", or "refused to answer" responses.

For each question, the valid response percent was calculated as the number of deaths for which the question was asked that also had a valid response divided by the number of deaths for which the question was asked. The questions were ordered according to percent valid responses by calculating their percentile rank among all questions. Smaller percentiles are associated with larger percent valid responses – percentile rank 0 is best and 100 is worst.

IMPORTANCE

Reference deaths with a cause were used to quantify the importance of each question. Two complementary statistical methods were used:

1. TMLE: the strength of the relationship between each cause and each VA symptom, and thereby the question(s) used to create the symptom. This method does not rely on any of the existing algorithms so that the resulting importance indicator does not privilege any algorithm over the others.

2. Entropy coefficient: Also known as uncertainty coefficient, it provides information about the nominal association between one symptom or sign and the distribution of ALL causes of death in the dataset. This is different from the TMLE score which investigates the association between one symptom and one cause at a time. It uses the concept of 'information entropy' to assess how much uncertainty around the distribution of causes of deaths is explained by the existence of one symptom.

Values of the resulting importance indicator range from -1 to 1. A value of 0 indicates no relationship between the symptom and cause, values close to zero indicate a weak relationship, values close to -1 indicate a strong negative relationship, and values close to 1 indicate a strong positive relationship. For both TMLE and entropy coefficient, the questions were ordered according to importance by calculating their percentile rank among all questions using the absolute value of the importance indicator, i.e., the valence of the relationship is ignored. Smaller percentiles are associated with larger importance – percentile rank 0 is best and 100 is worst.

Interpreting Importance - limitations

There are limitations inherent to the importance indicator.

1. There are comparatively few reference deaths with cause so there is limited information available to calculate the importance indicator, particularly for causes that are rare.
2. Some causes and some symptoms are rare, and this results in some symptom-cause combinations not having enough observations to calculate the importance indicator. This issue is less so for the calculation of the entropy coefficient but still important to consider.
3. The overall effect of (1) and (2) above is that the importance indicator is only available for a subset of symptoms, and crucially, *it should not be viewed as generally authoritative.*

Because of the limitations described above, ***the importance indicator should be viewed as suggestive*** – as one contribution to the array of information available for each question. No decision to keep or drop a question was based solely on the importance indicator.

VA USERS AND EXPERTS

The revision process stemmed from feedback from users on the 2016 WHO implementation, on users' contribution and collaboration to the global VA dataset, and centered on a series of workshops to coordinate exchanges between users, VA experts and clinicians with PCVA experience on the reliability and diagnostic value of VA questions. A total of five workshops were conducted since August 2019, when a technical group consisting of the developers of algorithms and VARG members met to review item reduction approaches and develop a protocol for the revision process. Appendix B lists the series of workshops held to review data analysis results and discuss recommendations for the revision of the WHO VA instrument, including a list of participants.

RESULTS

Limitations and Considerations for Interpretation

The following limitations should be taken into consideration when reviewing findings:

- With the exception of data from Thailand and some CHAMPS data from Bangladesh, the available VA data only represent Sub-Saharan Africa. The limited representation of the qualitative cognitive testing results (representing only Zambia and Morocco) versus the quantitative dataset is acknowledged.
- While the most recent version of the WHO VA questionnaire (v1.5.3[2]) contains a question on sex of the respondent, early versions were used for the datasets utilized in this analysis; accordingly, impact of the respondent sex on response is limited to the cognitive testing results, as this information was documented by cognitive testing.
- There is some expected variation in the way the final VA instrument is applied in a given setting, due to different versions of the 2016 questionnaire being used, or other modifications that teams may make that have an impact on the electronic skip patterns. As such, some numbers do not track exactly as expected throughout this analysis. Analyses presented here are limited to those where such deviations had minimal to no impact.
- Percentages presented throughout the documents providing findings of the revision process are rounded and do not always equal 100%.

QUESTION BY QUESTION REVIEW

A Google Sheet document "**QbyQ mixed-methods analysis.xlsx"**[3] contains a list of the WHO-2016 questions along with the quantitative information developed to identify candidates for dropping, recommendations and considerations taken by experts during the revision process, as well as the final decision for each question. In summary, the revision process of the 2016 WHO VA instrument has led to:

- 18% reduction in number of questions used for cause of death assignment from the 2016 WHO VA instrument (Appendix C – list of questions dropped from the WHO VA instrument);
- 10 new questions added for COD assignment (Appendix D – list of new questions added to the WHO VA instrument);
- 88% of 2016 WHO VA questions improved:
    - Improvements made include clarification of intent, simplification of questions and sequences, and reallocation of questions to improve quality of responses; and
    - Restructuring of the maternal section to simplify the interview process;
- Hints added for the interviewers in 26% of questions:
    - to clarify intent of questions; and
    - to improve response patterns; and
- Use of standardized medical terminology (i.e., as opposed to use of colloquial terms) to facilitate translations.

[2] *Note: Questions to assess COVID-19 have been included since the 2016 WHO VA instrument v1_5_3.*

[3] https://docs.google.com/spreadsheets/d/1f7r3ai9mePZ-XGh7_6ritjZCdBtfwhSmiGjMpCwk4w0/edit?usp=sharing

Additional modifications made to the WHO VA instrument are expected to lead to improved sequencing and interview flow and less time to conduct the interview. Examples of these include:

- Reallocation of the open narrative to the start of the VA interview (i.e., in 2016 version, the open narrative was at the end of the questionnaire); and
- Simplified interview process for injury deaths; when injury happens within 7 days of death, only the open narrative, the medical diagnosis section, and a few maternal questions (where relevant) will be asked.

Alterations made to the instrument are expected to provide a more parsimonious, concise, clear and efficient instrument that can be analyzed with currently available algorithms and by physicians.

ENUMERATED VA ISSUES

Details on the results of the quantitative and qualitative analysis for the review of enumerated issues are found in the Google doc **"Mixed-methods analysis of selected issues"**[4]: compiling evidence from response pattern analysis, cognitive testing, where relevant literature searches, and the considerations and recommendations from the VARG and VA experts.

From the VARG maintenance process of the WHO VA instrument, 21 issues were targeted for review, including the following:

1. Tobacco use
2. Swallowing
3. Sores and ulcers
4. Swelling, lump, ulcers, pits in the breast
5. Other female health related questions
6. Diagnosis by a health professional vs symptom report
7. Vaccinations
8. Injury section
9. Urine
10. Abdominal problems
11. Lumps
12. Vomiting
13. Violence
14. Baby size
15. Convulsions
16. Movement in the womb – stillbirths/neonates
17. Targeting of age groups
18. Unconsciousness
19. The need for late maternal deaths
20. Maternal section review
21. Revision to sections not used for cause of death assignment

The kinds of problems the issues represent relate to lack of clarity in terminologies and constructs used, redundancy between questions, and confusing sequence of questions. The

[4] https://docs.google.com/document/d/1ltmVX6BUHAsIb98MVwnekGnfwICOgAWq/edit?usp=sharing&ouid=104236517009977097186&rtpof=true&sd=true

following subsections describe the enumerated VA issues targeted for resolution during the revision process, a total of 21 issues – providing information on the context of the issue and respective resolution proposed.

TOBACCO USE

The 2016 WHO VA instrument captures information on tobacco consumption through the use of 5 questions (2 root questions and 3 follow up questions, Table 3). The aim was to assess whether the series of questions could be shortened and/or simplified.

Table 3- Question series, asked for adults (12 years and above) in the 2016 WHO VA instrument.

Item	Question	Comments
Id10412	Did (s)he use tobacco?	Required
Id10413	Did (s)he smoke tobacco?	Required
Id10414	What kind of tobacco did (s)he use?	Asked if selected Id10413 'yes' or selected Id10412 'yes' and selected Id10413 'no'
Id10415	How many cigarettes did (s)he smoke daily?	Asked if selected Id10413 'yes' or selected Id10412 'yes' and selected Id10413 'no'
Id10416	How many times did (s)he use tobacco products each day?	Asked if selected Id10414 'pipe or selected Id10414 'chewing tobacco' or selected d10414 'local_form_of_tobacco' or selected Id10414 'other'

OUTCOME

The solution shown in Table 4, has a total number of 6 questions - involving the removal of Id10412, Id10415 and Id10416, and the addition of 4 new questions. Despite the increase of the total number of questions, the series is simplified with the previous redundancy in the questions removed, and less time spent in the series due to proposed skip patterns based on two root questions.

The redundancy between Id10412-10414 is resolved by combining the three questions into a modified version of Id10413 and Id10414 that act as root questions enquiring about smoking tobacco and chewing and/sniffing tobacco, simplifying the series.

The questions attempting to capture the quantity of cigarettes and tobacco products consumed daily are indicated for removal as response pattern analysis revealed 47% of "Don't know" responses. There was consensus that capturing daily or regular use of tobacco products (smoking and chewing) and duration of consumption was more reliable information to acquire and more relevant for COD. Literature is supportive of this consideration and other surveys capturing tobacco also focus on daily smokers or smoking at least 1 time per day, given the significant health risks associated with daily smoking, even at low levels of consumption.

Table 4 - Revised sequence proposed from workshop for the WHO VA instrument.

Questions	Comments

(Id10413) Did s/he ever smoke tobacco? • Yes • No • DK • Ref	Add hint: "To clarify, the series inquires about tobacco consumption about any period during life (i.e. not only the current status before death)."
1.2. (NewId) For how long did s/he smoke tobacco? • Months, years	
1.3 (NewId) Did s/he ever smoke daily? • Yes • No • DK • Ref	Add hint to clarify interpretation (i.e. smoking daily during a period and then stopping) -
(Id10414) Did s/he ever chew and/or sniff tobacco? • Yes • No • DK • Ref	Add hint: To clarify, the series inquires about tobacco consumption about any period during life (i.e. not only the current status before death).
2.1. (NewId) For how long did s/he chew and/or sniff tobacco? • (months, years)	
2.2. (NewId) Did s/he ever chew and/or sniff tobacco daily? • Yes • No • DK • Ref	Add hint to clarify interpretation (i.e. chewing daily during a period and then stopping)

SWALLOWING

The question series related to difficulties in swallowing (total of 4 questions, 2 root and 2 follow up), reportedly leads to confusion for respondents and interviewers alike in distinguishing between having "difficulty swallowing" and "pain with swallowing".

Table 5 shows the question series from the 2016 WHO VA instrument. In the original sequence, both Id10261 and Id10264 are required/root questions to be asked of respondents (i.e. Id10264 is asked independently of the answer to Id10261). Follow up

questions, Id10262_units-Id19263, are asked if the respondent answered "Yes" to Id10261 (difficulty swallowing).

Table 5 - Question series, asked for adults and children in the 2016 WHO VA instrument.

Item	Question	Comments
Id10261	Did (s)he have difficulty swallowing?	Required
Id 10262_units	For how long before death did (s)he have difficulty swallowing?	If "yes" to Id10261 units: days, months
Id10263	Was the difficulty with swallowing with solids, liquids, or both?	If "yes" to Id10261
Id10264	Did (s)he have pain with swallowing?	Required

OUTCOME

A new sequence totaling 3 questions (1 root, 2 follow ups) was proposed to resolve the issue, Table 6, that involves the removal of Id10263 and Id10264 and the addition of a new question.

The sequence of "pain" and "difficulty" events is thought to change, depending on illness. There was consensus that there is likely misinterpretation by respondents of the constructs of "pain" and "difficulty". Instead, the newly proposed question was thought to capture the aspect more relevant for COD assignment and which is likely to have better recall by respondents – "if swallowing became impossible".

Table 6 - Revised sequence proposed from workshop for the WHO VA instrument.

Questions	Comments
(Id10261) Was there difficulty or pain in swallowing? • Yes • No • DK • Ref	If "Yes", questions Id10262_units and the newly added question (NewId) should be asked.
(Id10262_units) For how long did (s)he have difficulty or pain in swallowing? • Days, weeks, months	
(NewId) Did swallowing become impossible?	Add hint to clarify the intent

SORES AND ULCERS

The question series on sores and ulcers asks multiple questions (Table 7, total of 7 questions, 3 root and 4 follow up) about similar but different constructs, raising concerns about redundancy and whether the constructs are clearly understood by respondents.

Table 7 - Question series in the 2016 WHO VA instrument.

Item	Question	Comments
Id10227	Did (s)he have sores or ulcers anywhere on the body?	Required for adults and children
Id10228	Did (s)he have sores?	Required for adults
Id10229	Did the sores have clear fluid or pus?	Required for adults, if "yes" to Id10228 and for children, if "yes" to Id10227

Id10230	Did (s)he have an ulcer (pit) on the foot?	Required for adults and children
Id10231	Did the ulcer on the foot ooze pus?	Required for adults and children, if "yes" to Id10230
Id10232_units	How long did the ulcer on the foot ooze pus?	Required for adults and children, if "yes" to Id10231

OUTCOME

Response pattern analysis results and clinical inputs suggest the removal of Id10228; and a change in order of the questions - firstly asking about sores or ulcers on the foot as the most important sign/symptom relevant for diabetes; and then if there were sores or ulcers anywhere else on the body. Id10232_units was considered for removal but the duration having an ulcer on the foot with pus was concluded to be important on the probbase for diabetes mellitus and sepsis. Rephrasing and standardization of terms used across the series are also proposed to clarify potential confusion in questions Id10230, Id10227 and Id10229. The new proposed sequence is shown in Table 8.

Table 8 - Revised sequence proposed from workshop for the WHO VA instrument.

Questions	Comments
(Id10230) Did (s)he have an ulcer on the foot?	Required for adults and children. Clarify in QbyQ guidance that valid responses can include having more than 1 ulcer on the feet.
(Id10231) Did the ulcer on the foot have pus?	Required for adults and children, if "yes" to Id10230
(Id10232_units) For how long did the ulcer on the foot have pus?	Required for adults and children, if "yes" to Id10231
(Id10227) Did (s)he have ulcers or sores anywhere else on the body?	Required for adults and children
(Id10229) Did the ulcers or sores have pus?	Required for adults, if "yes" to Id10228 and for children, if "yes" to Id10227

SWELLING, LUMP, ULCERS, PITS IN THE BREAST

Potential confusion was reported between the constructs of swelling or lump in the breast (Id10294) and ulcers (pits) in the breast (Id10295) – see Table 9. The VARG investigated whether respondents have been able to answer these questions and if both constructs are required for COD assignment.

Table 9 - Question series for Id10294 and Id10295 in the 2016 WHO VA instrument, asked for adult females

Item	Question	Comments
Id10294	Did she have any swelling or lump in the breast?	Required
Id10295	Did she have any ulcers (pits) in the breast?	Required

OUTCOME

There is odd response pattern in the two questions, cognitive testing indicates constructs are well understood, and both questions are used in PCVA for breast cancer, whereas they don't have much effect in probbase. Due to the conflicting results found for both questions, the proposed solution involves combining the questions into a single one and rephrasing for clarity: (Id10294) Did she have any lump(s) and/or ulcer(s) in the breast?

Question	Comments
(Id10294) Did she have any lump(s) and/or ulcer(s) in the breast?	Required

OTHER FEMALE HEALTH RELATED QUESTIONS

The questions shown in Table 10 have been reported as challenging both for interviewer and respondent. The VARG assessed whether respondents are being able to provide reliable answers to these questions and if the series can be simplified.

Table 10 - Question series for Id10296-Id10302, asked for adult females in the 2016 WHO VA instrument.

Item	Question	Comment
Id10296	Did she ever have a period or menstruate?	Required
Id10297	When she had her period, did she have vaginal bleeding in between menstrual periods?	If "yes" to Id10296
Id10298	Was the bleeding excessive?	If "yes" to Id10297
Id10301	Was there excessive vaginal bleeding in the week prior to death?	If "yes" to Id10296
Id10299	Did her menstrual period stop naturally because of menopause or removal of uterus?	If "yes" to ID10296
Id10302	At the time of death was her period overdue?	If "No", "DK" or "Ref" to Id10299

OUTCOME

The questions on intermenstrual period (Id10297-10298) are used for cervix/uterus cancer, however this is very rare, and the questions have poor performance. Clinical experts agreed that removing questions on intermenstrual bleeding shouldn't have an impact on COD assignment for the WHO VA target list of causes.

Another agreed change was the rephrasing of Id10299 into a simple question asking only about menopause, as the removal of uterus is already captured by "(Id10340) Did she have an emergency operation to remove her uterus shortly before death?".

The questions regarding menstrual period being delayed (Id10302-10303) were initially considered for removal as they were thought to be redundant with "(Id10305) Was she pregnant at the time of death?". Additionally, the questions have 20-24% DK responses and contradictory significance performance values. However, the final recommendation is to keep both questions as they are important for the diagnosis of ectopic pregnancies (together with having sharp abdominal pain and fainting).

The proposed solution is reflected in Table 11. Questions Id10297 and Id10298 are proposed for removal from the WHO VA instrument.

Table 11 - Revised sequence proposed from workshop for the WHO VA instrument.

Question	Comment
(Id10296) Did she ever have a period or menstruate?	Required
(Id10299) Did her menstrual period stop naturally because of menopause?	If "yes" to Id10300
(Id10300) Did she have vaginal bleeding after cessation of menstruation?	If "yes" to Id10301
(Id10301) Was there excessive vaginal bleeding in the week prior to death?	If "yes" to Id10296
(Id10302) At the time of death was her period overdue?	If "yes" to Id10303
(Id10303) For how many weeks had her period been overdue?	If "yes" to Id10302

DIAGNOSIS BY A HEALTH PROFESSIONAL VS SYMPTOM REPORT

Concerns were raised over the reliability of responses given to the series on diagnostic questions (Id10125-10144), with measurement error being more likely with questions on diagnosis than with questions on symptoms.

OUTCOME

Analysis showed that response errors on these diagnosis questions stemmed from general lack of understanding or knowledge of the condition listed. Despite a recommendation to relocate the series on diagnostic questions to the section on health service use for additional contextualization and clarity on the intent of the series; the solution adopted is to move the series before the injury section, and to add an introduction to the series to emphasize the diagnosis from a health professional.

VACCINATIONS

The question "(Id10431) Select EPI vaccines done" is challenging for VA, as it requires the interviewer to know what the complete vaccine schedule is for their country and to assess the vaccination card for completion. Also, documentation of vaccine status is required for a response to Id10431; a concern has been reported that for many respondents, this documentation may not be available, because it was thrown away, buried with the child, or otherwise lost.

Table 12 - Existing question series, asked for neonates (not stillbirths) and children in the 2016 WHO VA instrument.

Item	Question	Comment
Id10428	Did (s)he receive any immunizations?	Required
Id10429	Do you have the child's vaccination card?	If "yes" to Id10428

Id10430	Can I see the vaccination card (note the vaccines the child received)?	If "yes" to Id10429
Id10431	Select EPI vaccines done	If "yes" to Id10430

OUTCOME

As proportion of respondents that get relevant information from the series is extremely low – the solution is to keep only the initial question - (Id10428) Did (s)he receive any immunizations?"- i.e., removing Id10429-10431. Instead, it is recommended that vaccination history should be explored in an optional health system module or through social autopsy.

INJURY SECTION

Feedback from the field indicates significant frustration by interviewers and respondents in completing the remainder of the long questionnaire when somebody who was not otherwise ill clearly died of an injury. Specifically, if they have answered "Yes" to "(Id10077) Did (s)he suffer from any injury or accident that led to her/his death?", after answering the remainder of the injury series (Id10078-Id10100), should the respondent continue through all of the remaining questions of the questionnaire?

OUTCOME

Reasons to ask subsequent questions after indication of death by injury include to determine if the death was maternal related or to determine if the injury was caused by an underlying medical condition.

It was agreed that following "(Id10077) Did (s)he suffer from any injury or accident that led to her/his death?", a follow up question should be added to determine the time interval between the injury and death: "How long after the injury or accident did s/he die?" (response options: less or equal to 7 days/more than 7 days/Dk/Ref); a flag should be added if less than or equal to 7 days is checked for interviewer to confirm the answer, so as to not mistakenly skip the remainder of the questionnaire.

- The flow of the VA interview and the subsequent questions to be asked will depend on the interval between injury and death:
  - If within 7 days - besides the full injury section, ask few maternal questions (see issue on "maternal section").
  - If longer than 7 days -full VA interview.
  - DK/Ref - full VA interview
- Agreed to add a hint to the newly proposed question: "Establish whether the deceased died within 7 days or more of the accident or injury that led to death. This is important as it will determine the length of the VA interview. If within 7 days then the deceased likely died from the accident or injury and only maternal questions will be asked in addition to the injury section. If more than 7 days, the full VA interview will be conducted."

URINE PROBLEMS

In this series (Table 13), the following three questions are skipped in the 2016 WHO VA instrument, if NO/DK/Ref to "Id10223 Did (s)he have any urine problems?":

- (Id10225) Did (s)he go to urinate more often than usual?
- (Id10224) Did (s)he stop urinating?
- (Id10226) During the final illness did (s)he ever pass blood in the urine?

There were concerns over the consistency between Id10223 and the follow-up questions. Inconsistencies would flag potential false positives; respondent may not know what urine problems are (e.g., blood in pee). For important questions, it may be better to ask the specific construct of interest directly and not screen out by root question.

Table 13 - Existing question series, asked for children and adults in the 2016 WHO VA instrument.

Item	Question	Comment
Id10223	Did (s)he have any urine problems?	Required
Id10224	Did (s)he stop urinating?	If "Yes" to Id10223
Id10225	Did (s)he go to urinate more often than usual?	If "Yes" to Id10223
Id10226	During the final illness did (s)he ever pass blood in the urine?	If "Yes" to Id10223

OUTCOME

The solution involved adding a hint to filter question, Id10223, to clarify the kinds of relevant urine problems; and Id10225 is set for removal from the WHO VA instrument as question showed poor results in the significance analysis and is considered non-essential for the diagnosis of diabetes.

Table 14 - Existing question series, asked for children and adults in the 2016 WHO VA instrument.

Item	Question	Comment
Id10223	Did (s)he have any urine problems?	Required
Id10224	Did (s)he stop urinating?	If "Yes" to Id10223
Id10226	During the final illness did (s)he ever pass blood in the urine?	If "Yes" to Id10223

ABDOMINAL PROBLEMS

There is potential for redundancy and/or inconsistency across the series of questions (10 questions, 4 root and 6 follow up, Table 15) between the first root question (Id10193) and the 3 other subsequent root questions (Id10194, Id10200 and Id10204).

Table 15 - Question series, asked for children and adults in the 2016 WHO VA instrument.

Item	Question	Comment
Id10193	Did (s)he have any belly (abdominal) problem?	Required
Id10194	Did (s)he have belly (abdominal) pain?	Required
Id10195	Was the belly (abdominal) pain severe?	If yes to Id10194
Id10196_unit	For how long did (s)he have belly (abdominal) pain?	If yes to Id10194
Id10199	Was the pain in the upper or lower belly (abdomen)?	If yes to Id10194
Id10200	Did (s)he have a more than usually protruding belly (abdomen)?	Required
Id10201_unit	For how long before death did (s)he have a more than usually protruding belly (abdomen)?	If yes to Id10200
Id10203	How rapidly did (s)he develop the protruding belly (abdomen)?	If yes to Id10200
Id10204	Did (s)he have any mass in the belly (abdomen)?	Required
Id10205_unit	For how long did (s)he have a mass in the belly (abdomen)?	If yes to Id10204

OUTCOME

There was consensus that the first root question "(Id10193) Did (s)he have any belly (abdominal) problem?" should be removed from the WHO VA instrument – as the specific questions on abdominal pain, swelling and mass cover the relevant abdominal problems for COD assignment (Table 16). With the addition of a reference image of abdominal areas of interest, it was also agreed to change Id10199 (location of abdominal pain) to allow the addition of other response options on "4 quadrants", "left", "right", and "all over".

It was highlighted that duration questions (Id10196_unit, Id10201_unit and Id10205_uniut) are generally not performing well (e.g. Id10196_units has only generated 49.6% of valid responses and has 48.4% of missing responses) – being proposed that the VARG should investigate reasons behind poor performance of duration questions and explore how response rates could be potentially improved.

Table 16 - Revised sequence proposed from workshop for the WHO VA instrument.

Item	Question	Comment
Id10194	Did (s)he have abdominal pain	Required
Id10195	Was the abdominal pain severe?	If yes to Id10194
Id10196_unit	For how long did (s)he have abdominal pain?	If yes to Id10194
Id10199	Where was the location of the abdominal pain?	If yes to Id10194. Question needs to be rephrased
Id10200	Did (s)he have a more than usually protruding abdomen?	Required
Id10201_unit	For how long before death did (s)he have a more than usually protruding abdomen?	If yes to Id10200
Id10203	How rapidly did (s)he develop the protruding abdomen?	If yes to Id10200
Id10204	Did (s)he have any mass in the abdomen?	Required
Id10205_unit	For how long did (s)he have a mass in the abdomen?	If yes to Id10204

LUMPS

The question series on lumps (totaling 5 questions, 1 root and 4 follow up – Table 17) was reviewed to assess if respondents are being able to provide reliable answers and if the sequence can be simplified.

Table 17 - Question series, asked for children and adults in the 2016 WHO VA instrument.

Item	Question	Comment
Id10253	Did (s)he have any lumps?	Required
Id10254	Did (s)he have any lumps or lesions in the mouth?	If "yes" to Id10253, for adults only
Id10255	Did (s)he have any lumps on the neck?	If "yes" to Id10253
Id10256	Did (s)he have any lumps on the armpit?	If "yes" to Id10253
Id10257	Did (s)he have any lumps on the groin?	If "yes" to Id10253

OUTCOME

The solution for the series on lumps (Table 18), involves:

- Rephrasing for clarity and re-ordering of Id10254 as question different from the others in the series.
- Rephrasing of Id10253 to accommodate for the change in order.
- Addition of a hint to Id10253 to remind interviewer that the interest is in looking for lumps in the neck, armpit or groin at least.

Table 18 - Revised sequence for the WHO VA instrument.

Question	Comments
(Id10254) Did (s)he have any lumps or sores in the mouth?	
(Id10253) Did (s)he have lumps anywhere else on the body?	
(Id10255) Did (s)he have any lumps on the neck?	If "yes" to Id10253
(Id10256) Did (s)he have any lumps on the armpit?	If "yes" to Id10253
(Id10257) Did (s)he have any lumps on the groin?	If "yes" to Id10253

VOMITING

In the series of questions related to vomiting episodes (Table 19), there is redundancy between the two root questions Id10188 and Id10189 (I.e., when answering "No" to not having had vomiting, a respondent is still asked if the deceased vomited in the week preceding death). The objectives were to eliminate the redundancy and clarify potential confusion between timing and duration of vomiting for Id10190_units.

Table 19 - Question series, asked for neonates, children, and adults in the 2016 WHO VA instrument.

Item	Question	Comment
Id10188	Did (s)he vomit?	Required
Id10189	To clarify: Did (s)he vomit in the week preceding the death?	Required
Id10190_units:	How long before death did (s)he vomit?	If "yes" to Id10188
Id10191	Was there blood in the vomit?	(selected(${Id10188}, 'yes') or selected(${Id10189}, 'yes')) and ${isNeonatal} !='1'
Id10192	Was the vomit black?	(selected(${isChild}, '1') or selected(${isAdult}, '1')) and (selected(${Id10188}, 'yes') or selected(${Id10189}, 'yes'))

OUTCOME

To resolve the redundancy, the proposed solution makes Id10188 the only root question, and to clarify the difference between timing and duration, the sequence of Id10190_units and Id10189 was changed, along with rephrasing of Id10190_units (Table 20).

Besides capturing duration and timing, it was thought that "being unable to keep the food down" is an important marker of the severity of vomiting and the question is being proposed to be added as a follow up question within the series. The proposed solution also involves adding response options for the question ON AGE for less than 1 year; over 1 year; and removing DK/Ref response options. For neonates it is already asked about the specific days.

Table 20 - Revised sequence for the WHO VA instrument.

Questions	Comments
(Id10188) Did s/he vomit?	
(Id10190_units) For how long did s/he vomit?	Not asked for neonates
(Id10189) Did s/he vomit in the week preceding death?	If baby was of age less than 1 week = question is skipped
(NewId) Did s/he vomit every time s/he ate and/or drank?	All ages
(Id10191) Was there blood in the vomit?	
(Id10192) Was the vomit black?	

VIOLENCE

Although asked for all age groups, the 2016 WHO VA instrument has a hint for interviewers to not mention "suicide" when asking about a potential suicide (i.e., Id10090) for a deceased under 12 years old (see table 21). There is concern over under-reporting of suicide in children, and it is up for review the age limit for which suicide should be asked for in Id10090.

Table 21 - Question series, asked for neonates (not stillbirths), children, and adults in the 2016 WHO VA instrument.

Item	Question	Comment
Id10077	Did (s)he suffer from any injury or accident that led to her/his death?	Required
....		
Id10090	Was (s)he subject to violence (suicide, homicide, abuse)? *Hint: (don't say suicide for under-12-year olds)*	If "yes/DK/ref" to Id10077 and "no/DK/ref" to road traffic accident (Id10079)
Id10098	Was the injury accidental?	If "yes/DK/ref" to Id10077
Id10099	Was the injury self-inflicted?	If "no/DK/ref" to Id10098, only asked for adult
Id10100	Was the injury intentionally inflicted by someone else?	If "no/DK/ref" to Id10098 and Id10099

OUTCOME

Based on literature, it was agreed that the target for asking about suicide should be from 10 years and above. Question Id10090 is dropped as it is redundant with Id10098-10100.

Table 22 - Revised sequence for the WHO VA instrument.

Item	Question	Comment
Id10077	Did (s)he suffer from any injury or accident that led to her/his death?	Required
....		
Id10098	Was the injury accidental?	If "yes/DK/ref" to Id10077
Id10100	Was the injury intentionally inflicted by someone else? Hint: An intentionally inflicted injury by someone else refers to homicide.	If "no/DK/ref" to Id10098 and Id10099
Id10099	Was the injury intentionally self-inflicted? Hint: An intentionally self-inflicted injury refers to suicide.	Make question for children and adults. If "no/DK/ref" to Id10098 Skip question if below 10 years old.

BABY SIZE

There is redundancy in the question series (Table 23, total of 5 questions, 2 root and 3 follow up) used to capture baby size and potential to improve the sequence.

Table 23 - Question series, asked for neonates and children under 1 year in the 2016 WHO VA instrument.

Item	Question	Issue
Id10362	At birth, was the baby of usual size?	Required
Id10363	At birth, was the baby smaller than usual, (weighing under 2.5 kg)?	If "no" "don't know" or "refused" to Id10362
Id10364	At birth, was the baby very much smaller than usual, (weighing under 1 kg)?	If "yes" to Id10363
Id10365	At birth, was the baby larger than usual, (weighing over 4.5 kg)?	If "no" "don't know" or "refused" to Id10362 AND "no" to Id10363
Id10366	What was the weight (in grammes) of the deceased at birth?	Required

The Interviewer guide provides the following instructions for recording the birth weight for Id10366:

"Ask if the child health card is available. If the card is available and the birth weight is recorded, enter the birth weight from the card. If the card is not available, record the weight based on the respondent's report if known."

The ODK file provides the following constraints for answering Id10366 that will be applied automatically for teams using the electronic questionnaire:

(.>=0 and .<=9999) and (not(selected(${Id10365},'yes') and .<=4500)) and (not(selected(${Id10364},'yes') and .>=1000)) and (not(selected(${Id10363},'yes') and .>=2500)) and (not(selected(${Id10364},'no') and .<1000))

This means that unless a respondent answers as follows...:

- between 0 and 9999 grammes; and
- not yes to Id10363 (smaller than usual) and >= 2500 grammes; and
- not yes to Id10364 (very much smaller than usual) and >= 1000 grammes; and
- not no to Id10364 (very much smaller than usual) and < 1000 grammes; and
- not yes to Id10365 (larger than usual) and <= 4500 grammes

...the respondent will be requested to "Please enter a value between 0 and 9999 and coherent with previous answers." This constraint supports consistency in responses across this series.

OUTCOME

The agreed solution involves the removal of Id10362 and Id10364 – since having the information from Id10363 is sufficient for COD assignment. The revised sequence also involves a change in the order, with Id10366 (recording of birth weight directly from health card) becoming the first root question – See Table 24. In this manner, the follow up questions (Id10363-Id10365) are only asked when there is no health card with recorded birthweight.

Regarding Id10363-10364, it was acknowledged that questions are helpful in differentiating between LBW and Prematurity, and useful for physicians to have both. There

was consensus that most respondents are unlikely to provide reliable information to distinguish between the two, and for PCVA and even with algorithms, other related questions (gestational age of the pregnancy at time of delivery, etc.) can be more helpful in combination with these three questions to differentiate between LBW and Prematurity.

It was also thought that reference images of smaller than normal and larger than normal should be provided to improve the validity of responses. Another aspect raised was that the QbyQ and training materials should emphasize the importance of having the mother or mother-in-law as best respondents.

Table 24 - Revise sequence for the WHO VA instrument.

Questions	Comments
(Id10366) What was the birth weight (in grammes) of the deceased at birth? Add note/instruction asking if the child health card is available. If the card is available and the birth weight is recorded, enter the birth weight from the card.	Logic checks on the range of acceptable values for weight and for "DK" responses. Instead of hint, use instruction, similar to death certificate section. If available with weight ask; if not - skip to following questions.
(Id10363) At birth, was the baby smaller than usual (weighing under 2.5 kg)?	If Id10366 is not answered
(Id10365) At birth, was the baby larger than usual (weighing over 4.5 kg)?	If 10363 is "NO/DK/Ref"

CONVULSIONS

There is redundancy between questions "(Id10219) Did (s)he have convulsions?" and "(Id10220) Did (s)he experience any generalized convulsions or fits during the illness that led to death?" (Table 25). Additionally, there was a proposal to group convulsion related questions that are spread across the questionnaire for neonates and children under 1 year old: Id10219-10222; Id10275; Id10276.

Table 25 - Question series, asked for the different age groups in the 2016 WHO VA instrument.

Questions	Age group relevancy and skips
(Id10219) Did (s)he have convulsions?	All ages
(Id10220) Did (s)he experience any generalized convulsions or fits during the illness that led to death?	Children if YES to Id10219
(Id10221) For how many minutes did the convulsions last?	Children/Adult if YES to Id10219
(Id10222) Did (s)he become unconscious immediately after the convulsion?	Children/Adult if YES to Id10219

_____(several other questions asked in between)_____

Questions	Age group relevancy and skips
(Id10275) Did the baby have convulsions starting within the first 24 hours of life?	(selected(${isNeonatal}, '1') and ${Id10114}!='yes') or (selected(${isChild}, '1') and (${ageInMonthsByYear} = 'NaN' or string-length(${ageInMonthsByYear}) = 0)) or (selected(${isChild}, '1') and ${ageInMonthsByYear} != 'NaN' and string-length(${ageInMonthsByYear}) > 0 and ${ageInMonthsByYear}<12)
(Id10276) Did the baby have convulsions starting more than 24 hours after birth?	Neonates and under 1 year old; if NO/DK/Ref to Id10275

OUTCOME

There was consensus to group together the questions for the different age groups, moving Id10275-10276 next to Id10220-10222 (Table 26).

Regarding the redundancy between Id10219 and Id10220, it was decided in plenary that Id10219 should be dropped from the questionnaire and that Id10220 should be asked for children and adults.

The question on duration of convulsions, Id10221, is set for removal from the WHO VA instrument as it has poor performance in both response pattern (19.4% DK and 11.8% missing responses) and significance analysis in both TMLE and entropy scores.

Table 26 - Revised sequence proposed for the WHO VA instrument.

Questions	Age group relevancy and skips
(Id10220) Did (s)he experience any generalized convulsions during the illness that led to death?	Children and and Adults
(Id10222) Did (s)he become unconscious immediately after the convulsion?	Children and Adults if YES to Id10220
(Id10275) Did the baby have convulsions starting within the first 24 hours of life?	Neonates; if YES to Id10220 for children under 1 year old
(Id10276) Did the baby have convulsions starting more than 24 hours after birth?	Neonates; if NO/DK/Ref to Id10275

Regarding the use of Id10219 by SmartVA for adults, there is no data indicating that Id10220 will function better than Id10219 in capturing convulsions in adults (i.e., as Id10220 has only been asked to children). However, there was consensus that generalized convulsions are of most interest to capture COD (as opposed to localized convulsions which could be captured by Id10219 but not differentiated). Additionally, no reason was found why Id10220 would not work well for adults and why SmartVA won't be able to post-process the information needed for Id10219 from responses to Id10220.

MOVEMENT IN THE WOMB – STILLBIRTHS/NEONATES

It was proposed to move questions related to movement in the womb (Id10376, Id10377, Id10379_unit, Table 27) that are in the section for confirmed neonatal deaths to the section

of confirmed stillbirths, as most useful to distinguish antepartum from intrapartum stillbirths.

Table 27 - Question series related to confirming neonatal deaths and stillbirths and surrounding questions in the 2016 WHO VA instrument; age group relevance shown for key questions.

Questions	Comments
Section on verification of possible stillbirth	
(Id10104) Did the baby ever cry?	
(Id10105) Did the baby cry immediately after birth, even if only a little bit?	
(Id10106) How many minutes after birth did the baby first cry?	
(Id10107) Did the baby stop being able to cry?	
(Id10108) How many hours before death did the baby stop crying?	
(Id10109) Did the baby ever move?	
(Id10110) Did the baby ever breathe?	
(Id10111) Did the baby breathe immediately after birth, even a little?	
(Id10112) Did the baby have a breathing problem?	
(Id10113) Was the baby given assistance to breathe at birth?	
(Id10114) If the baby didn't show any sign of life, was it born dead?	
(Id10115) Were there any bruises or signs of injury on baby's body after the birth?	
(Id10116) Was the baby's body soft, pulpy and discoloured and the skin peeling away?	

_____(several other questions asked in between)_____

Questions	Comments
(neonatal_childB) Neonatal child questions part B	
(Id10376) Was the baby moving in the last few days before the birth?	
(Id10377) Did the baby stop moving in the womb before labour started?	
Baby moving	
(Id10379_unit) How long before labour did you/the mother last feel the baby move?	selected(${Id10377}, 'yes')

OUTCOME

There was consensus on moving Id10376 and Id10377 to the beginning of the section on possible stillbirths – so that it is asked for all neonates. It was also agreed on rephrasing Id10109, Id10377, Id10376 as shown in Table 21. Id10379_unit is proposed for removal as the question does not add value for COD assignment with the changes proposed, and is of difficult recall.

Table 28- Revised sequence for the WHO VA instrument.

Questions	Comments
Section on verification of possible stillbirth	
(Id10377) Did the baby stop moving in the womb?	If no, go to Id10109
(Id10376) Did the baby stop moving before or after the onset of labour? • Before • After • DK • Ref	
(Id10109) Did the baby ever move after being delivered?	

TARGETING OF AGE GROUPS

The targeting of age groups is a two-parts issue.

Part A – Age specific questionnaire for under 1 year olds/18 months

To improve the flow of questions in a printed version of the questionnaire, it was proposed that it would be helpful to group questions only relevant for age subgroups under 1 year old. To enable grouping, there is a suggestion to change the target age group for questions on fontanelle (Id10278, Id10279) to be for deceased aged less than 12 months (i.e., currently, questions are asked for those under 18 months).

The tables below show the current questions for the relevant age subgroups.

Less than 1 year old:

(Id10271) Was the baby able to suckle or bottle-feed within the first 24 hours after birth?
(Id10272) Did the baby ever suckle in a normal way?
(Id10273) Did the baby stop suckling?
(Id10274_units) How long after birth did the baby stop suckling?
(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?
(Id10277) Did the baby's body become stiff, with the back arched backwards?

Less than 18 months (no break- questions follow one another)

(Id10278) During the illness that led to death, did the baby have a bulging or raised fontanelle?
(Id10279) During the illness that led to death, did the baby have a sunken fontanelle?

Less than 1 year old (no break- questions follow one another):

(Id10281) During the illness that led to death, did the baby become unresponsive or unconscious?
(Id10282) Did the baby become unresponsive or unconscious soon after birth, within less than 24 hours?
(Id10283) Did the baby become unresponsive or unconscious more than 24 hours after birth?

_____(several other questions asked in between)_____

(Id10354) Was the child part of a multiple birth?
(Id10355) Was the child the first, second, or later in the birth order?
(Id10356) Is the mother still alive?
(Id10357) Did the mother die before, during or after the delivery?
(Id10358_units) How long after the delivery did the mother die?
(Id10360) Where was the deceased born?
(Id10361) Did you/the mother receive professional assistance during the delivery?
(Id10362) At birth, was the baby of usual size?
(Id10363) At birth, was the baby smaller than usual, (weighing under 2.5 kg)?
(Id10364) At birth, was the baby very much smaller than usual, (weighing under 1 kg)?
(Id10365) At birth, was the baby larger than usual, (weighing over 4.5 kg)?

Part B- Target ages for abnormalities, see "Notes" in table below

Id10370-10373, questions on abnormalities, are currently only asked of children under 1 year, although they may have implications on deaths of children beyond one year. The VARG is reconsidering the appropriate target age groups for these questions.

- The prevalence and survival rates for children born with congenital abnormalities in low- and middle-income countries are not documented. Some evidence can be found in Toobaie et al. 2019[5] and Sitkin et al. 2015[6]

ABNORMALITIES: These questions are currently only asked of children under 1 year, though they may have implications on deaths of children beyond one year. Reconsider appropriate target age groups for these questions.	
	Notes
(Id10370) Was any part of the baby physically abnormal at time of delivery? (for example: body part too large or too small, additional growth on body)?	**Question is asked for those that died <1 year. Physical abnormalities may still be important for deaths beyond age 1.**
(Id10371) Did the baby/ child have a swelling or defect on the back at time of birth?	**Question is asked for those that died <1 year. Hydrocephalus/macrocephalic status may be important for deaths beyond 1 year. Neural tube defects may be important for deaths beyond age 1. E.g. Spina bifida may live longer and at higher risk for complications.**

[5] Toobaie A, Yousef Y, Balvardi S, St-Louis E, Baird R, Guadagno E, et al. Incidence and prevalence of congenital anomalies in low- and middle-income countries: A systematic review. J Pediatr Surg. 2019;54(5):1089-93.

[6] Sitkin NA, Ozgediz D, Donkor P, Farmer DL. Congenital anomalies in low- and middle-income countries: the unborn child of global surgery. World J Surg. 2015;39(1):36-40.

(Id10372) Did the baby/ child have a very large head at time of birth?	**Question is asked for those that died <1 year. Hydrocephalus/macrocephalic status may be important for deaths beyond 1 year.**
(Id10373) Did the baby/ child have a very small head at time of birth?	**Question is asked for those that died <1 year. Microcephaly may be important for deaths beyond 1 year. Given the upsurge in Zika, it could warrant obtaining this history for later deaths.**

OUTCOME

For part A of the issue, although there was consensus that the creation of a specific questionnaire for deceased 1 year old and below is not needed; there was agreement to change the age on fontanelle questions to children less than 1 year old. There is no standard time period in which the fontanelle is expected to be closed. Most textbooks and guidelines define 7-19 months as the window to be considered as normal. For older babies, mothers or other respondents may not easily see the bulging or sunken fontanelle. Based on data evidence shared, few cases will be missed, but can be captured from a combination of other symptoms.

For part B, it was agreed that questions on abnormalities should be asked to children up to 11 years old - criteria based on most deaths occurring under 10 years and on practicality (child questionnaire goes up to 11 years old).

UNCONSCIOUSNESS

For neonates and children less than 1 year old, several redundant questions are asked related to unconsciousness. Besides the general questions (Id10214-Id10218) that are asked for most age groups (see Table 29 for differences), neonates and children are also asked Id10281-10283.

- For neonates there are also: "(Id10214) Was (s)he unconscious during the illness that led to death?" and "(Id10215) Was s(he) unconscious for more than 24 hours before death?"
- For children less than 1 year old, besides the same ones for neonates, there are also: "(Id10216_units) How long before death did unconsciousness start?", "(Id10217) Did the unconsciousness start suddenly, quickly (at least within a single day)?", and "(Id10218) Did the unconsciousness continue until death?"

Additionally, "(Id10216_units) How long before death did unconsciousness start?" is only asked for children and it should be asked as well for adults.

Table 29- Question series, age group relevance and skip patterns in the 2016 WHO VA instrument.

Questions	Comments
(Id10214) Was (s)he unconscious during the illness that led to death?	All ages
(Id10215) Was (s)he unconscious for more than 24 hours before death?	All ages
(Id10216_units) How long before death did unconsciousness start?	selected(${isChild}, '1') and (selected(${Id10215}, 'no') or selected(${Id10215}, 'dk') or selected(${Id10215}, 'ref'))

(Id10217) Did the unconsciousness start suddenly, quickly (at least within a single day)?	(selected(${isChild}, '1') or selected(${isAdult}, '1')) and selected(${Id10214}, 'yes')
(Id10218) Did the unconsciousness continue until death?	(selected(${isChild}, '1') or selected(${isAdult}, '1')) and selected(${Id10214}, 'yes')

_____(several other questions asked in between)_____

Questions	Comments
(Id10281) During the illness that led to death, did the baby become unresponsive or unconscious?	(selected(${isNeonatal}, '1') and ${Id10114}!='yes') or (selected(${isChild}, '1') and (${ageInMonthsByYear} = 'NaN' or string-length(${ageInMonthsByYear}) = 0)) or (selected(${isChild}, '1') and ${ageInMonthsByYear} != 'NaN' and string-length(${ageInMonthsByYear}) > 0 and ${ageInMonthsByYear}<12)
(Id10282) Did the baby become unresponsive or unconscious soon after birth, within less than 24 hours?	((selected(${Id10281}, 'yes') and (selected(${isNeonatal}, '1')) and ${Id10114}!='yes') or (selected(${Id10281}, 'yes') and selected(${isChild}, '1')))
(Id10283) Did the baby become unresponsive or unconscious more than 24 hours after birth?	(selected(${Id10281}, 'yes') and not(selected(${Id10282}, 'yes'))) and ((selected(${isNeonatal}, '1') and ${Id10114}!='yes') or selected(${isChild}, '1'))

Notes on skip/logics: Id10281, relevant when: (The deceased person is a Neonate AND (Id10114) If the baby didn't show any sign of life, was it born dead? was NOT answered with Yes) OR (The deceased person is a Child AND (Age in Months was NOT answered)) OR (The deceased person is a Child is True AND Age in Months is less than 12). **Id10282,** relevant when:(((Id10281) During the illness that led to death, did the baby become unresponsive or unconscious? was answered with Yes AND (The deceased person is a Neonate) AND (Id10114) If the baby didn't show any sign of life, was it born dead? was NOT answered with Yes) OR ((Id10281) During the illness that led to death, did the baby become unresponsive or unconscious? was answered with Yes AND The deceased person is a Child)). **Id10283, r**elevant when:((Id10281) During the illness that led to death, did the baby become unresponsive or unconscious? was answered with Yes AND (Id10282) Did the baby become unresponsive or unconscious soon after birth, within less than 24 hours? was NOT answered with Yes) AND ((The deceased person is a Neonate AND (Id10114) If the baby didn't show any sign of life, was it born dead? was NOT answered with Yes) OR The deceased person is a Child).

OUTCOME

The solution targets questions by age groups, avoiding a broad root question to all ages that results in repetition (see Table 30). To resolve redundancy, there was agreement that Id10215 should be removed and Id10214 kept for children and adults. In this way:

- Children and adults are only asked Id10214-10217.
- Id10281-10283 are only asked for neonates.

It was also agreed to improve the clarity for Id10282 by simplifying it into "(Id0282) Did the baby become unresponsive or unconscious within 24 hours after birth?".

Table 30 - Revised sequence for the WHO VA instrument.

Questions	Comments

(Id10214) Was (s)he unconscious?	Children and adults
(Id10216_units) How long before death did unconsciousness start?	Children and adults; if yes to Id10214
(Id10217) Did the unconsciousness start suddenly, quickly (at least within a single day)?	Children and adults; if yes to Id10214

Questions	**Comments**
(Id10281) During the illness that led to death, did the baby become unresponsive or unconscious?	Neonates
(Id10282) Did the baby become unresponsive or unconscious within 24 hours after birth?	Neonates r - if yes to Id10281
(Id10283) Did the baby become unresponsive or unconscious more than 24 hours after birth?	Neonates - if No/DK/Ref to Id10282

THE NEED FOR LATE MATERNAL DEATHS?

A question was raised as to the need to determine late maternal deaths (i.e., Id10307 and Id10308, see Table 31) as they are not used to assign a COD. However, literature indicates significant global burden of late maternal deaths. There is also concern about Id10307 being redundant for classification of late maternal deaths.

Table 31 - Maternal death determination question series in the 2016 WHO VA instrument.

Questions	**Comments**
(Id10305) Was she pregnant or in labour at the time of death?	not(selected(${Id10299}, 'yes'))
(Id10306) Did she die within 6 weeks of delivery, abortion or miscarriage?	selected(${Id10305}, 'dk') or selected(${Id10305}, 'no') or selected(${Id10305}, 'ref')
(Id10307) Did this woman die more than 6 weeks after being pregnant or delivering a baby?	(selected(${Id10306}, 'dk') or selected(${Id10306}, 'no') or selected(${Id10306}, 'ref')) and (selected(${Id10305}, 'dk') or selected(${Id10305}, 'no') or selected(${Id10305}, 'ref'))
(Id10308) Was this a woman who died less than 1 year after being pregnant or delivering a baby?	selected(${Id10307}, 'yes')
(Id10309) For how many months was she pregnant?	selected(${Id10305}, 'yes') or selected(${Id10306}, 'yes') or selected(${Id10308}, 'yes')
(Id10310) Please confirm, when she died, she was NEITHER pregnant NOR had delivered, had an abortion, or miscarried within 12 months of when she died--is that right?	

OUTCOME

The decision was to record late maternal deaths due to its significance in mortality trends. However, it was thought that there is no need to have both questions in the questionnaire - Id10307 is to be removed, keeping only Id10308.

Note that late maternal deaths will not be added as a cause of death to the WHO target list of causes – but Id10308 will enable the capture of the indicator that can be used by countries to assess mortality trends for late maternal deaths; this possibility will be added to the Q by Q guide for team awareness.

MATERNAL SECTION REVIEW

This section reflects the issues and solutions related to the maternal death section of the 2016 WHO VA instrument, being structured into three parts: A, B and C.

Part A - Interview flow for injury and suicide deaths related to maternal deaths

The first part of the issue concerns if a death is injury/suicide related, if it should also be established whether it was related to a maternal death.

Part B – Different constructs over overlapping time frames (Id10321-10329)

The series of questions, shown in Table 32, is difficult to ask because we are asking about different but similar constructs across different and sometimes overlapping periods of time. There is concern about the likelihood of misclassification and false answering around the subtle differences in time periods (e.g., during pregnancy, during the first 3 months of pregnancy, during the last 3 months of pregnancy, during labour, during delivery, after delivery).

Table 32 - Question series and skip patterns from the 2016 WHO VA instrument.

Questions	Comments
(Id10321) During pregnancy, did she suffer from high blood pressure?	not(selected(${Id10305}, 'yes')) or not(selected(${Id10312}, 'yes')) or (selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes'))
(Id10322) Did she have foul smelling vaginal discharge during pregnancy or after delivery?	not(selected(${Id10305}, 'yes')) or not(selected(${Id10312}, 'yes')) or (selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes'))
(Id10323) During the last 3 months of pregnancy, did she suffer from convulsions?	not(selected(${Id10305}, 'yes')) or not(selected(${Id10312}, 'yes')) or (selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes'))
(Id10324) During the last 3 months of pregnancy did she suffer from blurred vision?	not(selected(${Id10305}, 'yes')) or not(selected(${Id10312}, 'yes')) or (selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes'))
(Id10325) Did bleeding occur while she was pregnant?	not(selected(${Id10305}, 'yes')) or not(selected(${Id10312}, 'yes')) or (selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes'))
(Id10326) Was there vaginal bleeding during the first 6 months of pregnancy?	selected(${Id10325}, 'yes')

(Id10327) Was there vaginal bleeding during the last 3 months of pregnancy but before labour started?	selected(${Id10325}, 'yes')
(Id10328) Did she have excessive bleeding during labour or delivery?	(selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes')) or selected(${Id10306}, 'yes') or (selected(${Id10305}, 'no') and selected(${Id10306}, 'yes')) or (selected(${Id10305}, 'no') and selected(${Id10306}, 'no') and selected(${Id10307}, 'yes') and selected(${Id10308}, 'yes')) or (selected(${Id10316}, 'yes') or selected(${Id10316}, 'no'))
(Id10329) Did she have excessive bleeding after delivery or abortion?	(not(selected(${Id10305}, 'yes')) and not(selected(${Id10312}, 'no')))
(Id10330) Was the placenta completely delivered?	selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes')) or selected(${Id10306}, 'yes') or (selected(${Id10305}, 'no') and selected(${Id10306}, 'yes')) or (selected(${Id10305}, 'no') and selected(${Id10306}, 'no') and selected(${Id10307}, 'yes') and selected(${Id10308}, 'yes')) or (selected(${Id10316}, 'yes') or selected(${Id10316}, 'no'))
(Id10331) Did she deliver or try to deliver an abnormally positioned baby?	(selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes')) or selected(${Id10306}, 'yes') or (selected(${Id10305}, 'no') and selected(${Id10306}, 'yes')) or (selected(${Id10305}, 'no') and selected(${Id10306}, 'no') and selected(${Id10307}, 'yes') and selected(${Id10308}, 'yes')) or (selected(${Id10316}, 'yes') or selected(${Id10316}, 'no'))
(Id10332) For how many hours was she in labour?	(selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes')) or selected(${Id10306}, 'yes') or (selected(${Id10305}, 'no') and selected(${Id10306}, 'yes')) or (selected(${Id10305}, 'no') and selected(${Id10306}, 'no') and selected(${Id10307}, 'yes') and selected(${Id10308}, 'yes')) or (selected(${Id10316}, 'yes') or selected(${Id10316}, 'no'))
(Id10333) Did she attempt to terminate the pregnancy?	
(Id10334) Did she recently have a pregnancy that ended in an abortion (spontaneous or induced)?	not(selected(${Id10316}, 'yes'))
(Id10335) Did she die during an abortion?	selected(${Id10334}, 'yes')
(Id10336) Did she die within 6 weeks of having an abortion?	selected(${Id10334}, 'yes') and not(selected(${Id10335}, 'yes')) and not(selected(${Id10305}, 'yes') and selected(${Id10312}, 'yes'))

Part C – Sequence of relevance for "abortion"-related deaths

Several questions that are potentially irrelevant for abortion-related deaths are asked in the 2016 WHO VA instrument. Note that "abortion" in this context includes induced abortion, miscarriage, and incomplete miscarriage.

OUTCOME

Part A - Interview flow for injury and suicide deaths related to maternal deaths

It was agreed that for injury and suicide deaths, it should be established if the women died within 1 year of pregnancy, abortion or miscarriage (Id10305-10308=YES). Interview is

then considered terminated (i.e. the full remaining questions in the maternal section are not asked).

Regarding how to manage abortion, incomplete abortion, and miscarriage, it was agreed to add a hint to Id10305 to clarify: “A "Yes" response to this question means a foetus or baby remained in the mother's body after she died. If she was already in labour or actively aborting - please answer "NO" to Id10305.”

Part B - Different constructs over overlapping time frames (Id10321-10329)

A task group focused on the review of the maternal section, reviewed and proposed relevant symptoms and time periods to be included in the revised version of the WHO VA instrument as shown in Table 33.

Table 33 - Matrix of relevant symptoms and associated time periods during pregnancy, during labour/delivery and after delivery or abortion. Grey areas indicate the combination of symptom – pregnancy period is not relevant for cause of death assignment.

	Pregnancy	**First 3 months**	**First 6 months pregnancy**	**Last 3 months pregnancy**	**During labour/ delivery**	**After delivery /abortion**
(Id10304) Sharp abdominal pain		Ectopic or possibly abortion related				
(Id10321) High blood pressure	chronic vs preg induced HTN	chronic HTN [not maternal cause but may be risk factor]				
(Id10322) Foul vaginal discharge						Pregnancy-related sepsis
(Id10323) Convulsions				preg induced HTN		preg induced HTN

(Id10324) Blurred vision				preg induced HTN		preg induced HTN
(Id10325-7) Bleeding				Obstetric haemorrhage or possibly abruption related to preg induced HTN or possibly anemia(not underlying COD; cause of bleeding)		
(Id10328-9) Excessive bleeding					Obstetric haemorrhage or Uterine rupture	Obstetric haemorrhage or Uterine rupture

- Id10326 is to be removed from the WHO VA instrument, as information not essential for determining abortions; and can be inferred from answers to Id10325 and Id10327.
- Id10304 is to be rephrased into "Did she have a sharp abdominal pain in the first 3 months of pregnancy?"; and to add a new follow up question to help ascertain ectopic pregnancies - "Did she faint when she had the sharp abdominal pain?"
- Id10322 -is to be split into two questions: (Id10322_a) Did she have foul smelling vaginal discharge during pregnancy?; and (Id10322_b) Did she have foul smelling vaginal discharge after delivery/abortion?
- Id10323 is to be rephrased into: Did she suffer from convulsions during the last 3 months of pregnancy and/or after delivery?
- Id10324- is to be rephrased into: Did she have blurred vision during the last 3 months of pregnancy and/or after delivery?
- It was also agreed to add a hint to Id10327 – that any bleeding is abnormal in the last three months of pregnancy.

In terms of format, individual questions are preferred to the matrix format for simplicity in the interview process; and questions will be ordered chronologically instead of group by symptom cluster. Table 34 shows the revised maternal death section.

Part C - Sequence of relevance for "abortion"-related deaths

Agreed that there should be consistent use of terms "abortion and/or miscarriage" as relevant to the questions (i.e. don't use only the term "abortion" when miscarriage is intended to be implied).

The questions on abortion will be reallocated to the beginning of the maternal section - following Id10306. This will facilitate skips to questions later in the questionnaire that are irrelevant for abortion or miscarriage related deaths.

To simplify the series, resolve redundancies and improve on clarity, it was agreed to:

- Rephrase Id10334 into: (Id10334) Did she have a pregnancy that ended in an abortion or miscarriage within 6 weeks of her death?
- Drop Id10335 as information that is important for COD is already covered by Id10333 and Id10334.
    - Change in order - ask first Id10334, followed by Id10333
- Rephrase Id10306 to only refer to delivery - as information relevant to abortion is covered by Id10333 and Id10334. In this way, Id10306 is rephrased into: (Id10306) Did she die within 6 weeks after delivery?
- Agreed to split "(Id10329) Did she have excessive bleeding after delivery or abortion?" into two questions to enable the separate flow in the interview process specific for abortions and miscarriages: "(Id10329_a) Did she have excessive bleeding after delivery?" AND "(Id10329_b) Did she have excessive bleeding during or after abortion or miscarriage?".
- Id10316 was initially thought to be rephrased into - Was the baby born alive or dead? However, final recommendation is to drop question as it is associated with several causes including ruptured uterus, eclampsia, obst heamorrhage - being too nonspecific and not very contributive to COD assignment process.
- Id10315 is proposed for dropping as it is redundant with the rephrasing of question Id10306 and Id10334.

Table 34 - Revised structure and order of questions in the maternal death section.

Signs and symptoms associated with pregnancy and women

(Id10294) Did she have any lump(s) and/or ulcer(s) in the breast?

(Id10296) Did she ever have a period or menstruate?

(Id10299) Did her menstrual period stop naturally because of menopause?

(Id10300) Did she have vaginal bleeding after cessation of menstruation?

(Id10301) Was there excessive vaginal bleeding in the week prior to death?

(Id10302) At the time of death was her period overdue?

(Id10303) For how many weeks had her period been overdue?

(Id10305) Was she pregnant and not yet in labour at the time of death?

(Id10312) Did she die during labour or delivery?

(Id10313) Did she die after delivering a baby?

(Id10314) Did she die within 24 hours after delivery?

(Id10306) Did she die within 6 weeks after delivery?

(Id10334) Did she have a pregnancy that ended in an abortion or miscarriage within 6 weeks before her death?

(Id10333) Did she attempt to terminate the pregnancy?

(Id10308) Did she die less than 1 year after delivery, abortion or miscarriage?

[Please confirm that in the 12 months prior to her death, the woman was not pregnant, she did not have a delivery and she also did not have an abortion or miscarriage.]

(Id10304) Did she have a sharp abdominal pain in the first 3 months of pregnancy?

(Id10304_a) Did she faint when she had the sharp abdominal pain?

Questions about possible maternal deaths

(Id10309) For how many months was she pregnant?

(Id10317) How many babies was she pregnant with?

(Id10321) During pregnancy, did she suffer from high blood pressure?

(Id10322_a) Did she have foul smelling vaginal discharge during pregnancy?

(Id10325) Did bleeding occur while she was pregnant?

(Id10327) Was there vaginal bleeding during the last 3 months of pregnancy but before labour started?

(Id10323) Did she suffer from convulsions during the last 3 months of pregnancy and/or after delivery?

(Id10324) Did she have blurred vision during the last 3 months of pregnancy and/or after delivery?

(Id10328) Did she have excessive bleeding during labour or delivery?

(Id10329_a) Did she have excessive bleeding after delivery?

(Id10329_b) Did she have excessive bleeding during or after abortion or miscarriage?

(Id10322_b) Did she have foul smelling vaginal discharge after delivery/abortion?

(Id10331) Did she deliver or try to deliver an abnormally positioned baby?

(Id10332) For how many hours was she in labour?

(Id10342) Was the delivery normal vaginal, without forceps or vacuum?

(Id10343) Was the delivery vaginal, with forceps or vacuum?

(Id10344) Was the delivery a Caesarean section?

(Id10330) Was the placenta completely delivered?

(Id10337) Where did she give birth?

(Id10319) How many births, including stillbirths, did she/the mother have before this pregnancy?

(Id10320) Had she had any previous Caesarean section?

(Id10340) Did she have an operation to remove her uterus shortly before death?

SUMMARY

The “mixed-methods” approach to the revision highlighted the importance of triangulating different methods to enable more understanding and fair assessments over whether a VA item should be kept, removed or changed to address any clarity or redundancy issues. The recommendations described in this report reflect conclusions based on a review of information available throughout this “mixed-methods” approach. It is acknowledged that evidence was not available for all questions that emerged throughout this revision process, and a number of areas have been flagged for further study. Despite its limitations, this revision process has demonstrated the feasibility and value of compiling and assessing VA data to improve international standards for VA, and it is recommended that such efforts continue.

A Beta version of the revised WHO VA instrument is planned for release in April 2022. As part of the next steps, the effect of the removal of identified VA items from the WHO VA will be tested on algorithms, and the performance of the 2022 WHO VA instrument will need to be validated in the field.

APPENDIX A – WHO TARGET LIST OF CAUSES OF DEATH FOR VERBAL AUTOPSY

WHO cause of death list for verbal autopsy with corresponding ICD-10 codes. 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 labeled by column 2 were coded to ICD-10. The third column lists the ICD-10 codes that relate to the text label of the cause of death category in Column 2.

Verbal autopsy code	Verbal autopsy title	ICD-10 codes (from ICD - 2016)
VAs-01 Infectious and parasitic diseases		
VAs-01.01	Sepsis	A40-A41
VAs-01.02	Acute respiratory infection, including pneumonia	J00-J22; J85
VAs-01.03	HIV/AIDS related death	B20-B24
VAs-01.04	Diarrheal diseases	A00-A09
VAs-01.05	Malaria	B50-B54
VAs-01.06	Measles	B05
VAs-01.07	Meningitis and encephalitis	A39; G00-G05
VAs-01.08	Tetanus[7]	A33-A35
VAs-01.09	Pulmonary tuberculosis	A15-A16
VAs-01.10	Pertussis	A37
VAs-01.11	Haemorrhagic fever[8] Ex	A92-A96, A98-A99
VAs-01.12	Dengue fever	A97
VAs-01.13	Coronavirus disease (COVID-19)	U07.1; U07.2

[7] *Excludes: Neonatal tetanus VAs-10.05*

[8] *Excludes: Dengue VAs-01.12*

VAs-01.99	Unspecified infectious disease	A17-A19; A20-A32; A36; A38; A42-A89; B00-B04; B06-B19; B25-B49; B55-B99

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 **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; G50-G99; H00-H95; J30-J39; J47-J84; J86-J99; K00-K31; K35-K38 K40-K69; K77-K93 L00-L99; M00-M99; N00-N16; N20-N99;
VAs-02 Neoplasms		
VAs-02.01	Oral neoplasms	C00-C06
VAs-02.02	Digestive neoplasms	C15-C26
VAs-02.03	Respiratory neoplasms	C30-C39
VAs-02.04	Breast neoplasms	C50
VAs-02.05	Female reproductive neoplasms	C51-C58
VAs-02.06	Male reproductive neoplasms	C60-C63

VAs-02.99	Other and unspecified neoplasms	C07-C14; C40-C49; C64- D48; C91-C95

VAs-03 Nutritional and endocrine disorders		
VAs-03.01	Severe anaemia	D50-D64
VAs-03.02	Severe malnutrition	E40-E46
VAs-03.03	Diabetes mellitus	E10-E14
VAs-04 Diseases of the circulatory system		
VAs-04.01	Acute cardiac disease[9]	I11.0; I20-I26; I46.1; I46.9; I50.1
VAs-04.02	Stroke	I60-I69
VAs-04.03	Sickle cell with crisis	D57
VAs-04.99	Other and unspecified cardiac disease	I00-I10; I11.9-I15; I27-I46.0; I47-I50.0; I50.9-I52; I70-I99
VAs-05 Respiratory disorders		
VAs-05.01	Chronic obstructive pulmonary disease (COPD)	J40-J44
VAs-05.02	Asthma	J45-J46
VAs-06 Gastrointestinal disorders		
VAs-06.01	Acute abdomen	R10
VAs-06.02	Liver cirrhosis[10]	K70.2; K70.3; K71.7; K74
VAs-07 Renal disorders		
VAs-07.01	Renal failure	N17-N19
VAs-08 Mental and nervous system disorders		
VAs-08.01	Epilepsy	G40-G41

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

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

VAs-09 Pregnancy-, childbirth and puerperium-related disorders		
VAs-09.01	Ectopic pregnancy	O00
VAs-09.02	Abortion-related death	O03-O08
VAs-09.03	Pregnancy-induced hypertension	O10-O16
VAs-09.04	Obstetric haemorrhage	O46; O67; O72
VAs-09.05	Obstructed labour	O63-O66
VAs-09.06	Pregnancy-related sepsis	O75.3; O85
VAs-09.07	Anaemia of pregnancy	O99.0
VAs-09.08	Ruptured uterus	O71.0-O71.1
VAs-09.99	Other and unspecified maternal cause	O01-O02; O20-O45; O47-O62; O68-O70; O71.3-O71.9; O73-O84; O86-O99
VAs-10 Neonatal causes of death		
VAs-10.01	Prematurity or low birth weight	P05; P07
VAs-10.02	Birth asphyxia[11]	P20-P22
VAs-10.03	Neonatal pneumonia	P23-P24
VAs-10.04	Neonatal sepsis	P36
VAs-10.05	Neonatal tetanus	A33
VAs-10.06	Congenital malformation	Q00-Q99
VAs-10.99	Other and unspecified perinatal cause of death	P00-P04; P08-P15; P25-

[11] *Includes: Hypoxia and respiratory distress*

		P35; P37- P94; P96

VAs-11 Stillbirths		
VAs-11.01	Fresh stillbirth	P95
VAs-11.02	Macerated stillbirth	P95
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	[12]
VAs-12.02	Other transport accident	
VAs-12.03	Accidental fall	W00-W19
VAs-12.04	Accidental drowning and submersion	W65-W74
VAs-12.05	Accidental exposure to smoke, fire and flames	X00-X19
VAs-12.06	Contact with venomous animals and plants	X20-X29
VAs-12.07	Accidental poisoning and exposure to noxious substance	X40-X49
VAs-12.08	Intentional self-harm	X60-X84; Y87.0
VAs-12.09	Assault	X85-Y09; Y87.1

[12] *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*

VAs-12.10	Exposure to force of nature	X30-X39
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;
VAs-99	Cause of death unknown	R95-R99

APPENDIX B - LIST OF WORKSHOPS FOR REVISION PROCESS OF THE WHO VA INSTRUMENT

WHO VARG item reduction meeting, Lisbon

- 15-17 August 2019
- Participants: Technical group consisting of the developers of the algorithms and the coordination of the VARG
- Review of item reduction approaches
- Development of protocol

WHO VARG workshop: Response pattern analysis for the revision of the 2016 WHO VA instrument

- 8-9; 15-16 July 2020
- Total of 43 participants: 24 participants from country field teams; 12 VARG members and 7 participants from relevant institutions
- Investigate response patterns for enumerated problematic items and issues with the 2016 WHO VA instrument;
- Determine remaining steps to complete revision of 2016 WHO VA instrument

Training Workshop – Item reduction for the 2016 WHO VA Instrument

- Virtual training by OpenVA team with 4 country teams on the item reduction process, methodologies and item response and importance analysis on October 26, 28, 30, 2020.

WHO VARG workshop: "Revision of the 2016 WHO verbal autopsy instrument – final phase, part 1"

- 23-25 February 2021
- Around 40 participants, including the members of the VARG, collaborators and physicians and medical experts that have experience conducting PCVA with the WHO VA instrument.
- Review and finalization of issues with response pattern analysis using updated "Global 2016 WHO VA dataset"; consensus on solutions for identified issues

WHO VARG workshop: "Revision of the 2016 WHO verbal autopsy instrument – final phase, part 2"

- 3-4 May 2021
- Around 40 participants, including the members of the VARG, collaborators and physicians and medical experts that have experience conducting PCVA with the WHO VA instrument.
- Review and triangulation of the results of the different analysis; and consensus on questions recommended for removal from the WHO VA instrument.

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APPENDIX C – QUESTIONS DROPPED FROM THE 2016 WHO VERBAL AUTOPSY INSTRUMENT

(Id10080) What was the counterpart that was hit during the road traffic accident?
(Id10081) What was her/his role in the road traffic accident?
(Id10108) How many hours before death did the baby stop crying?
(Id10152) Did (s)he have night sweats?
(Id10168) Did (s)he have breathlessness?
(Id10169_a) For how many days did (s)he have breathlessness?
(Id10169_b) [Enter how long (s)he had breathlessness in days]:
(Id10169_c) [Enter how long (s)he had breathlessness in months]:
(Id10169_units) How long did (s)he have breathlessness?
(Id10178) [Enter how long the chest pain lasted in minutes]:
(Id10187) Was there blood in the stool up until death?
(Id10193) Did (s)he have any belly (abdominal) problem?
(Id10210) Did (s)he have a painful neck during the illness that led to death?
(Id10211_a) [Enter how long before death (s)he had a painful neck in days]:
(Id10211_b) [Enter how long before death (s)he had a painful neck in months]:
(Id10211_units) How long before death did (s)he have a painful neck?
(Id10215) Was (s)he unconscious for more than 24 hours before death?
(Id10218) Did the unconsciousness continue until death?
(Id10219) Did (s)he have convulsions?
(Id10221) For how many minutes did the convulsions last?
(Id10225) Did (s)he go to urinate more often than usual?
(Id10228) Did (s)he have sores?

(Id10241) During the illness that led to death, did (s)he bleed from anywhere?
(Id10264) Did (s)he have pain upon swallowing?
(Id10263) Was the difficulty with swallowing with solids, liquids, or both?
(Id10270) Did (s)he drink a lot more water than usual?
(Id10285) How many days old was the baby when it started feeling cold to touch?
(Id10290) Did the baby or infant appear to be healthy and then just die suddenly?
(Id10295) Did she have any ulcers (pits) in the breast?
(Id10297) When she had her period, did she have vaginal bleeding in between menstrual periods?
(Id10298) Was the bleeding excessive?
(Id10307) Did this woman die more than 6 weeks after being pregnant or delivering a baby?
(Id10315) Did she die within 6 weeks of childbirth?
(Id10316) Did she give birth to a live baby (within 6 weeks of her death)?
(Id10318) Was she breastfeeding the child in the days before death?
(Id10326) Was there vaginal bleeding during the first 6 months of pregnancy?
(Id10335) Did she die during an abortion?
(Id10336) Did she die within 6 weeks of having an abortion?
(Id10338) Did she receive professional assistance during the delivery?
(Id10347) Was the baby born more than one month early?
(Id10355) Was the child the first, second, or later in the birth order?
(Id10356) Is the mother still alive?
(Id10357) Did the mother die before, during or after the delivery?
(Id10358_units) How long after the delivery did the mother die?
(Id10358) How many months after the delivery did the mother die?
(Id10359_a) How many weeks after the delivery did the mother die?

(Id10359) How many days after the delivery did the mother die?
(Id10360) Where was the deceased born?
(Id10361) Did you/the mother receive professional assistance during the delivery?
(Id10362) At birth, was the baby of usual size?
(Id10364) At birth, was the baby very much smaller than usual, (weighing under 1 kg)?
(Id10368) Were there any complications in the late part of the pregnancy (defined as the last 3 months, before labour)?
(Id10379_unit) How long before labour did you/the mother last feel the baby move?
(Id10379) [Enter how long before labour did you/the mother last felt the baby move in days]: (maybe the respondent or health worker had examined the mother)
(Id10380) [Enter how long before labour did you/the mother last felt the baby move in hours]: (maybe the respondent or health worker had examined the mother)
(Id10392) How many doses?
(Id10394) How many births, including stillbirths, did the baby's mother have before this baby?
(Id10412) Did (s)he use tobacco?
(Id10415) How many cigarettes did (s)he smoke daily?
(Id10416) How many times did (s)he use tobacco products each day?
(Id10429) Do you have the child's vaccination card?
(Id10430) Can I see the vaccination card (note the vaccines the child received)?
(Id10431) Select EPI vaccines done
(Id10445) Has the deceased s (biological) mother ever been tested for HIV?
(Id10450) In the final days before death, did s/he travel to a hospital or health facility?
(Id10451) Did (s)he use motorised transport to get to the hospital or health facility?
(Id10452) Were there any problems during admission to the hospital or health facility?

(Id10453) Were there any problems with the way (s)he was treated (medical treatment, procedures, interpersonal attitudes, respect, dignity) in the hospital or health facility?
(Id10454) Were there any problems getting medications or diagnostic tests in the hospital or health facility?
(Id10455) Does it take more than 2 hours to get to the nearest hospital or health facility from the deceased's household?
(Id10456) In the final days before death, were there any doubts about whether medical care was needed?
(Id10457) In the final days before death, was traditional medicine used?
(Id10458) In the final days before death, did anyone use a telephone or cell phone to call for help?
(Id10459) Over the course of illness, did the total costs of care and treatment prohibit other household payments?
(Id10428) Did (s)he receive any immunizations?
(Id10427) Was (s)he discharged from hospital very ill?
(id10431_check) It is not possible to select "No vaccines", "Don't know" or "refuse" together with other options. Please go back and correct the selection.
(Id10432) Was care sought outside the home while (s)he had this illness?
(Id10433) Where or from whom did you seek care?
(id10433_check) It is not possible to select "Don't know" or "refuse" together with other options. Please go back and correct the selection.
(Id10434) What was the name and address of any hospital, health center or clinic where care was sought
(Id10437) Do you have any health records that belonged to the deceased?
(Id10438) Can I see the health records?
(Id10439_check) [Is the date of the most recent (last) visit available?]

(Id10439) [Record the date of the most recent (last) visit]
(Id10440_check) [Is the date of the second most recent visit available?]
(Id10440) [Record the date of the second most recent visit]
(Id10441_check) [Is the date of the last note on the health records available?]
(Id10441) [Record the date of the last note on the health records]
(Id10442) [Record the weight (in kilogrammes) written at the most recent (last) visit]
(Id10443) [Record the weight (in kilogrammes) written at the second most recent visit]
(Id10444) [Transcribe the last note on the health records]
(Id10352_units) How old was the child when the fatal illness started?
(Id10339) Who delivered the baby / completed the miscarriage / performed the abortion?
(Id10488) In the two weeks before death, did (s)he travel to an area where COVID-19 is known to be present?
(Id10090) Was (s)he subject to violence (suicide, homicide, abuse)?
(Id10060_check) [Is the date of marriage available?]
(Id10060) What was the date of marriage?
(Id10069) [Is there a need to collect civil registration numbers on the deceased?]

APPENDIX D – QUESTIONS ADDED TO THE WHO VERBAL AUTOPSY INSTRUMENT

(NewId) How long after the injury or accident did s/he die? (response options: less or equal to 7 days/more than 7 days/Dk/Ref)
(NewId) Did s/he vomit every time s/he ate and/or drank?
(NewId) Did swallowing become impossible?
(NewId) Did she faint when she had the sharp abdominal pain?
(Id10329_B) Did she have excessive bleeding during or after abortion or miscarriage?
(Id10322_B) Did she have foul smelling vaginal discharge after delivery or abortion?
(NewId) For how long did (s)he smoke tobacco? (responses in the units of months, years)
(NewId) Did (s)he ever smoke daily?
(NewId) For how long did (s)he chew and/or sniff tobacco? (responses in the units of months, years)
(NewId) Did (s)he ever chew and/or sniff tobacco daily?
Interview language