

# An Overview of WHO Standard Verbal Autopsy Tools and Procedures

WHO Verbal Autopsy Reference Group



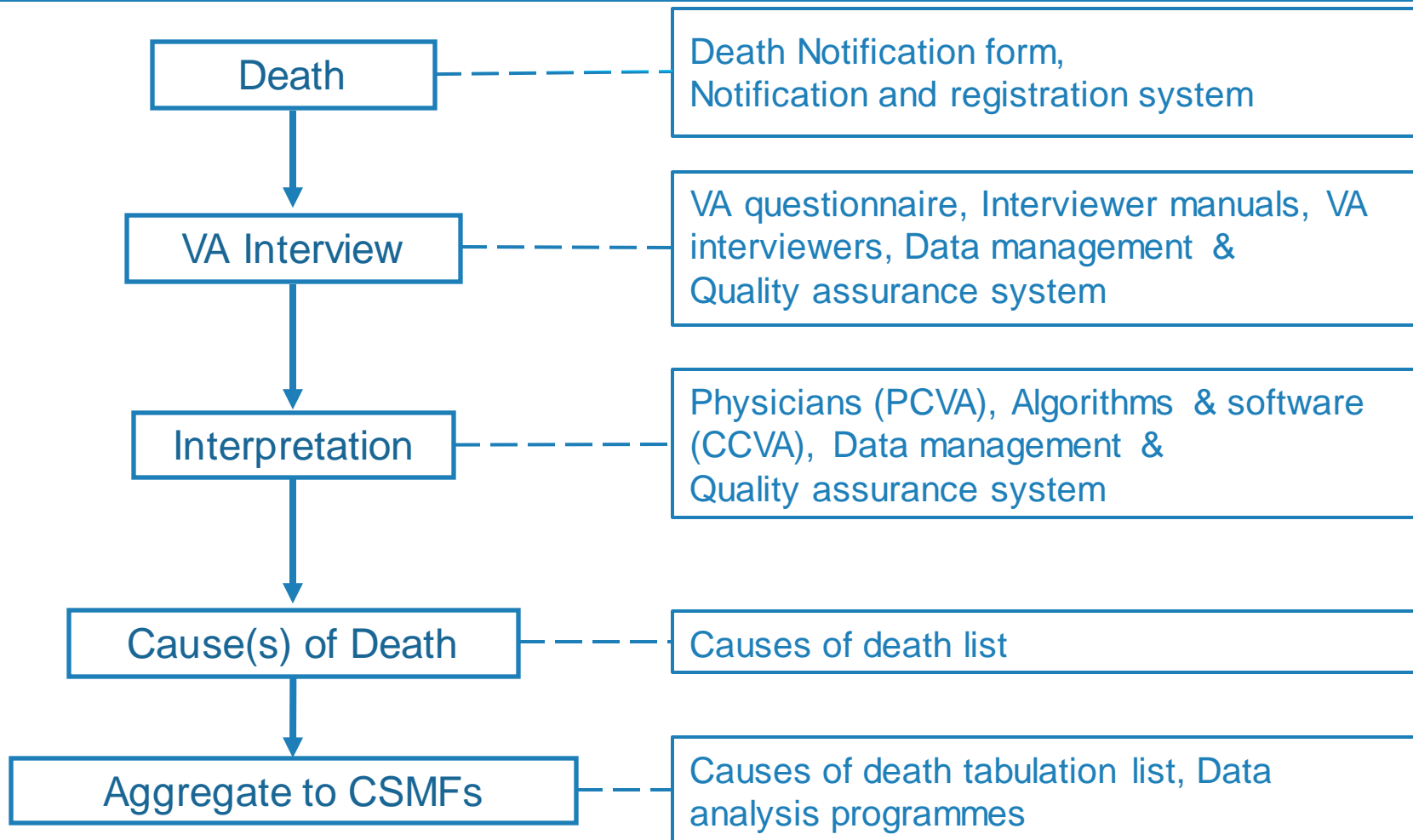
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# Acknowledgments

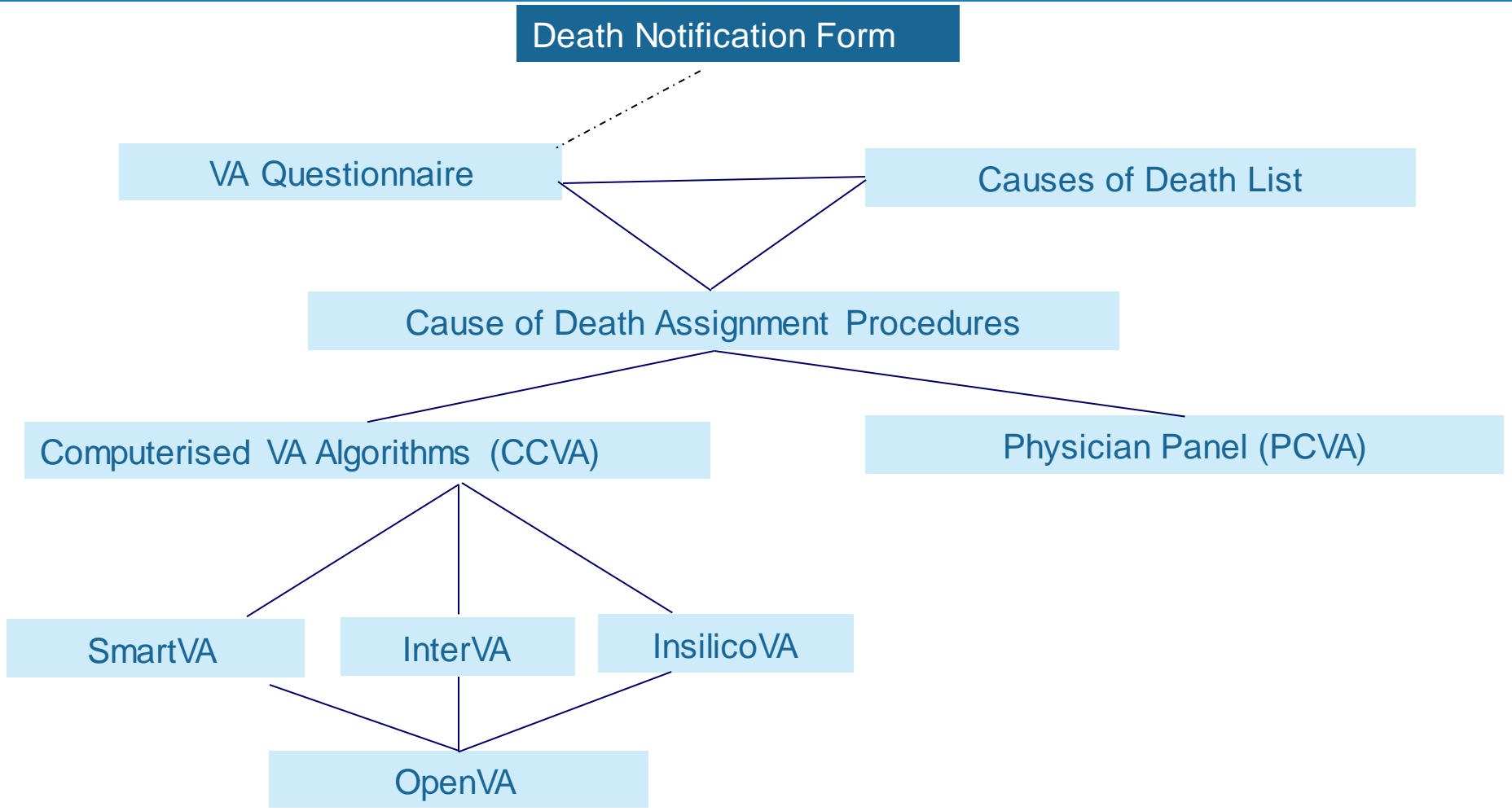
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# Verbal Autopsy System



# Verbal Autopsy Tools

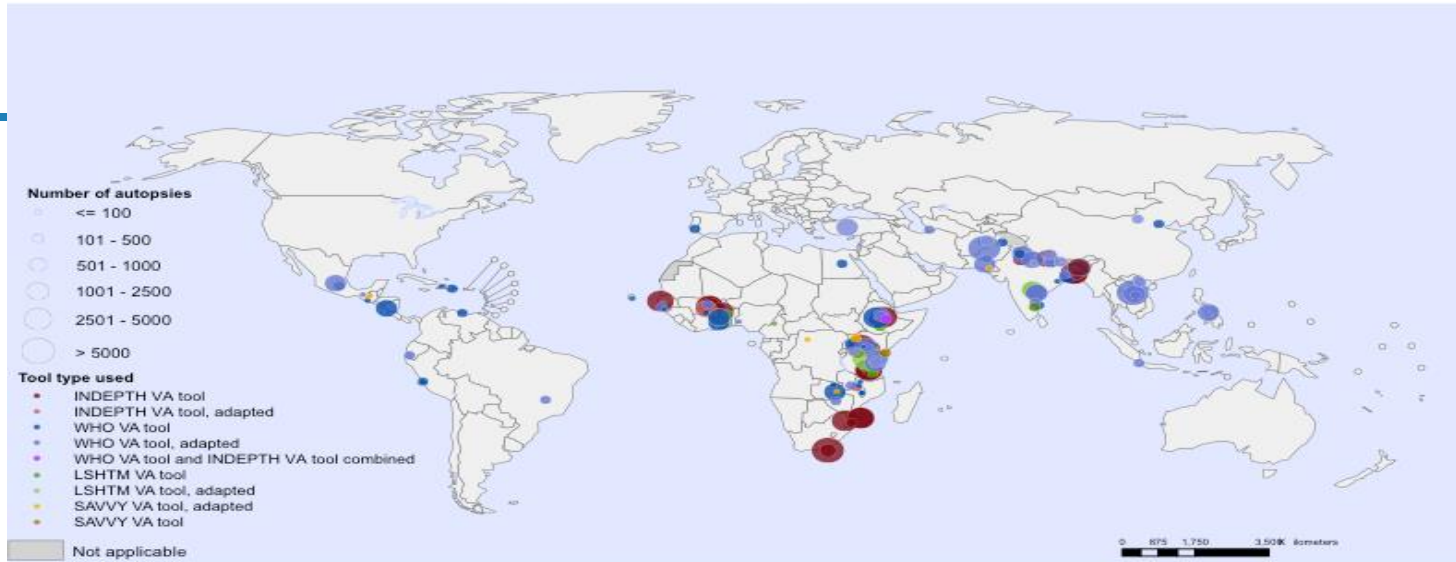


# Verbal Autopsy Tools: Historical Background

- ❖ Since 1930 – maybe earlier since 1600
- ❖ 2004 WHO VA review meeting
  - Variety of VA tools (Questionnaires, CoD list & VA interpretation procedures) - limited comparability between settings and over time
  - ➔ **Need International Standard VA tools**
- ❖ 2007 WHO and HMN standard VA Questionnaire
- ❖ 2012 WHO VA experts and stakeholders meeting
  - ➔ **Simplified VA tools (WHO VA questionnaire and CoD list) for routine use**
- ❖ 2016 WHO VA working group and stakeholders meeting
  - ➔ **2016 WHO VA questionnaire compatible with the existing cause of death assignment software (SmartVA, InterVA & InsilicoVA)**

# Review of VA tools by WHO VA Working Group in 2012

Reviewed verbal autopsy studies by site, size and instrument 1989-2010



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Data Source: World Health Organization  
Map Production: Public Health Information and Geographic Information Systems (GIS)  
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- ❖ 25 studies using VA instruments: WHO, INDEPTH, SAVVY, LSHTM and their adaptations
- ❖ 41 countries: 54.5% in Africa; 40.2% in Asia; 8.9% in Central and South America
- ❖ VA systems: Disease surveillance systems, Demographic surveillance systems, sample registration systems, CRVS, X-sectional surveys, research
- ❖ Uses of VA: Estimating burden of disease, Measuring impact of public health interventions, Outbreak investigations

## Context of the review of VA tools in 2012

- ❖ Recognition of the need for a standard VA tool that is compatible with available software
- ❖ Experience of using WHO 2007 VA questionnaire
- ❖ Need for additional questions for SmartVA
- ❖ Need for simplifying the VA tools for implementing within routine data collection systems like CRVS

# Review of VA tools by WHO VA Working Group in 2016

## Context and rationale of the review

- ❖ Experience in using WHO2012 in several settings
- ❖ Refinement of algorithms used by SmartVA and InterVA
- ❖ Recognition of the need for adding more indicators to maximise the performance of SmartVA
- ❖ Need for shorter VA questionnaire for data collection in routine systems
- ❖ Availability of cognitive test study results

# Criteria for Developing WHO Standard VA Tools

## Short list of causes of death for VA

- ❖ Feasible to ascertain from VA
- ❖ Public health importance
- ❖ VA Causes of death mapped to ICD10 codes

## WHO standard VA questionnaire

- ❖ Relevance of indicators (symptoms/signs/contextual factors) for diagnosing COD included on the short list
- ❖ Feasible to recognise, recollect and report in VA interviews
- ❖ Time efficient (shorter duration of interview)
- ❖ Suitable for electronic data collection and management
- ❖ Compatible with exiting causes of death assignment software (SmartVA, InterVA and InsilicoVA)



# Verbal Autopsy Causes of Death & Corresponding ICD-10 Codes

Verbal autopsy code	Verbal autopsy title	ICD-10 codes (from ICD - 2016)
<b>VAs-01 Infectious and parasitic diseases</b>		
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	A33-A35
VAs-01.09	Pulmonary tuberculosis	A15-A16
VAs-01.10	Pertussis	A37
VAs-01.11	Haemorrhagic fever	A92-A96, A98-A99

# Verbal Autopsy Causes of Death & Corresponding ICD-10 Codes

Verbal autopsy code	Verbal autopsy title	ICD-10 codes (from ICD - 2016)
VAs-01.12	Dengue fever	A97
VAs-01.13	Coronavirus disease (COVID-19)	U07.1; U07.2
VAs-01.99	Unspecified infectious disease	A17-A19; A20-A32; A36; A38; A42-A89; B00-B04; B06-B19; B25-B49; B55-B99

# Sections of the 2016 WHO Verbal Autopsy Questionnaire

## 1. Personal information

1. Age, sex
2. Date and place of death, place of residence, marital status, parents, education, economic activity

## 2. Information on the respondent

## 3. Cause of death related indicators

1. Medical history
2. General signs and symptoms
3. Signs and symptoms associated with pregnancy
4. Neonatal and child history, signs and symptoms
5. History of injuries and accidents
6. Risk factors
7. Health service utilization

## 4. Background and context

## 5. Optional open narrative text field

## 6. Death certification and health record

# Numbers of Indicators by Age Groups

First is the compulsory entry question.

Second, third and fourth are sub-questions need to be asked only if related “first” question is answered as “yes”.

**The table shows the minimum and maximum number of cause related questions (indicators) by age group.**

**Questions for maternal deaths are embedded, starting from age of 12 years.**

**Personal, respondent and context indicators are relevant for VR purposes and they can be modified as required.**

Median time to complete VA interview including general module

<i>Neonatal</i>	~25 mins <sup>1</sup>	19 mins <sup>2</sup>
<i>Child</i>	~25 mins	27 mins
<i>Adult</i>	~25 mins	32 mins

Segment/depth	Neonate	Child	Adult maternal)	(incl.
Presets	3	3	3	
Information on the respondent and background about interview	5	5	5	
Personal (Information on the Deceased)	19	23	24	
Entry Level	12	12	12	
Level 2	7	11	12	
Civil registration numbers	7	7	7	
Entry Level	1	1	1	
Level 2	6	6	6	
Verification of possible stillbirth	13	0	0	
Entry Level	4	0	0	
Level 2	9	0	0	
History of injuries/accidents	22	22	24	
Entry Level	1	1	1	
Level 2	21	21	23	
Health history	160	187	210	
Entry Level	35	27	26	
Level 2	125	160	184	
Background and context	10	10	10	
Entry Level	6	6	6	
Level 2	4	4	4	
Death certificate with cause of death	12	12	12	
Entry Level	1	1	1	
Level 2	11	11	11	
Open narrative	1	1	1	
<b>Grand Total</b>	<b>252</b>	<b>270</b>	<b>296</b>	
<b>Entry Level</b>	<b>60</b>	<b>48</b>	<b>47</b>	

<sup>1</sup> Data for Health Initiative (2016). Strengthening CRVS Systems: Technical guidance for the introduction of verbal autopsy into civil registration and vital statistics systems. Technical Report 2.

<sup>2</sup> Mishra, V. (2017). Verbal Autopsy: Comparative analysis of three verbal autopsy algorithms with the WHO 2016 verbal autopsy questionnaire. MSc. Thesis, SwissTPH, University of Basel.

# Format of 2016 WHO VA Questionnaire

An excel table presents all the questions with skip patterns and other instructions in a format that facilitates implementation in software.

Table of indicators – IT friendly

- ❖ Sections
- ❖ Unique id of questions
- ❖ Definitions
- ❖ Categorization
- ❖ Skip patterns

type	name	label-English	hint-English	relevant
<b>begin group</b>	<b>prevnts</b>	<b>Prevnt HIV/AIDS mortality and season.</b>		
select_one HIGH_LOW_VERY	h10002	(h10002) Is this a region of high HIV/AIDS mortality?	Should be completed by the central office.HIGH corresponds to more than 1% of deaths due to HIV/AIDS, LOW around 0.1%, VERY LOW less than 0.1%	
select_one HIGH_LOW_VERY	h10003	(h10003) Is this a region of high malaria mortality?	Should be completed by the central office.HIGH corresponds to more than 1% of deaths due to malaria, LOW around 0.1%, VERY LOW less than 0.1%	
select_one select_58	h10004	(h10004) During which season did (s)he die?		
<b>end group</b>				
<b>begin group</b>	<b>respondent_high</b>	<b>Respondent high information on the respondent and background about interview.</b>		
text	h10007	(h10007) What is the name of VA respondent?		
select_one select_32	h10008	(h10008) What is your/the respondent's relationship to the deceased?	First verify if the respondent is a family member, and only if it is not a family member choose the other categories like health worker or public off	
select_one YES_NO_REF	h10009	(h10009) Did you/the respondent live with the deceased in the period leading to her/his death?		
text	h10010	(h10010) Name of VA interviewer		
today	h10012	(h10012)		
select_one YES_NO	h10013	(h10013) Did the respondent give consent?		
start	h10011			
<b>end group</b>				
<b>begin group</b>	<b>deceased</b>	<b>Information about the deceased and vital registration.</b>		selected{5}(h10013), 'yes'
<b>begin group</b>	<b>deceased_CRVS</b>	<b>Information about the deceased and vital registration.</b>		
<b>begin group</b>	<b>info_on_deceased</b>	<b>Information on the Deceased</b>		
text	h10017	(h10017) What was the first or given name(s) of the deceased?		
text	h10018	(h10018) of the deceased?		
select_one select_2	h10019	(h10019) What was the sex of the deceased?		
select_one YES_NO_REF	h10020	(h10020) Is the date of birth known?		
date	h10021	(h10021) When was the deceased born?	To select previous years, click or tap the month name, then click or tap the year.	selected{5}(h10020), 'yes'
select_one YES_NO_REF	h10022	(h10022) Is the date of death known?		selected{5}(h10022), 'yes'
date	h10023_a	(h10023_a) When did (s)he die?		selected{5}(h10022), 'yes'
date	h10023_b	(h10023_b) When did (s)he die?		selected{5}(h10022), 'yes'
calculate	h10023_c	(h10023_c) When did (s)he die?		selected{5}(h10022), 'yes'
date	h10024	(h10024) Please indicate the year of death.		selected{5}(h10022), 'no'
calculate	agenDays			
calculate	agenYears			
calculate	agenYearsRemain			
calculate	agenMonths			
calculate	agenMonthsRemain			
calculate	h10024a1			
calculate	h10024a1			
calculate	isAdult1			
note	displayAgeNeonatal	NEONATE was 5(agenDays) days old.	Please verify that the age is correct, before you proceed. You will now be filling in the questionnaire for a NEONATE 5(agenDays) days old.	

Traditional paper questionnaires are ready for printing – if necessary.

Traditional style questionnaire

- ❖ Sections
- ❖ Unique id of questions
- ❖ Skip patterns

Case or national VR ID,  
Interview ID

ID	Question	Answer(s)	Skip To
h10152	(h10152) Did (s)he have night sweats?	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Doesn't know <input type="radio"/> Refused to answer	
h10153	(h10153) Did (s)he have a cough?	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Doesn't know <input type="radio"/> Refused to answer	h10159 h10159 h10159
h10154_1	(h10154_1) For how long did (s)he have a cough? Enter 1 unit only: 0-30 days or 1-60 months. Less than 1 day or 24 hours = 0 days; 1 week = 7 days.	<input type="radio"/> Days <input type="radio"/> Months <input type="radio"/> Doesn't know <input type="radio"/> Refused to answer	h10154_b h10155 h10155
h10154_a	(h10154_a) [Enter how long (s)he had a cough in days]: Enter 0-30 days. Less than 1 day or 24 hours = 0 days; 1 week = 7 days.	<input type="text"/> Days	h10155

# An Example of Electronic 2016 WHO VA Questionnaire



*Images conceded with permission by Peter Byass*



# Application of 2016 WHO VA Tools in CRVS

## Death notification system

### VA system

- ❖ VA CoD list: 63 CoD mapped to ICD-10
- ❖ 2016 WHO VA questionnaire: Personal & vital registration information of the deceased; 270 CoD-related indicators; Background and context; optional open narrative; death certificate data if available

- ❖ Data collection software for generic java-enabled mobile devices
- ❖ ODK version of WHO 2016 VA questionnaire for CRVS
- ❖ VA data quality assurance system

### Data analysis and CoD assignment

Data management & analysis capacity using *InterVA*; *SmartVA*, *InsilicoVA*, *OpenVA*

and  
or

Physician review

### Data storage

Data stored in centralized location (e.g. district level)

Central database at national level

: *Statistical office; Ministry of health; Ministry of justice; Ministry of Interior*

# VA Cause of Death Assignment Methods

## ❖ PCVA

## ❖ CCVA

- SmartVA-n
- InterVA-n
- Insilico-n
- OpenVA



# Components of the CCVA

CCVA	Symptom-CoD probability matrix	Mathematical model
<b>InterVA-n</b>	InterVA-SC probability matrix – clinical opinion of experts plus minimal VA data based adjustments	Bayesian model
<b>SmartVA-n</b>	PHMRC VA of hospital deaths based SC probability matrix plus minimal clinical opinion based adjustments	Tariff
<b>InsilicoVA</b>	InterVA-SC probability matrix and/or PHMRC SC probability matrix and/or community VA based SC probability matrix	Bayes framework with refinements (Bernoulli distribution & Metropolis-within-Gibbs algorithm)

# Performance of CCVA

Accuracy (Chance corrected concordance rate and CSMF accuracy) of CCVA is variable.

## It depends on....

- ❖ Quality of VA data (VA data collection tools, process and context)
- ❖ Number and mix of CoDs
- ❖ Distribution of CSMFs
- ❖ CoD assignment method (CS probability matrix and mathematical models)
- ❖ Source of training set
- ❖ Quality of the reference standard
- ❖ ? Investigators (algorithm developers vs non-developers)

# Performance of Automated CoD Assignment Methods

## ❖ Probability matrix

- Dynamic
- Diverse
- Limited geographic representation
- Biased towards users of hospitals for the final illness that lead to death

## ❖ Mathematical models

- Complex
- Diverse
- ? Black box for end users

# Options of CoD Assignment Now?

## Countries that have experience in using an automated method

- ❖ Continue to use the method already selected and use it consistently
- ❖ Establish a quality assurance system for the VA data
- ❖ Assess the performance of CoD assignment methods periodically
  - Reference standard can be PCVA
  - Plausibility assessment of the CSMF

## Countries yet to select an automated method and using 2016 WHO

- ❖ Select any method based on the local expertise and support
- ❖ Primary purpose of the cause specific mortality data

# CRVS-VA Features Comparison: Community Automated VA Options for CRVS Systems

Feature	Smart VA	WHO
<b>Questionnaire</b>	<b>PHMRC Shortened</b>	<b>WHO VA 2016</b>
<b>Modules:</b> General info / demographics Neonatal Child Adult Health service use before death Health care treatment & experience before death Open narrative check list Open narrative text Questions on civil registration of death UNSD set compliance for CRVS questions	Yes Yes Yes Yes Yes No Yes No Yes Yes Yes	Yes Yes <sup>1</sup> Yes <sup>2</sup> Yes <sup>3</sup> Yes Yes Yes Yes Yes Yes Yes
<b>Number of Indicators</b> General, identification and context indicators Neonate mortality indicators Child mortality indicators Adult mortality indicators	Approx. 30 91 99 152	Approx. 44 122 161 184
<b>Median time to complete VA interview including general module</b> Neonatal Child Adult	~25 mins ~25 mins ~25 mins	19 mins 27 mins 32 mins
<b>Versions</b> Paper version ODK Tablet version	Yes Yes	Yes Yes
Country applications as of September 2017	13 countries	21 countries

# CRVS-VA Features Comparison: Community Automated VA Options for CRVS Systems

Analytics	On PHMRC Shortened	On WHO VA 2016
Questionnaire mapped to cause lists: WHO ICD-10 Global Burden of Disease	Yes (47 codes) Yes	Yes (72 codes) Yes
Diagnostic algorithms available Tariff 2.0 InterVA5 InSilicoVA openVA analytic platform to run multiple algorithms	Yes Yes No No	Yes Yes Yes Yes
Validation of algorithm against PHMRC gold standard Tariff 2.0 InterVA4 InSilicoVA	Yes n/a n/a	Yes <sup>9</sup> Yes <sup>11</sup> Yes
Number of Indicators used by algorithm Tariff 2.0 InterVA5 InSilicoVA	211 n/a n/a	211 304 304
Number of target causes Stillbirths Neonatal Maternal Communicable Non-communicable External	32 causes 1 cause <sup>14</sup> 6 causes 1 cause 12 causes 19 causes 9 causes	64 causes 2 causes 7 causes 12 causes 17 causes 22 causes 11 causes
Batched analytics	Yes	Yes
UN Statistics compliance Tariff 2.0 InterVA5 InSilicoVA	No n/a n/a	No <sup>18</sup> Yes Yes
Computing platform compatibility	Windows only	All platforms (Windows, Mac OS X, Linux)

# CRVS-VA Features Comparison: Community Automated VA Options for CRVS Systems

Additional specific features of diagnostic algorithms	SmartVA Tariff	InterVA5	InSilicoVA
<i>Exact implementation/replication in openVA<sup>1</sup></i>	No	Yes	Yes
<i>Implementation without training dataset</i>	No	Yes	Yes
<i>Implementation with shortened instrument</i>	Yes	Yes	Anticipated <sup>2</sup>
<i>Can produce instantaneous results for a single death</i>	Yes	Yes	Yes <sup>3</sup>
<i>Only significant symptoms are used at individual level</i>	Yes	No	Anticipated <sup>4</sup>
<i>Accounts for absence of symptoms</i>	No	No	Yes
<i>Accounts for missing symptoms</i>	No	No	Yes
<i>Provides distribution of probabilities for each cause for a single death</i>	No	No	Yes
<i>Provides measure of uncertainty for individual cause assignments</i>	No	No	Yes
<i>Direct estimation of cause-specific mortality fractions</i>	No	No	Yes
<i>Provides a distribution of probabilities for each CSMF</i>	No	No	Yes
<i>Provides uncertainty measure for cause-specific mortality fractions</i>	No	No	Yes

<sup>1</sup> Source: Samuel J. Clark, openVA development team. [www.openva.net](http://www.openva.net).

<sup>2</sup> This will be done; testing and planned release 2018.

<sup>3</sup> There are multiple ways that this can be done with InSilicoVA; work in progress to provide a standard approach; planned release 2018.

<sup>4</sup> Work in progress to allow InSilicoVA to use same 'significant' symptoms identified for use by SmartVA, and additionally, a new set of 'significant' symptoms drawn from the entire WHO 2016 instrument and identified by InSilicoVA, planned release 2018.

n/a = not applicable

Version 2.5 September 29, 2017

# Next steps...

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- ❖ Refine WHO 2016 VA instrument
- ❖ Harmonisation of VA CoD assignment methods
- ❖ VA repository