



MANUAL FOR CAUSE OF DEATH ASSIGNMENT

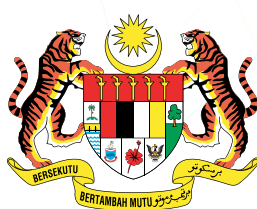
VERIFICATION OF NON - MEDICALLY CERTIFIED DEATH DATA

This manual is adopted from the Manual for Cause of Death Assignment used in “Study on Determination of Cause of Deaths in Malaysia” conducted by the Public Health Institute, Ministry of Health Malaysia: NMRR-13-136-18689 (IIR).

For the implementation of Verification of Non-Medically Certified Death as a system in Malaysia, verbal autopsy method as prescribed by the WHO is used.

This manual is intended to be a guidebook for physicians who are nominated to certify causes of death and to provide them with a broad overview of the principles of selection and coding of the underlying cause of death.

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

- Explain the trends and differentials in overall mortality
- Decide priorities for allocation of resources to and within the health sector
- Decide priorities for intervention programs
- Monitor public health programs
- Decide priorities for biomedical and sociomedical research
- Provide clues for epidemiological research

Mortality statistics, as compared to morbidity, are advantageous for these purposes, as they can be collected efficiently on a routine basis through vital registration systems. Also, statistical analysis of mortality data is facilitated by the fact that death is a unique, clearly defined and final event, resulting in one count per individual as compared to episodes of morbidity. Hence collection and analysis of mortality data at the population / national level is more feasible and elegant. From an epidemiological perspective though, it is important to understand that mortality informs about health status based on past exposures and experiences, while morbidity data informs of what the health situation is at the current time and portends for the future. A complete health information system would include both types of data.

Data on causes of death is collected most efficiently through vital registration systems, in which every death is legally required to be registered, along with a medical opinion as to cause. Complete vital registration systems require vast resources both in terms of financial inputs as well as trained manpower. A viable alternative lies in conducting efficient mortality registration in a sample of nationally representative population clusters, which has been demonstrated to provide reliable information on levels and trends in overall mortality in a population. However, the absence of medical attention at death hinders authentic certification as to cause.

To fill the existing data gap, verbal autopsy methods hold much promise as an interim measure till vital registration systems are built up to full efficiency. These methods have been developed to ascertain the cause of death when the event occurs at home, in the absence of medical attention. By definition, verbal autopsy is an interview with relatives of the deceased, to obtain information on the symptoms and events during the illness leading to death. This is followed by a review of the collected information preferably by a medical practitioner, leading to the assignment of a cause of death using standard diagnostic guidelines for specific conditions, combined with clinical judgment.

The accuracy of cause of death ascertainment by this method is highly dependent on the verbal autopsy tool, quality of the interview, and procedures used to assign causes of death. The quality of the interview alone can be affected by a range of factors related to interviewer, respondent, or both. The method has been proved to work reasonably for ascertaining causes of death in infancy, or due to specific conditions such as injuries or maternal causes. However, medical causes of adult deaths are not so straightforward, when based solely on symptom description by relatives. This is because a number of such causes have common symptom complexes, and it is sometimes difficult to distinguish between different causes of death from such descriptions.

In recent times, it has been observed that the family of the deceased in some instances does possess some medical evidence on the illness preceding death, either verbal or documentary, based on visits to health facilities prior to death. For adult deaths, such information can include vital details, especially about non communicable diseases such as cancers, diabetes, cardiovascular conditions among others. This has enhanced the scope and applicability of the verbal autopsy interview, by seeking and collecting such information in addition to that on symptoms and events.

Pilot studies in Tanzania, China, India, Indonesia and Viet Nam have successfully tested a combination of demographic and mortality surveillance using verbal autopsy in a representative sample of population clusters, leading to the development of a framework for 5

measuring population level cause-specific mortality using verbal autopsy methods. Chapter 2 describes the principles and applications of verbal autopsy methods, largely focusing on the technical aspects of the nature of interviews and design of questionnaires.

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

- Sequential stages in the natural history of one disease
- Complications arising from one of the intermediate conditions
- Different diseases existing simultaneously at the time of death.

To overcome this problem, the WHO recommends the use of a standard ‘Medical Certificate of Cause of Death’, which enables the recording of several causes. The definitions, concepts and guidelines regarding the certification of causes of death are discussed in detail in Chapter 3, which includes a description of the duties and responsibilities of certifying medical practitioners in filling in the certificate.

From an analytical perspective however, the WHO also developed the concept of the underlying cause of death, to enable uniform statistical presentation and interpretation for international comparison. WHO recommends that all primary tabulations on causes of death should be based on the underlying cause of death. Therefore, a complete understanding of the concepts of underlying cause of death is critical for personnel responsible for coding causes of death according to the principles of the International Classification of Diseases (ICD). The usability of aggregated cause specific mortality statistics is significantly influenced by the accuracy of cause of death assignment and coding at the individual level, and Chapter 4 provides details on these aspects. Certain specific principles related to statistical tabulations are described in Chapter 5, and this includes a brief description of a ‘short’ list of causes that are amenable to identification using verbal autopsy methods, for most of which specific diagnostic guidelines are provided in Chapter 6. The last chapter in this manual – Chapter 7 - provides a broad training curriculum for medical practitioners in the certification of cause of death, as well as for staff responsible for ICD coding and statistical tabulation of data.

This manual is intended to be a guidebook for physicians who are nominated to certify causes of death from verbal autopsy data, as well as provide them with a broad overview of the principles of selection and coding of the underlying cause of death, as prescribed by the WHO. Overall, a cadre of well-trained specialist ICD coders would best serve the implementation of verbal autopsy and medical death certification, which too would benefit from this manual, in terms of understanding the manner in which causes of death are ascertained from information gathered through household interviews, and how these are listed on the cause of death certificate. A close collaboration and feedback system between physician certifiers and ICD coders would have a beneficial effect on the final quality of the cause of death data that will emanate from a national mortality and cause of death reporting system. While specialist coder teams are being developed within countries, it is acceptable for physicians trained in cause of death certification to also conduct the coding function as an interim solution, if necessary. The implementation of well-designed training programs attended by both physician certifiers and ICD coders, and which covers this manual in detail, would facilitate the development of an efficient national mortality statistics system.

Since many deaths in the sampled population occur at home in the absence of medical attention, the practice of verbal autopsy methods has been adopted to obtain the best evidence available to identify the probable cause of death for such cases. By original definition, verbal autopsy involves an interview of the relatives of the deceased to elicit details of symptoms, signs, clinical events/circumstances during the illness preceding death, and an evaluation of the collected information by physician reviewers, to reason out a probable cause of death.

Cause of death ascertainment using verbal autopsy was principally developed to provide information where there was very limited access to health care, and in communities with low educational status, and is based on two key assumptions:

- The symptom complex for each disease of interest is unique such as neonatal tetanus or motor vehicle accidents
- Family members can accurately recall symptoms and their timing

These assumptions have been successfully validated for causes of infant deaths and a few clearly demarcated causes of adult deaths such as injuries and pregnancy related deaths. Certain common causes of adult mortality could be easy to recognize by the community, based upon their cardinal symptoms e.g. cerebrovascular disease causing one-sided paralysis, chronic breathlessness and cough in COPD. However, other common communicable (tuberculosis, malaria, HIV) and non-communicable diseases (cancers, diabetes, renal, digestive tract disorders etc) have overlapping symptomatology, which makes it difficult to clearly distinguish one from another even for clinical diagnosis, let aside verbal autopsy. Also, as described earlier, there could be multiple illnesses or conditions in an individual, either sequentially or simultaneously. This is particularly so in the case of adult deaths. All the same, it is now recognized that while many adult deaths still occur at home or outside registered clinical facilities, the deceased could have accessed some health care in the period preceding death. For these reasons, the VA interview includes the collection of relevant health facility access and health care data from the family of the deceased. This could include details from available medical documents, or any opinion on the illness conveyed to the family by the consulted

health professional. If possible, the health facility could be contacted to obtain more detailed information, if provided consent for this is obtained from family members.

Characteristics of VA Forms

VA forms are used to report deaths and collect information on the history of illness, symptoms, and signs preceding death. Broadly speaking, there are different forms for deaths in different age groups; one set to capture data on perinatal, infant and childhood deaths; and another set to capture data for adult deaths.

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

General Structure of VA Forms

VA forms are divided into several sections. The general structure of all the three forms includes:

- Identifying information about the deceased (such as age, sex, and place of death)
- An initial brief description (as told by the respondent) of the illness suffered by the deceased
- A series of structured questions on specific symptoms, with their duration as applicable
- Details of past medical illness
- Summary of medical evidence available at the household, including evidence from laboratory test reports, prescriptions, and other medical documents
- Health services used by the deceased during illness in a period before death
- Information conveyed by a health professional to the respondent / family as to the cause of death

In addition to the general questions, each form contains sections and questions that are specific to the circumstances of the death. For example, a section on the condition of a deceased child's mother during and after pregnancy; events during birth and immunization history is included only on the forms for perinatal and infant deaths. A checklist of symptoms and their duration specific to women aged 13 years and older, and those specific to women of childbearing ages (13-49 years of age) are included in the adult VA form; which also includes a section for injuries. Sections on risk factors are also in the adult form, collecting data on socio-economic

status, tobacco and alcohol use; and where possible, obesity, and other cardiovascular risk factors.

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

A verbal autopsy situation relates to a clinical event that has occurred at a time much prior to the interview, and the respondent is not the one who experienced the symptoms / illness, but one who observed the symptoms / signs in the deceased. This fundamental difference between the two results in the somewhat 'lay' design of the symptom duration checklist, in terms of use of terminology, and level of clinical detail sought. Medical practitioners would like to review information similar to a clinical history record, which include questions on specific details and characteristics of individual symptoms – e.g. number of diarrhoeal episodes per day, consistency, colour, odour of faeces, vomiting episodes, specific symptoms and signs of circulatory failure. They consider these questions important to verify the diagnosis, since their treatment plans hinge on such verification of the diagnosis. However, these are not feasible in the verbal autopsy setting, where respondents can be expected to remember only some major symptoms or grossly visible signs e.g. presence of diarrhoea, and presence of blood, and a reasonable estimate of the duration. Table 1 highlights some conceptual differences between design characteristics of a clinical history and a verbal autopsy interview, and it is useful for medical practitioners involved in VA studies to consider these aspects, while evaluating information from verbal autopsies to identify probable causes of death. More details of the actual process of cause of death certification from verbal autopsies are provided in later chapters.

Table 1: Differences between clinical histories and verbal autopsies

Design characteristic	Patient history	Verbal autopsy
Motive	Preliminary step in search for exact diagnosis to plan treatment	Retrospective questioning to identify underlying cause of death with reasonable certainty
Respondent	Patient in person	Relative, who should not be expected to remember anything more than gross details
Procedure	Interview followed by physical examination, and possibly investigations etc	One-off interview, no follow up
Recall period	Generally a few days, since onset of symptoms	Weeks / months
Interviewer	Physicians / assistants whose notes are reviewed by examining physicians	Mostly non physician interviewers
Instrument	Narrative written after completing interview, and composing thoughts, requires much training and practice to become skilled	Short narrative to start the interview, followed by a structured questionnaire, including health facility visits
Disease classification	Any possible disease	Search for a limited number of causes, which <ul style="list-style-type: none">– are important causes of death in the population– are characterized by symptoms easily recognized by the community– can be uniquely identified from these symptoms

Given this background, verbal autopsy can at best be considered an imperfect method to arrive at a probable cause of death, applicable only in situations where there is no reliable data on cause specific mortality, in the form of medical opinion on cause of death. Although basic forms of verbal autopsy have been in operation since the past 4-5 decades, interest in verbal autopsies has increased in recent times as a practical and cost-effective method to obtain data of public health importance. Despite its limitations, the usefulness and applicability of VA has broadened in recent times, and can sometimes generate better data than simple VR systems, in terms of details on associated population characteristics – risk factor profiles, coverage of interventions, access to health care facilities, health care seeking behaviour, etc, which can be used for health system analysis, planning and policy.

As mentioned earlier, the VA questionnaire records several types of information related to the cause of death, in addition to the symptom duration checklist. It is likely that each completed verbal autopsy instrument would contain information from at least some, if not all these diverse sources. However, this depends on the quality of interviews conducted, and VA interviewers play an important role in this respect. Since the completed questionnaires are to be reviewed by medical practitioners who will have to use the recorded information to certify the cause of death, high quality data collection on the questionnaire is important. There are prescribed standards for the selection of verbal autopsy interviewers, and also for the conduct specialized training programs for them. Further, the program has developed specific manuals to assist field work, and provides field support through on-site supervision and training by experienced personnel. Despite this, there may be some shortcomings in the data collection. In this regard, physician reviewers have an important role to play in identifying any key problems in the data collection that makes ascertainment of cause of death difficult, and providing this as feedback to the field interviewers. To assist this process, it would be useful if medical practitioners familiarize themselves with the field interviewer's manuals and training programs. Also, their participation feedback sessions during field interviewer refresher training sessions conducted periodically will improve the quality of data collection over time.

Several other issues could also influence the quality of data collection and processing. Important factors in the respondent include age, sex, educational status, relationship to the deceased, and presence within the household during the illness or at the time of death. In general, the mother is considered the most appropriate respondent for child deaths, the sister for maternal deaths, and spouse for adult deaths. Interviewers are also trained in selection of

the most appropriate respondent for the interview, and certain details of the respondent are also available from the questionnaire. However, the medical reviewer has to take these into account along with all the other information collected on the questionnaire. Recall periods could influence the responses to the symptom duration checklist, as well as possible information regarding visits to health facilities or information conveyed by health professionals. The recommended recall periods range from about two weeks till about six months. Finally, standardized protocols for certifying and coding causes of death, and tabulating statistics are also critical in the development of mortality measures that are comparable between populations and across time. It is important for medical practitioners tasked to certify causes of death from VA questionnaires to be cognizant of these aspects, and take them into account as necessary.

In conclusion, it can be said that Verbal autopsy is an imperfect method to obtain information on causes of death. Despite its limitations, it can serve as an interim measure to derive such information, until adequate health care systems are set up to provide wider coverage of medical attention, leading to availability of expert opinion on the cause of death as part of vital registration.

Causes of death have been defined as all those diseases, morbid conditions or injuries that either resulted in or contributed to death and the circumstances of the accident or violence that produced any such injuries. A death often results from the combined effect of two or more conditions. These conditions may be completely unrelated but present simultaneously; or they may be causally related to each other in a patho-physiological sequence. Where there is a sequence, it is important to ascertain the underlying cause of death (defined below), which is the cause that is selected for the purpose tabulation.

The underlying cause of death is defined as

- The disease or injury which initiated the train of events leading directly to death

OR

- The circumstances of the accident or violence which produced the fatal injury

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

Example 1:

Massive upper gastro intestinal haemorrhage

caused by

Bleeding esophageal varices

caused by

Cirrhosis of the liver

caused by

Chronic Hepatitis B infection

It is evident from this case that Chronic Hepatitis B infection initiated the chain of events that resulted in the upper gastrointestinal haemorrhage and death, and hence Chronic Hepatitis B infection is selected as the underlying cause.

Example 2: Aspiration bronchopneumonia

due to (or as a consequence of)

Prolonged coma

due to (or as a consequence of)

Cerebrovascular infarction

Cerebrovascular infarction is adjudged as the underlying cause.

Example 3: Pulmonary embolism

due to

Pathological fracture of femur

due to

Secondary carcinoma of femur

due to

Carcinoma of breast

Carcinoma of breast is adjudged as the underlying cause

Example 4:

Cerebral haemorrhage

due to

Hypertension

due to

Chronic pyelonephritis

due to

Prostatic adenoma

Prostatic adenoma is adjudged as the underlying cause

Example 5:

Traumatic shock

due to

Multiple fractures of lower limbs and hip

due to

Pedestrian hit by truck (traffic accident)

Pedestrian hit by truck is adjudged as the underlying cause

In each of the above examples, there is a clear sequence of events that can be constructed from detailed information available in most situations of hospital deaths or those occurring with medical attention. Similar detail of information is not available from VA interviews. In many instances, **only one cause** can be identified from the history and symptom duration checklist. In that case, only the identified cause needs to be listed on the certificate. Where more than one cause is identified, they should be listed in such a pathophysiological sequence of events, on the standard death certificate in Figure 1. In case there are causes present which do not fall directly in the pathophysiological sequence, they are to be listed in Part II of the certificate.

Cause of death		Approximate interval between onset and death
I		
Disease or condition directly leading to death*	(a)..... due to (or as a consequence of)
<i>Antecedent causes</i>		
Morbid conditions, if any, giving rise to the above	(b)..... due to (or as a consequence of)
cause, stating the underlying condition last	(c)..... due to (or as a consequence of)
	(d).....
II		
Other significant conditions contributing to the death, but not related to the disease or condition causing it
*This does not mean the mode of dying e.g. heart failure, respiratory failure. It means the disease, injury, or complication that caused death.		

Where there is a clear cut sequence of events on the certificate, the cause of death listed on the lowermost line of the sequence in part 1, which initiated the train of events leading to death is defined as the **underlying cause of death**.

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

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

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

Guidelines for physician cause of death certification from VA

Reliability and validity of cause of death assignment from verbal autopsy data are the key elements in determining their usefulness. Previous experience has proved that physician review of completed VA instruments is the preferred method for cause of death assignment. However, a standard approach to assigning causes of death is essential, which can be achieved through adequate training on cause of death certification and verbal autopsy review, to reduce inter observer variation. Also, the use of standard disease / condition specific diagnostic guidelines will increase reliability and reduce inter observer bias.

Chapter 7 provides a set of standard disease descriptions and criteria for some of the common causes of deaths, based on previous epidemiological observations and experience. It is probably important to rely on presence of key words or cardinal symptoms of the disease (e.g. sudden onset chest pain for diagnosing myocardial infarction, recurrent bouts of cough with breathlessness for COPD), as well as associated symptoms (e.g. radiation of pain, associated sweating etc for MI, clinical features of cor pulmonale for COPD), as is usually done while making a clinical diagnosis. This is mentioned because from past experience, relatives may not be able to recall minute details, especially when they are mostly subjective in nature.

It is very important that reviewers use these descriptions and criteria as general guidelines and for reference, and to apply clinical diagnostic knowledge and skills to judge whether the information from individual verbal autopsies is sufficient to assign a specific condition as a probable cause of death. It may also be noted here that you are expected to provide an opinion on the cause to the best of your knowledge and belief, based on the information available to you, and with the assurance that these data are collected purely for the purpose of generating health statistics for policy formulation and program evaluation, and not for any legal purposes.

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

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

related to the sequence of events causing death should be listed in part II as a contributory cause.

Special features of non communicable diseases

Multiple causes of death have special relevance in the case of adult deaths from chronic diseases. From one aspect, it is possible that the one underlying cause of death e.g. cerebrovascular disease could pass through different pathophysiological sequences of events to terminate in bronchopneumonia, infected bed sores, or urinary tract infection as the immediate cause of death. Similarly, bronchopneumonia could be an immediate cause of death secondary to cerebrovascular disease, several cancers, or COPD, among other underlying causes of death. Hence, the sequence of events would have to be determined on a case by case evaluation of available information.

Also, non-communicable diseases can have symptoms and signs that may or may not be organ / system specific, as illustrated in the following examples:

- Diabetes can manifest as renal failure, peripheral vascular disease, skin infections, or ketoacidosis and coma
- Cancers may present only at the time of metastases, with symptoms and signs related to an organ (liver, lung) which is not the primary site
- Pathology in individual intra abdominal organs present with similar symptoms and signs, and cannot be differentiated based on clinical observations alone.

To further compound the issue, non communicable diseases commonly terminate in an infectious disease complication (pneumonia, urinary tract infection, septicaemia, etc), that serves as the immediate cause of death. Therefore, the identification of such infectious causes, especially among adults, should stimulate a careful examination of the data from the questionnaire to identify any possible non communicable underlying causes of death. Finally, due to the long standing nature of non communicable diseases, individuals may have a history of visiting multiple health care facilities, with varying accounts of diagnostic / treatment services provided, and this could also complicate certification of the cause of death.

Hence, it is important to take into account the response to each symptom along with its duration, while constructing the sequence of events, and also taking into account details about past history, previous hospitalizations, or information conveyed by health professionals.

Childhood infectious diseases

Acute febrile illnesses among children pose a particular problem with reference to identifying a specific disease as the underlying cause of death, because of the common presence of multiple conditions at the time of death. Also, the relatively short interval between onset of symptoms and passage into a stage of severity marked by lethargy, drowsiness and even unconsciousness compounds the problem of trying to identify which symptom appeared first, which could be a pointer to the underlying cause. For instance, children with either malaria or measles are prone to develop pneumonia at some stage in their illness. Similarly, meningitis could be confused with malaria, and convulsions could be a common symptom in both, and meningitis could also be preceded by pneumonia.

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

Given all these uncertainties in identifying specific underlying causes, reviewers could exercise judgment in applying these diagnostic guidelines, and certify multiple causes on the death certificate, noting their choice of the underlying cause on the lowermost line on Part I of the death certificate. On Part II, it is important to note the presence of malnutrition or

anemia, as significant contributory conditions co existing with any of the above infectious diseases.

Infectious diseases in adulthood

HIV/AIDS is a condition that required careful attention, both for inclusion as well as exclusion as an underlying cause of death. Of course, the availability of serological evidence on HIV status is definitely sufficient for labelling it as the underlying cause, but care should be taken to identify any specific coexisting infections (TB, fungal infections, diarrhoea, or opportunistic pneumonia), which should be listed as the immediate cause of death.

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

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

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

of treatment and relapses, with terminal respiratory symptoms could guide clinical judgment of TB.

Maternal causes of death

Death of a woman in the reproductive age group (approximately 12 to 50 years) should prompt a detailed investigation into whether or not it was associated with pregnancy, or within at least six weeks of childbirth (some definitions extend this period to one year after delivery). To ascertain this accurately, previous experience suggests that the respondent for the VA interview should be a female relative of the deceased, and wherever possible, a sister. The VA questionnaire has relatively straightforward questions in the 'maternal' module to identify pregnancy status, and conditions such as ante / post partum haemorrhage, obstructed labour, and abortion. To identify eclampsia and other hypertensive disorders of pregnancy, the reviewer would have to integrate responses to the 'maternal' module with responses to other items in the questionnaire such as history of hypertension, presence of ankle swelling, and presence and nature of convulsions. Similarly, a diagnosis of puerperal sepsis would need positive responses to questions on fever, foul vaginal discharge, and lower abdominal pain, located in other sections of the questionnaire. Finally, occurrence of other medical conditions (e.g. hepatitis, rheumatic heart disease, malaria, diabetes etc) while the deceased is pregnant requires their mention on the death certificate, which will lead to their coding as indirect maternal causes of death.

Stillbirths and perinatal causes of death

Distinguishing between a live and still birth is crucial to accurately measure early age mortality e.g. such as perinatal, neonatal and infant mortality rates. In verbal autopsy settings, identifying signs of life at birth is riddled with difficulties, largely stemming from the occurrence of birth without skilled attendance. While a gold standard assessment of life at birth would be based on an Apgar score measured by a trained clinician, the best a VA could use to differentiate live from stillbirths would be the observation by the mother or birth attendant of a cry, or breathing, or voluntary muscle movement at birth. Other signs such as presence of heartbeat, or umbilical cord pulsation are too technical for traditional birth attendants to observe, record and finally report the same to the bereaved mother. Also, the mother (the most likely respondent for such events) who would in all probability be too exhausted at the end of labour to notice such minute details, and would rely on what is conveyed to her by those present at childbirth. Finally, in many societies, deaths occurring within a few hours of birth are conveniently dismissed from

memory, and at best are reported as stillbirths, to avoid any legal implications of registration, and also mental stress to the mother. Given these realities, the questionnaire includes an item on the mother's appreciation of fetal movement prior to labour, a specific question on breathing at birth, followed by a general question on life at birth (which takes into account the cry, muscle movement and skin colour at birth).

Interviewer training programs stress on the need for careful investigation and recording of responses to these questions. Similar attention is required from physician reviewers in interpreting these responses and distinguishing to the best extent possible live from still births. To assist such interpretation, specific validation studies are being conducted, to assess the predictive values of responses to each of these specific questions in arriving at the correct diagnoses in this dimension. The results of these validation studies, and any recommended changes to the question items will be incorporated into future training sessions for field interviewer and physician reviewers. These individual diagnoses will be used to develop measures of stillbirth, perinatal, neonatal and infant mortality rates, as these are critical indicators to develop health policy and monitor the impact of interventions to improve maternal and child health.

For those live births that do not survive the first week of life, the duration of gestation and weight or size at birth are important to assess the cause of death. The questionnaire contains several items to identify the common causes of neonatal death, details of which are provided in Chapter 7. The WHO prescribes a detailed special certificate for recording the causes of perinatal death, which includes information regarding the mother's obstetric history and clinical conditions of the current pregnancy, circumstances of the delivery, and the diseases / conditions in the child. However, for diagnoses from verbal autopsy, the standard medical cause of death certificate for all ages is recommended. In this regard, as per current convention, the condition of 'low birth weight' is to be listed as a 'contributory' cause, with the direct pathological condition (sepsis, trauma, asphyxia, etc) listed in Part I of the certificate.

Injuries

Intuitively, external causes of death should be readily identified in verbal autopsy settings, given the relatively straightforward circumstances and events of the injury or violence resulting in death. However, in the absence of an adequate medico-legal system that requires accurate identification and registration of these details, a range of sociological factors come into play

that could mask the true cause of death in many cases. While these may not be that significant for transport accidents or falls, they could be so in the case of suicides, cases of assault, and poisoning.

Even in the former, while the event may be obvious (traffic accident), it is important to record the actual circumstances on the death certificate (motor cycle rider hit by car OR pedestrian hit by tram etc), as this would permit detailed coding of the underlying cause according to the ICD (see chapter 5 and 6). The VA questionnaire permits the recording of these details in the open narrative section, and interviewers have been trained to do so accordingly. Similar details are required for all external causes of death. Physician reviewers could play an important role in providing feedback into the quality of recording details relevant to external causes.

Guidelines for cause of death certification

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

- Carefully screen all modules of the completed instrument for relevant information
- Make a separate record of all the positive evidence
- Use clinical judgment and diagnostic guidelines (Appendix A) to identify specific causes of death
- In some instances, the absence of a particular symptom / sign etc might be indicative or helpful in judging cause
- In general, **precedence should be given to available medical opinion** on the cause of illness / death, **if it can be corroborated** with the details of symptoms and events described by the relatives
- Place identified clinical conditions / events into chronological and pathophysiological sequence.
- Do not imagine the sequential events which are not documented in VA forms. Keep yourself adhered to the words/sentences/facts provided in the VA forms only.
- After assessing all the available information, the reviewer can attempt to record the identified sequence of causes as immediate, antecedent, underlying, and contributory causes, in the form of a standard death certificate described above.

Common Do's and Don'ts in Assigning Cause of Death

Do's

1. Use common sense and best clinical judgement. There is no substitute.
2. Read the narrative, history and any other information very carefully. You can avoid going down blind alleys and false diagnosis by a careful read.
3. Corroborate what a health care provider may have said on the form with some other symptom or signs in the checklist.
4. Do look for important negatives in the history. These can narrow down several possible causes to one or two.
5. Do think from a public health perspective- common causes are common.
6. Do not be afraid to state that no cause can be assigned. This is reality.
7. Write only one cause of death on each line of the death certificate.
8. Write legibly, and do not use any abbreviations or acronyms.

Don'ts

1. Do not make a random diagnosis if none is found.
2. Do not try to make a pathological diagnosis. It is very difficult from the Verbal Autopsy report to make a pathological diagnosis (e.g., various types of myocardial infarction). Moreover, while such pathological diagnosis is appropriate for clinical and hospital care, getting right the overall categories of causes of death is far more important for public health.
3. Do not rely on the respondent's education level, or other characteristics, only use them as supporting information. Misconceptions abound across education or income levels of respondents.
4. Do not rely on the **risk factors** alone for making a diagnosis. For example, cirrhosis occurs not only among alcohol drinkers but also among non-drinkers. Similarly, lung cancer can happen among smokers and non-smokers. Although this is common clinical and epidemiological knowledge, the mention of these examples here is merely to serve as a reminder for physicians at the time of certification of cause of death.

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

While the concept of underlying cause of death appears relatively straightforward, it is not commonly implemented by physicians at the time of death certification. This could be due to several reasons, including insufficient training, presence of multiple independent conditions, or confusion as to the chronological sequence of events. However, there is a need to identify an appropriate underlying cause of death, and the WHO has developed a set of rules and guidelines for this purpose. Usually, a cadre of well-trained ICD coders (usually medical records administrators) would be the ideal solution for a national mortality and cause of death reporting system, and is a goal to be aimed for. However, as an interim solution, physicians who write death certificates could themselves apply the ICD rules for selecting and coding the underlying cause of death. Once selected, the underlying cause requires to be assigned a specific alphanumeric code. This chapter includes a basic description of the WHO system for selection and coding of the underlying cause of death, commonly referred to by the acronym ICD.

The current definition of the ICD is the International Statistical Classification of Diseases and Health Related Problems. Its original use was to classify causes of mortality as recorded at the registration of death. Later, its scope has been expanded to classify diseases and other health related problems recorded on many types of health and vital records. Although the ICD is primarily designed for the classification of diseases and injuries with a formal diagnosis (and hence the retention of the original acronym ICD, despite the expanded definition), the current version includes a wide variety of signs, symptoms, abnormal findings, complaints, and social circumstances that may appear in place of a diagnosis on health related records, and may be

important for analysis. The ICD first originated in 1893. The current tenth revision (ICD-10) was adopted in 1993 by the World Health Organization.

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

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

ICD-10 comprises three volumes: Volume 1 contains the main tabular lists according to the three and four character ICD codes (described below); Volume 2 provides instructions and guidance to users of the ICD; and Volume 3 is the Alphabetical Index to the classification.

Volume 1 contains the basic ICD, which is a coded list of three-character alphanumeric categories, with a letter in the first position, followed by a number in the second and third positions, as follows:

A15 – respiratory tuberculosis

This three-character code constitutes the core classification of the ICD-10, and is the mandatory level of coding for international reporting to the WHO mortality database and for general international comparisons. Each three-character category can be subdivided into up to ten four-character sub categories, with the fourth character after a decimal. The ICD has

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

- o Epidemic diseases,
- o Constitutional or general diseases,
- o Local diseases arranged by system,
- o Developmental diseases,
- o Injuries.

As per the above-defined grouping pattern, the ICD classification has grouped the three character categories into a total of 21 chapters. As can be seen, this type of grouping of infectious diseases, neoplasms, injuries etc brings together conditions that are epidemiologically related and would be inconvenient for analysis if they were scattered in a classification arranged primarily by body site. The distinction between these ‘special group’ chapters and the ‘body system’ chapters has practical implications for understanding the structure of the classification, for coding, and interpreting statistics that are based on it.

- Chapter I : Certain infectious and parasitic diseases A00-B99
- Chapter II : Neoplasms C00-D48
- Chapter III : Diseases of the blood and blood forming organs D50-D89
- Chapter IV : Endocrine, nutritional and metabolic diseases E00-E90
- Chapter V : Mental and behavioural disorders F00-F99
- Chapter VI : Diseases of the nervous system G00-G99
- Chapter VII : Diseases of the eye and adnexa H00-H59
- Chapter VIII : Diseases of the ear and mastoid process H60-H95
- Chapter IX : Diseases of the circulatory system I00-I99
- Chapter X : Diseases of the respiratory system J00-J99
- Chapter XI : Diseases of the digestive system K00-K93
- Chapter XII : Diseases of the skin and subcutaneous tissue L00-L99
- Chapter XIII : Diseases of the musculoskeletal system M00-M99
- Chapter XIV : Diseases of the genito urinary system N00-N99
- Chapter XV : Pregnancy, childbirth and the puerperium O00-O99
- Chapter XVI : Certain conditions originating in the perinatal period P00-P96
- Chapter XVII : Congenital malformations and chromosomal abnormalities Q00-Q99 29

Chapter XVIII: Symptoms, signs and abnormalities not elsewhere classified R00-R99

Chapter XIX : Injury, poisoning and other consequences of external causes S00-T98

Chapter XX : External causes of morbidity and mortality V01-Y98

Chapter XXI : Factors influencing health status and contact with health services Z00-Z99

The chapters are divided into homogenous ‘blocks’ of three-character categories, to enable easy identification of specific disease groups or conditions that are closely related to each other within a chapter. Within the three and four character codes, there are usually listed a number of other diagnostics terms, which are either to be included or excluded from classification under the code. Further, Volume 1 employs some special conventions relating to the use of parentheses, square brackets, the abbreviation ‘NOS’ (not otherwise specified) or ‘NEC’ (not elsewhere classified), among others. These need to be clearly understood by coders, and will be covered in detail during training programs on death certification and mortality coding. Coders are required to search for the core three - character ICD for the underlying cause, which is then used for statistical tabulation of the data. There are specific principles that guide the use of the Alphabetical Index (Volume 3) in searching for the ICD code for a specific disease or condition, and these are described in detail in Volume 2. More importantly, however, Volume 2 prescribes detailed procedures for selection of the underlying cause of death, and its coding for mortality tabulation.

Firstly, if there is only one cause of death reported on the certificate, then it is deemed as the underlying cause, and used for tabulation. When there are multiple causes of death recorded on the death certificate, the first step lies in determining whether there is a coherent pathophysiological sequence of events. In other words, the question asked is ‘Does the condition listed on the lowermost line on Part 1 of the certificate give rise to all the conditions listed above it? If the answer to this question is yes, then this lowermost listed condition is deemed the underlying cause of death, and therefore selected for tabulation. This rule is termed the **General Principle** for selection of underlying cause of death, and is directly applicable in all properly completed medical certificates of cause of death.

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

For certificates in which the General Principle is not applicable, one of three Selection Rules is called into play, for selection of the underlying cause. However, it is recommended by the WHO that where the General Principle cannot be applied, clarification of the certificate should be sought from the certifier whenever possible, since the selection rules are somewhat arbitrary and may not always lead to a satisfactory selection of the underlying cause. Also, it should be borne in mind that the medical certifier's statement reflects an informed opinion about the conditions leading to death and about their inter relationships, and should not be disregarded lightly.

In some circumstances, the ICD allows the underlying cause selected according to the General Principle to be superseded by one more suitable among those listed on the certificate, for expressing the underlying cause in tabulation. For example, there are some categories for combinations of conditions (HIV and TB; rheumatic mitral stenosis, etc), or there may be epidemiological reasons for giving precedence to another specific condition on the certificate (hypertension with cerebral infarction – code to cerebral infarction). The ICD has developed a series of Modification Rules A to F (see below) for these purposes, which are applicable in specific situations.

Rule A: Senility and other ill defined conditions.

Rule B: Trivial conditions

Rule C: Linkage

Rule D: Specificity

Rule E: Early and late stages of disease

Rule F: Sequelae

These modification rules are intended to improve the usefulness and precision of cause of death data, and should be applied after selection of the underlying cause using either the General Principle or one of the selection rules. A complete description of the coding rules (General principle, Selection rules 1 to 3, and modification rules A to F) is available in Volume 2 (pp 30 – 123) , and may be studied to get a clear understanding of the process of selection and coding the underlying cause of death. While cause of death certification is to be performed by medical practitioners, coding of underlying causes of death can be done by trained medical records staff, who have a basic knowledge of medical terminology and hold responsibilities for classification, archiving, retrieval and possibly analysis of health related data. Such distinct

separation of the tasks is widely practised, and is intended to enable medical practitioners to conduct their part of the process efficiently, without getting involved in the complex and what could be confusing process of applying the various rules for selection and coding of the underlying cause, and handling the bulky volumes of the ICD to search for and assign specific ICD codes.

It is important to note also that medical practitioners should be adequately trained in the process of cause of death certification, and should understand the structure of the death certificate, and what needs to be entered in its different parts. They should also receive an overview of the purpose, process and rules involved in selection and coding of the underlying cause of death. They should also know that a well written cause of death certificate would almost always result in the application of the General Principle in the selection and coding of the underlying cause, and this function can be readily performed by trained medical records staff. On the other hand, where the General Principle is not applicable, trained coders could get in touch with the certifier to verify and if necessary correct the cause of death certificate, or deal with the same using the ICD prescribed procedures. In particular, the application of the modification rule of linkage (Rule C) is more common than the others, especially even when the General Principle is applicable. A comprehensive set of notes on for use in underlying cause mortality coding is available on pages 50 – 62 of Volume 2, as well as a detailed linkage table on pages 62 – 65. These notes and table need to be consulted and implemented wherever necessary, and are best left to be used by trained medical coders, rather than medical practitioners.

For efficient coding, the ICD Volume 3 (Alphabetical Index) is essential. It includes many terms that are synonymous with the standard terms listed in Volume 1. These synonyms are commonly used by medical certifiers, given the different medical terminology in place for the same conditions in different populations or across different periods of time. For example, the terms cardiac angina, anginal syndrome, ischaemic chest pain, and angina could be used by different physicians to identify the same disease, and are represented by the same code (I20.9). All these terms are listed in the Alphabetical Index, which enables easy search for the code for the term in question. However, the use of the Alphabetical Index requires training, and coding requires that both the Index and the Tabular List (Volume 1) should be consulted before a code is assigned. Also, before attempting to code, the coder needs to know the principles of classification and coding and to have carried out practical exercises.

Basic coding guidelines

The following steps are required to be carried out for coding:

1. Identify the type of statement to be coded and refer to the appropriate section of the Alphabetical Index. If the statement is a disease or injury or other condition classifiable to Chapters I-XIX or XXI, consult Section 1 of the Index. If the statement is the external cause of an injury or other event classifiable to Chapter XX, consult Section II.
2. Locate the lead term. For diseases or injuries this is usually a noun for the pathological condition. However, some conditions expressed as adjectives or eponyms are included in the Index as lead terms.
3. Read and be guided by any note that appears under the lead term.
4. Read any terms enclosed in the parentheses after the lead term (these modifiers do not affect the code number), as well as any terms indented under the lead term (these modifiers may affect the code number), until all the words in the diagnostic expression have been accounted for.
5. Follow carefully any cross-references (“see” and “see also”) found in the Index.
6. Refer to the tabular list to verify the suitability of the code number selected.
7. Be guided by any inclusion or exclusion terms under the selected code or under the chapter, block or category heading.
8. Assign the code.

All these guidelines are provided in Volume 2, as well as many other details relevant for efficient coding. A comprehensive training program to cover the essential theoretical and practical aspects of ICD coding is essential. When a national team of ICD coders is being established, it is useful to have a few staff with medical background also trained in these coding procedures, so that they could serve in an advisory capacity whenever required to do so by the non-medical coders who will conduct the bulk of the coding process.

The National Centre for Health Statistics (USA) has developed an automated ICD coding software program that processes individual electronic cause of death certificates, to select an underlying cause of death in each case, and assign its appropriate ICD code. Specific care has been taken to program the different selection and modification rules as laid down in Volume 2. However, there is a need for accurate data entry of the cause of death in text, for the automated coding program to function efficiently. Currently, the program is being tested in several countries, which also cross check a proportion of the codes by manual procedures. In summary, this automated process offers promise to hasten the development of national cause

specific mortality statistics programs, but this will continue to rely on a sound and efficient medical certification of cause of death.

Special Note on Injury

For all deaths due to injuries, the code for the external cause of the injury from Chapter XX is to be used as the underlying cause code. That is only codes with the first letter V-Y are acceptable as underlying cause codes for deaths due to injuries, and codes with first letters S-T signifying the body site of injury etc are not to be used as the underlying cause code. The nature of injury (e.g., fracture, dislocation, etc.) along with the body part injured is coded under Nature of Injury of ICD-10 but will not be used here. One principal injury is coded here followed by additional codes for each accompanying injury. This is of importance to treating physicians (codes S00 – S99 and T00 – T98). Instead of nature of injury, Cause of Injury is coded depending on the ‘cause’, which are coded as E codes. Only one external cause is coded in every death. WHO recommends that from a public health perspective, E codes should be used as it helps in developing prevention programmes (codes V01 – X59).

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

- Accidental - X00-X09 - Exposure to smoke, fire and flames
- Intentional self harm (Suicidal) - X76 - Intentional self harm by smoke, fire and flames
- Assault (Domestic violence etc) - X97 - Assault by smoke, fire and flames

Sometimes, difficulties may be experienced to separate suicide – homicide – accidental deaths (e.g., in the absence of sufficient information, burn injuries can fit into any category). However, careful narrative in VA can help in differentiating these injuries.

In other instances, there may be difficulty in identifying the exact external cause code, e.g., injury due to snake bite is included under X20 (contact with venomous snakes and lizards) and W59 (bitten or crushed by reptile including non-venomous snakes). The difference here is between venomous and non-venomous snake. Since it may be difficult to identify the type of snake by verbal autopsy, best clinical judgement should be used to select the most appropriate codes.

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

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

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

In terms of tabulations by cause, the ICD recommends that primary tabulations should be according to the detailed list of three-character ICD categories. In general, the hierarchical structure of the ICD allows considerable flexibility for possible groupings of the three character categories (over 2000 in all), to produce a tabulation which is epidemiologically meaningful, at the same time with as few empty cells as possible. The ICD recommends several special tabulation lists for mortality statistics, which are provided in Volume 1, and these lists could be used in preparing statistics for the monitoring and analysis of population health status and mortality-related health concerns at both national and international level. Of these, the first list including 103 cause categories and is practical and convenient for most publication purposes, especially as it provides for residual elements within each ICD chapter, which enables the derivation of chapter specific sub totals for comparisons across populations and over time.

The use of these ICD lists implies that the source of data on causes of death is from medical certificates issued by the attending physician. The ICD also stipulates that deaths that are not medically certified should be published separately. For these reasons, it allows the preparation of locally designed lists, using an appropriate identifying prefix for each cause category item number, for the presentation and usage of statistics derived from alternate sources of cause of death data. Where such a local list is constructed, the key to the condensed categories should contain the three-character codes of the core classification. More details regarding these guidelines and recommendations on tabulation are available in the chapter titled 'Statistical Presentation' (pp 124-138) in Volume 2 of the ICD.

Based on these guiding principles in tabulation, there is potential to use a special **selected mortality list** for the purpose of tabulating cause of death statistics derived through verbal autopsy methods.

This list has been designed in accordance to the following principles:

- Structured according to the ICD10 chapters
- Includes causes of epidemiological and public health relevance for developing countries
- Of these, specific causes that have clearly distinguishable symptom complexes have been listed separately (expert algorithms for diagnosing these causes available)
- Some specific symptoms, which may be the only information gleaned from the verbal autopsy, have been listed as individual causes, to serve as clues to the possible underlying pathology
- Residual cause categories have been provided for some of the chapters where it is considered necessary to have a chapter total eg maternal causes, perinatal causes, infectious and parasitic diseases etc
- The cause categories enable evaluation of individual health programs for specific infectious diseases, IMCI, maternal health, injury prevention, chronic disease control etc
- An overall residual category has been provided, to complete the tabulation of all possible causes

The list consists of 57 cause categories, and provides information about many important diseases and external causes of death that can be identified by verbal autopsy methods, as well as some other significant conditions of public health importance that require supporting diagnostic information (e.g. cancers). Primary tabulation of deaths by age and sex and cause according to this list are recommended, for comparability of data collected by these VA

methods in different populations. Such tabulations facilitate comparison over time and observation of shifts in relative frequencies of individual causes as local health programs take effect. It also permits comparisons between sub national areas and population subgroups. Further, it enables the comparison between statistics derived from VA methods with statistics from vital registration systems or health facilities, where causes of death are medically certified.

Tabulations according to this list can be collapsed into broader cause categories, depending on further research / policy interests. Collapsing results to broader cause groups is also useful for assessing validity of data. If individual deaths were coded to specific ICD codes, tabulations based on such codes would be amenable to different ICD code groupings, based on specific research interests.

Table 2. Mortality Tabulation List for Verbal Autopsy Data

Code	Cause	ICD-10 Codes
VA-01	Intestinal infectious diseases (incl diarrhoeal diseases)	A00-A09
VA-02	Tuberculosis	A15-A19
VA-03	Tetanus	A33-A35
VA-04	Measles	B05
VA-05	Viral hepatitis	B15-B19
VA-06	Human immunodeficiency virus [HIV] disease	B20-B24
VA-07	Malaria	B50-B54
VA-08	Leishmaniasis	B55
VA-09	Remainder of infectious and parasitic diseases	A20-A28, A30-A32,A36-A38, A40-A49,A50-A64, A65-A79, A80-A89, A90-A99, B00-B04, B06-B09, B25-B49, B56-B64, B65-B99
VA-10	Malignant neoplasm of lip, oral cavity and pharynx	C00-C14
VA-11	Malignant neoplasm of oesophagus	C15

VA-12	Malignant neoplasm of stomach	C16
VA-13	Malignant neoplasm of small intestine	C17
VA-14	Malignant neoplasm of colon, rectum and anus	C18-C21
VA-15	Malignant neoplasm of liver	C22
VA-16	Malignant neoplasm of trachea, bronchus and lung	C33-C34
VA-17	Malignant neoplasm of breast	C50
VA-18	Malignant neoplasm of cervix, other and unspecified parts of uterus	C53-C55
VA-19	Other neoplasms	C23-C32, C37-C49, C51-C52, C56-C97
VA-20	Anaemia	D50-D64
VA-21	Diabetes mellitus	E10-E14
VA-22	Malnutrition	E40-E46
VA-23	Mental and behavioural disorders	F00-F99
VA-24	Meningitis	G00, G03
VA-25	Hypertensive diseases	I10-I13
VA-26	Ischaemic heart diseases	I20-I25
VA-27	Cerebrovascular diseases	I60-I69
VA-28	Pneumonia	J12-J18
VA-29	Asthma / Chronic obstructive pulmonary diseases	J40-J47
VA-30	Gastric and duodenal ulcer	K25-K27
VA-31	Diseases of the liver	K70-K77
VA-32	Disorders of the kidney	N00-N29
VA-33	Pregnancy with abortive outcome	O00-O08
VA-34	Hypertensive disorders of pregnancy	O10-O16
VA-35	Maternal haemorrhage	O44-O46, O67, O70-72
VA-36	Obstructed labour	O64-O66
VA-37	Complications predominantly related to the puerperium	O85-O92
VA-38	Other maternal causes	O20-O43, O47-O63, O68-O69, O73-O75, O95-O99

VA-40	Birth trauma	P10-P15
VA-41	Birth asphyxia, and other respiratory disorders specific to perinatal period	P20-P21, P23-P24
VA-42	Still births	P95
VA-43	All other conditions originating in the perinatal period	P00-P04, P08, P25-P29, P35-P94, P96
VA-44	Congenital malformations	Q00-Q99
VA-45	Abdominal pain	R10
VA-46	Fever of unknown origin	R50
VA-47	Convulsions, not elsewhere classified	R56
VA-48	Unspecified causes of mortality	R00-R99 except R10, R50, R56
VA-49	All other diseases	D00-D48, D55-D89, E00-E07, E15-E34, E50-E88, G04-G98, H00-H95, I00-I09, I26-I52, I70-I99, J00-J11, J20-J39, J45-J99, K00-K22, K28-K66, K80-K92, L00-L98, M00-M99, N30-N98, Q10-Q99
VA-50	Transport accidents	V01-V99
VA-51	Falls	W00-W19
VA-52	Accidental drowning and submersion	W65-W74
VA-53	Exposure to smoke, fire and flames	X00-X09
VA-54	Accidental poisoning by and exposure to noxious substances	X40-X49
VA-55	Intentional self-harm	X60-X84
VA-56	Assault	X85-Y09
VA-57	All other external causes	W20-W64, W75-W99, X10-X39, X50-X59, Y10-Y89

Introduction

Chapter 5 provides detailed instructions and guidelines on the certification of cause of death, using the standard international certificate. While this is adequately accomplished when detailed medical records are available that provide documented empirical evidence as to the medical diagnosis of the illness(es) present at the time of death, the same is not the case from a verbal autopsy questionnaire. Several critical issues that govern data quality from verbal autopsy questionnaires have been discussed in Chapter 3, and these could sometimes result in the recording of a multitude of symptoms, signs and other evidence as to the cause, which could create some uncertainty as to the cause(s) operating at the time of death.

For these reasons, this Chapter has been included in the manual to provide a set of general diagnostic guidelines for specific causes of death that could be identified from verbal autopsy data. As stated in Chapter 5, **these guidelines are not specific diagnostic algorithms or criteria** for selection of the individual causes that have been described here, but more for the purpose of differentiation of one cause from other competing causes, in case of overlapping symptomatology or any confusion arising from the verbal autopsy data. Also, **these guidelines are to be used to support clinical judgment** in the adjudication of cause of death, and should be used in conjunction with the ‘do’s’ and ‘don’ts’ listed at the end of Chapter 5.

CAUSE OF DEATH	CRITERIA
Infectious diseases	
Diarrhoea/Gastroenteritis/Dysentery	Frequent/liquid/water loose or soft stools AND any of the following: <ul style="list-style-type: none"> <input type="checkbox"/> Low/nil urine content <input type="checkbox"/> Restricted fluid intake <input type="checkbox"/> Vomiting <input type="checkbox"/> Eyes sunken or depressed
Pulmonary Tuberculosis	Chronic cough of long duration with fever AND any one of the following signs or symptoms: <ul style="list-style-type: none"> <input type="checkbox"/> Blood in sputum <input type="checkbox"/> Chest pain <input type="checkbox"/> Breathlessness

	<ul style="list-style-type: none"> ☐ Loss of appetite ☐ Chronic weight loss ☐ Treatment history of TB
Tetanus, Neonatal	<p>Baby able to suck after birth AND stopped sucking after 3 days AND baby's body became rigid with or without convulsions</p> <p>Possibly With Umbilical cord inflammation OR fever</p>
Measles	Rash all over body after an attack of fever > 3 days AND red or watery eyes or cough, running nose – Coryza
Viral Hepatitis	<p>Marked acute jaundice with abdominal pain; progressive yellowness of eyes and skin AND any of the following signs or symptoms:</p> <ul style="list-style-type: none"> ☐ Fever ☐ Headache ☐ Nausea ☐ Vomiting ☐ Loss of appetite ☐ Urine is yellow in colour ☐ Hepatitis B/C serology ☐ AND No other obvious cause
HIV/AIDS	<p>H/o severe weight loss in less than 3 months AND History of prolonged unexplained fever or diarrhea or persistent cough for more than 1 month (intermittent or continuous) OR HIV +ve serology</p> <p>Possibly With Mouth sores / white patches in mouth, Skin rash, Generalized swelling of nodes in armpits, neck, groin, History of spouse/partner with similar illness/death of spouse partner from illness</p>
Malaria	<p>Acute onset of high grade fever, with chills and rigor. Fever may be intermittent AND blood test positive for malaria AND any one of the following:</p> <ul style="list-style-type: none"> ☐ Jaundice ☐ Breathlessness ☐ Decreased urine output ☐ Convulsion/Unconscious ☐ Headache <p>PRESENCE OF SYMPTOMS OF</p>

	<ul style="list-style-type: none"> ☐ ARI ☐ Diarrhoea ☐ Burning during micturition <p>could be suggestive of immediate or contributory causes</p>
Neoplasms	
Oral Cancer (mouth)	<p>Lump or mass or swelling on tongue/ cheek/ mouth cavity/ gum/ palate, usually progressive</p> <p>AND any one of the following:</p> <ul style="list-style-type: none"> ☐ Non healing sore or ulcer ☐ Bleeding on touch ☐ Restriction/difficulty in opening mouth ☐ Weight loss <p>OR</p> <p>Diagnosed as mouth cancer</p>
Pharynx (C10-C11) larynx (throat) (C32) Trachea (C33) Cancer	<p>Growth in throat / neck or hoarseness of voice AND weight loss over several months OR diagnosed as throat cancer</p>
Oesophageal Cancer	<p>Progressive difficulty in taking foods AND weight loss over several months OR diagnosed as oesophageal cancer</p>
Stomach Cancer	<p>Vomiting/ Vomiting of blood. Difficulty in swallowing AND mass in upper abdomen AND any of the following:</p> <ul style="list-style-type: none"> ☐ Pain in abdomen ☐ Weight loss ☐ Enlarged liver ☐ Black stools <p>OR diagnosed as stomach cancer</p>
Colon/ Rectal Cancer	<p>Bleeding from anal opening AND any of the following:</p> <ul style="list-style-type: none"> ☐ Constipation alternating with loose stools or constipation alone ☐ Weight loss ☐ Painful abdominal distension ☐ Lump in lower part of abdomen <p>OR</p> <p>Diagnosed as colorectal cancer</p>

Liver Cancer	Enlargement of liver AND abdominal distension (Ascites) within weeks AND weight loss AND H/o hepatitis or jaundice. AND no regular fever OR diagnosed as liver cancer
Bronchus and Lung Cancer	Chronic cough and blood streaked sputum eventually leading to haemoptysis, and not responding to antibiotics and antitubercular drugs AND any of the following: <ul style="list-style-type: none"> ▢ Breathlessness ▢ Chest pain ▢ Hoarseness of voice ▢ Recurrent history of Pneumonia ▢ Rapid loss of weight towards end ▢ AND no h/o Tuberculosis (no fever) OR diagnosed as lung cancer
Breast Cancer	Painless lump in one or both breasts AND any of the following: <ul style="list-style-type: none"> ▢ Discharge from nipple ▢ Skin ulceration over breast ▢ Enlarged glands in the neck/maxilla OR Diagnosed as breast cancer
Carcinoma Cervix	Non-menstrual bleeding often after menopause OR intermenstrual bleeding OR foul smelling vaginal discharge with blood AND weight loss OR diagnosed as Carcinoma cervix
Nutritional anaemias	
Anaemia	Marked paleness of body AND any of the following: <ul style="list-style-type: none"> ▢ Weight loss ▢ Fatigue or weakness or breathlessness on exertion ▢ Giddiness ▢ History of bleeding anywhere ▢ AND ▢ None of the following: <ul style="list-style-type: none"> ▢ Jaundice ▢ Enlarged lymph glands ▢ Features of chronic cough ▢ Chest pain ▢ Fever OR Diagnosed as Anaemia

	Possibly With Pallor of fingers OR ankle swelling OR swelling of the whole body OR
Diabetes Mellitus	
Diabetes Mellitus	Frequent urination or increased thirst or and increased hunger AND any of the following: <ul style="list-style-type: none"> <input type="checkbox"/> Recurrent infection (particularly respiratory)/Septicaemia <input type="checkbox"/> Ulcers/foot sores or wounds not healing properly/gangrene <input type="checkbox"/> Neuropathy <input type="checkbox"/> Renal complications <input type="checkbox"/> Septicaemia <input type="checkbox"/> Vascular complications
Malnutrition	
Malnutrition	Not growing properly or losing weight and becoming very thin over months AND any of the following: <ul style="list-style-type: none"> <input type="checkbox"/> Recurrent febrile illness <input type="checkbox"/> Reddish brown discoloration of hair <input type="checkbox"/> Flaking of skin <input type="checkbox"/> Pallor <input type="checkbox"/> Abnormality distended abdomen <input type="checkbox"/> Swelling of feet <input type="checkbox"/> Night-blindness
Meningitis	
Meningitis	Continuous fever until death AND neck stiffness OR vomiting OR bulging fontanelle OR ear discharge
	Possibly With Loss of consciousness OR no symptoms of ARI, diarrhea OR photophobia
Ischaemic heart diseases	
Myocardial Infarction	Severe chest pain lasting for more than ½ hour but less than 24 hours, within the last month before death AND any of the following: <ul style="list-style-type: none"> <input type="checkbox"/> Shortness of breath <input type="checkbox"/> Vomiting <input type="checkbox"/> Anxiousness <input type="checkbox"/> Pain radiating to left arm <input type="checkbox"/> Sweating <input type="checkbox"/> Sudden death

	OR Diagnosed heart attack/Myocardial infarction
Congestive Heart Failure	<p>Progressive shortness of breath on lying down or at night, improving on sitting up AND any of the following signs or symptoms:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Swelling of feet <input type="checkbox"/> Distension of abdomen <input type="checkbox"/> Progressive cough <p>H/o previous MI/hypertension \ heart disease, which should be listed as the underlying cause of death</p>
Stroke (cerebrovascular disease)	<p>Sudden onset of paralysis of one or more limbs in the month preceding death AND any of the following:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Unconsciousness <input type="checkbox"/> Loss of vision <input type="checkbox"/> Urinary incontinence <input type="checkbox"/> Loss of sensations on any part of body <input type="checkbox"/> Altered speech <input type="checkbox"/> Sudden onset of headache with altered sensorium <p>In long standing cases, commonly leading to development of bed sores with septicaemia, or features of pneumonia as the immediate cause of death</p>
Pneumonia	
Pneumonia	<p>Acute cough (dry or productive) AND high fever AND any of the following:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Shortness of breath/fast breathing <input type="checkbox"/> Chest pain <input type="checkbox"/> Blood in sputum <p>AND any of the following:</p> <ul style="list-style-type: none"> <input type="checkbox"/> No Wheezing <input type="checkbox"/> No swelling of legs <input type="checkbox"/> No distension of abdomen
Chronic Obstructive Pulmonary Disease	
Chronic Obstructive Pulmonary Disease	<p>Recurrent episodes of productive cough >2yrs AND breathlessness, initially episodic (more in winter) later progressive or ankle swelling late in disease AND exclude TB</p>

Cirrhosis of Liver	
Cirrhosis of Liver	<p>Abdominal distension (fluid in abdomen) ascitis gradually AND swelling of lower limbs AND any of the following signs or symptoms:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Early progressive jaundice <input type="checkbox"/> Painless liver <input type="checkbox"/> Vomiting of blood <input type="checkbox"/> Passing of blood in stool <input type="checkbox"/> Drowsiness or coma <input type="checkbox"/> H/o chronic alcoholism <p>AND No fever</p>
Disorders of the kidney	
Renal Failure	<p>Progressive or acute onset of decreasing urinary output for more than 1 day AND any of the following signs or symptoms:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Progressive loss of appetite <input type="checkbox"/> Hiccups <input type="checkbox"/> Drowsiness <input type="checkbox"/> Confusion <input type="checkbox"/> Unconsciousness <input type="checkbox"/> Swelling of eyelids/face/body in the morning <p>OR History of dialysis</p>
Pregnancy	
Abortion	<p>Abortion (termination before 28 weeks of pregnancy) in less than 42 days before death AND any of the following:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lower abdominal pain <input type="checkbox"/> Excessive vaginal bleeding <input type="checkbox"/> Abnormal vaginal discharge <input type="checkbox"/> Fever till death
Eclampsia	<p>History of convulsions for first time in pregnancy OR doctors report of very high blood pressure with convulsions Possibly with ankle swelling</p>
Ante-Partum Haemorrhage	<p>Acute excessive bleeding in pregnancy after 28 weeks of gestation but before birth of baby</p>

Post-Partum Haemorrhage	Excessive bleeding after delivery of baby, for example, blood completely covering the floor or used many garments to soak blood
Obstructed Labour	Abnormal presentation (breech, shoulder, hand or transverse) AND baby not delivered OR difficulty in delivering baby, Forceps/vacuum delivery AND prolonged labour >24 hours Prim> 12 hr
Puerperal Sepsis	High fever persisting till death AND any of the following: <ul style="list-style-type: none"> ▢ Foul smelling vaginal discharge with or without blood ▢ Lower abdominal pain/distention ▢ Vomiting AND No cough, no burning, micturition, no yellowness of eyes
Low-Birth-Weight (Full term pregnancy)	Smaller than average size baby. If weighted, birth weight below 2.5 kilograms AND no other obvious causes of death AND Full Term Pregnancy
	Possibly With Poor sucking after birth OR Death at 3-7 days
Prematurity (Not full term)	Born between 28 and 36 but before 37 weeks of gestation AND no other obvious causes of death
Birth Trauma	Bruises at birth, or elongation/swelling/blood clots over skull OR any limb broken at birth OR convulsions in first 72 hours of birth
	Possibly With Instrumental delivery OR complicated delivery
Asphyxia At Birth	Delayed or poor breathing or no breathing at birth OR delayed or no cry at birth AND any sign of life present at birth (i.e. exclude stillbirths) OR convulsions in first 72 hours
	Possibly With Prolonged
Bacterial Sepsis of Newborn	Fever AND no other obvious causes of death (like ARI, diarrhea) Possibly With Postulant cord OR poor sucking OR limp
Congenital Malformations	Abnormality of head (small, flat, swelling), spine, body, arms or legs reported at birth For specific diagnoses refer to codes Q65-Q88

Abdominal pain	
Acute Abdomen (Not elsewhere classified)	Severe acute abdominal pain; Vomiting of blood; Abdominal distension AND any of the following signs or symptoms: <input type="checkbox"/> Fever <input type="checkbox"/> Constipation <input type="checkbox"/> Collapse/
Encephalitis	Convulsion of body/body parts or asymmetrical weakness or paralysis AND fever until death AND any of the following: <input type="checkbox"/> Vomiting <input type="checkbox"/> Unconsciousness <input type="checkbox"/> Stiff neck Possibly With Confusions, altered sensorium
Acute Lower Respiratory Tract Infection	Cough OR fever AND rapid breathing OR difficult breathing with in-drawing of chest (often local term)
Dengue Fever (Usually as epidemic outbreak)	Sudden onset of high fever AND any one of the following: <input type="checkbox"/> Vomiting <input type="checkbox"/> Prominent aches and pains in muscles, bones, forehead <input type="checkbox"/> And behind eyeballs <input type="checkbox"/> Bleeding from body orifices OR Blood test positive for dengue
Epilepsy/Seizures	History of convulsions of body or parts of body over years, with fit on the day of death AND loss of consciousness following fits AND no H/o injury to head or fever or neck stiffness
Hyperplasia of Prostrate	Difficulty in passing urine with frequent urging in elderly man >60 years AND lower abdominal pain AND any of the following signs or symptoms: Patient becomes dull and drowsy <input type="checkbox"/> Hiccups <input type="checkbox"/> Vomiting <input type="checkbox"/> Face is swollen <input type="checkbox"/> Delirium or coma AND Rule out Prostrate Cancer

Pyrexia of unknown origin	Fever of long duration (more than 4 weeks) AND no possible reason found OR diagnosed pyrexia of unknown origin by a doctor
Jaundice (Not elsewhere classified)	Progressive yellowness of eyes and skin AND any of the following signs and symptoms: <ul style="list-style-type: none"> <input type="checkbox"/> Fever <input type="checkbox"/> Headache <input type="checkbox"/> Nausea <input type="checkbox"/> Vomiting <input type="checkbox"/> Loss of appetite <input type="checkbox"/> Urine is yellow in colour <p>AND no other obvious cause (exclude: viral hepatitis)</p>

In list, but NO criteria

- Leishmaniasis
- External causes

WITH criteria, but not in list

- Dengue Fever (usually as epidemic outbreak)
- Epilepsy/Seizures
- Stroke
- Hyperplasia of Prostate
- Jaundice (not elsewhere classified)

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

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

Training workshops for VA reviewers should include the following modules:

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

Modules on standard procedures for death certification are included to enable physicians to understand the principle of the underlying cause of death. Such understanding is essential for later developing the ability to select the underlying cause of death from the information provided from the verbal autopsy instruments. This training will include practical exercises using real case summaries from deaths that have occurred in hospitals which will help

physician reviewers to understand the process of physician certification of cause of death in a hospital situation, with adequate clinical evidence on the illness preceding death.

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

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

Measures of reliability

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

