VERBAL AUTOPSIES FOR ASSESSING CAUSES OF ADULT AND MATERNAL DEATH: DEVELOPMENT AND VALIDITY OF A MODEL TOOL

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Abstract

Data on adult mortality are very limited in sub-Saharan Africa where only small proportions of deaths occur in health facilities. In such settings, ascertainment of causes of death from data obtained from relatives or associates of the deceased through interviews in surveys or longitudinal surveillance systems appears to be an attractive option. This technique, known as verbal autopsy (VA) is based on the assumption that important causes of death have distinctive symptoms and signs, and these can be recognised, remembered and reported by lay respondents, and that based on the reported information causes of death can be reached. The existing experience of VA for adult death is limited mainly to maternal deaths and the validity of VA for adult death is unknown.

We developed a VA questionnaire, mortality classification system and "expert opinion" based algorithms for reaching diagnoses for adult deaths and tested their validity on deaths occurring at hospitals in Tanzania (n=315), Ethiopia (n=249) and Ghana (n=232). Hospital records of adult deaths occurring at study hospitals from June 1993 to April 1995 were collected prospectively. VA interviews were conducted by trained non-medical interviewers. Caused of death from VA data were reached by a panel of three physicians and by a computerised algorithm. The validity of VA was assessed by comparing the VA diagnoses with hospital diagnoses.

Specificity of VA fell below 95% only for few common causes of adult death. Sensitivity and kappa of VA for all common causes of adult death were low and this suggests that the accuracy of VA at the individual level is low. However, the misclassification of causes of death was bi-directional and the number of false positive and false negative diagnosis for most common causes of adult death tend to be similar. Thus there was robust agreement between the true and VA estimates of cause specific mortality fractions of common causes of adult death and VA is useful for assessing cause specific mortality fractions of common causes of adult death.

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List of Abbreviations

AFI	Acute Febrile Illness
AIDS	Acute Immune Deficiency Syndrome
AMMP	Adult Morbidity and Mortality Project
ARI	Acute Respiratory Infection
CCF	Congestive Cardiac Failure
CI	Confidence Interval
COAD	Chronic Obstructive Airway Disease
COD	Causes of Death
CSMF	Cause Specific Mortality Fraction
CSMR	Cause Specific Mortality Rate
CVS	Cardio Vascular System
DSS	Demographic Surveillance System
HIV	Human Immunodeficiency Virus
ICD-10	International Classification of Deaths
NMC	Non Maternal Causes
NR	Not Reported
PPV	Positive predictive Value
PTB	Pulmonary Tuberculosis
RD	Reference Diagnoses
TB	Tuberculosis
VA	Verbal Autopsy
VAQ	Verbal Autopsy Questionnaire
VD	Verbalautopsy Diagnoses
WHO	World Health Organisation

1. Introduction and overview of the thesis

1.1. Mortality data and Health Policy

Much attention in recent years has been given to the determination of levels and causes of mortality among children in developing countries. Relatively little attention, however, has been paid to the problem of adult mortality, despite the potentially severe economic and social consequences of the premature death of adults, both for the family and for the national economy. Communicable tropical diseases and child health in general have been major determinants in setting priorities for intervention, operational and research activities in the last decade. Only recently has the awareness in large international bodies, development agencies and academic groups grown that health problems of adults not caused by tropical diseases represent a large gap in our understanding on their aetiologies as well as their impact.[1] Cause specific adult mortality data are very limited in most developing countries, and especially in sub-Saharan Africa, where only a small proportion of deaths are usually officially reported and even fewer are certified by medical practitioners. Yet information on mortality, morbidity and cost-effective interventions is urgently needed for national governments and donor agencies to be able to target their limited resources efficiently and equitably.

The World Bank has attempted to quantify the global burden of diseases in order to identify cost-effective interventions against priority health problems. Although their report is very useful, the authors acknowledge that several guestimates had to be used in this report due to the lack of accurate data on mortality and morbidity in many developing countries.[2] The authors of this report reiterate that the knowledge of levels, causes, distribution and determinants of morbidity and mortality among adults in developing countries is extremely deficient compared with the information available for children, and this lack of knowledge has been an important determinant of the policy

vacuum on adult health that exists within governments and agencies.[3]

The main reason for the lack of useful data on mortality is reliance on conventional systems of death registration, with diagnoses made by qualified physicians. The data collected through vital registration systems and routine health information systems are incomplete and unrepresentative in many developing countries.[4] For instance, only 3 countries from the Africa regions (Egypt, Mauritius, & South Africa), 18 countries from the central and Latin America region (Bahamas, Barbados, Trinidad, Costa Rica, Argentina, Chile, Columbia, Ecuador, Guyana, Paraguay, Surinam, Uruguay, & Venezuela) and 10 countries from the Asia region excluding former Soviet republics (China, Israel, Japan, Korea, Kuwait, Mongolia, Philippines, Qatar, Singapore, & Thailand) have reported causes specific death rates in the UN demographic year book for the year 1999.[5] There are several reasons for this inadequacy: (i) data for urban areas are likely to be more complete than rural areas; (ii) particular causes may be more readily recognised and therefore recorded; (iii) those of higher social class, who are more likely to have sought and obtained medical care prior to death, are more likely to have a detailed cause of death recorded. Furthermore usefulness of data collected through routine health information systems depend on the accuracy of clinical diagnosis by attending physicians, completion of death certificates by physicians, transcription of data from death certificate, classification and coding of data from death certificate, and processing, analysis, interpretation and dissemination of data. Inaccuracies and biases may occur in any of these processes involved in the collection and publication of routine statistics and this may affect their value to health policy-makers.

Policy decisions made on the basis of mortality data collected through formal health services alone may be erroneous in that they are derived from a particular segment of the population, often the urban middle class, and do not reflect the overall burden of disease

in the national population. Thus there is a need for alternative approaches to obtain data on mortality in developing countries.

1.2. Approaches to obtain mortality data

There are two dimensions in the mortality data – one is age and sex specific mortality and the other is the cause specific mortality. In countries with poor data on mortality, vital registration systems are weak and the proportion of people who die while under medical care is low. In such settings several indirect methods to assess the level of all cause mortality in specific age groups have been developed and used successfully in census, surveys and surveillance systems. These methods include the following: precedent birth[5] and birth history[6] techniques for under-five mortality, sisterhood method for maternal mortality[7] and orphanhood method for adult mortality[8]. Although these methods give robust estimates of age group specific all cause mortality they do not give estimates of cause specific mortality.

Attempts have been made to ascertain causes of death from information on history of illness preceding the death of an individual obtained from relatives or associates of the deceased through retrospective questioning in surveys or in demographic surveillance systems.[9] This technique is known as verbal autopsy (VA) and has been used in several settings to assess causes of childhood deaths. VAs have also been used to assess causes of adult deaths, but almost exclusively for maternal deaths.

Although VA appears to be a simple and attractive method to ascertain causes of death it is based on several assumptions, and there are several factors and processes, which can affect their reliability and validity. Nevertheless, the current recognition of the need for data on adult mortality and morbidity may require wider use of VAs. This highlights the need for understanding the factors and processes influencing the validity of VAs,

and also to develop and validate a standard VA tool for adult deaths for use in sub-Saharan Africa.

1.3. Outline of the thesis

The objectives of this thesis are as follows: (1) to describe and discuss the assumptions under pinning the VA method for assessing causes of adult death; (2) to present the results of a multi-centre validation study of a model tool,; (3) to identify causes of death that can be estimated accurately at population level using VA; (4) to explore the application of the results of the validation study for interpreting mortality estimates obtained using VA in demographic surveillance systems in sub-Saharan Africa.

This thesis examines the issues involved in the development and validation of VAs for adult deaths, and describes a study that developed and validated an adult VA tool. First the assumptions underlying VAs and the factors influencing their validity are described, and the existing literature on VAs is reviewed (Chapter 2). Then the process used to develop a model VA tool for assessing causes of adult deaths and the methods used to test the validity of the VA tool in a multi-centre study are described in Chapter 3. Validity of the VA tool for common causes of adult death and maternal death are described in Chapter 4. Methodological limitations of the study, interpretation of the observed validity of VAs, factors influencing the validity of VAs and caveats in the application of results of validation studies are discussed in Chapter 5. Main conclusions reached from the study are summarised in chapter 6.

2. Literature review

2.1. Introduction

The VA of childhood deaths was reviewed in an international workshop in 1989,[10] and discussed in the context of adult mortality in another workshop in 1993 at the London School of Hygiene and Tropical Medicine. The VA technique is based on the assumption that most causes of death have distinct symptom complexes, and that these can be recognised, remembered and reported by lay respondents. It also assumes that it is possible to classify deaths, based on the reported information, into useful categories of causes of death. The validity of VAs is influenced by the cause of death per se and characteristics of the deceased and by several other factors, relating to the classification of causes of death, the design and content of the questionnaire and field procedures. Some of the key factors and processes are summarised in Figure 1. The determinants of validity shown in the figure are far from complete and their relationships may be more complex than the framework shown. Using this conceptual framework, studies that have used VA and found published up to September 2001 are reviewed in this chapter. Studies using VA were identified from electronic databases mainly Medline and Popline by searching for the following key words: verbal autopsy, verbal post-mortem, demographic surveillance system, causes of maternal death. Few reports that were missed by this key word search were identified from the reference list of those studies yielded from the electronic database search.

Sixty two studies using VA for assessing causes of death were identified through searching electronic databases of published studies and unpublished reports. The country, study period, age group, main objectives, number of deaths, approach to mortality classification, format of questionnaire, characteristics of interviewer, recall period, type and number of assessors and the procedures used to derive diagnosis are

identified for each study. The methodological approaches applied in these studies are described and discussed in order to identify the critical issues in the development, use and validation of VAs to determine causes of adult deaths.

A brief description of 62 studies that are reviewed is presented in Table 1. A summary of the methods used in these studies is presented in Table 2. Thirty six studies have been done to assess causes of childhood deaths, three to assess adult deaths, eleven to assess both adult and childhood deaths, and twelve to assess maternal deaths.

2.2. Uses of VAs

VAs of childhood deaths have been applied to evaluate the impact of interventions against acute respiratory infections[12-16] and malaria,[17-20] to evaluate the impact of vitamin A supplementation[21-25] and of a primary health care project on cause specific mortality,[26] to establish the relative public health importance of causes of childhood death,[27-38] and to assess the determinants of common childhood deaths.[39-46] VAs also have been used to to establish the relative importance of causes of deaths in all age groups[52-64] to identify the common causes of maternal deaths.[65-79],and to describe symptoms and signs associate with HIV related deaths[80-82]

2.3. Issues in the development of VAs

Mortality classification

Two approaches can be adopted to develop and to derive diagnoses from VAs. In the first, a mortality classification is produced and then VA tools (a questionnaire together with diagnostic algorithms or procedures to derive diagnoses) are designed to classify deaths into these pre-defined categories. This is called the "restricted" approach. In the "open" approach, a mortality classification is defined post hoc on the basis of the diagnoses derived from the VA. For the latter, the VA tools are not determined by a

mortality classification defined prior to data collection. A special case of the "restricted" approach is the investigation of a single cause of death in the evaluation of a targeted intervention. For example, a VA tool to establish specifically whether a person died of AIDS or not.

Among the 69 published studies, 36 studies did not report the approach to mortality classification, 24 studies had used the restricted approach and 9 studies had used the open approach. The studies that used the restricted approach did not report the criteria and the process used to develop the mortality classification. The use of different approaches to mortality classification may affect the validity of VAs because of its influence on the design of the questionnaire, on the methods of deriving a diagnosis, and on the number and the combination of categories of causes of death diagnosed. For example, the use of filters and modules related to specific disease categories in VA questionnaires (see below) and predefined diagnostic algorithms is more appropriate for the restricted approach. The implications of differences in the design of questionnaires and methods of derivation of diagnoses are discussed in the respective sections of this review.

The categorisation of causes of death in the mortality classification of the reported studies varied significantly. The number of categories ranged from 5 to 15 for childhood deaths, 5-16 for maternal deaths and 8-29 for adult deaths. The choice of categories will affect the complexity of diagnostic algorithms and the ability of assessors to reach a diagnosis. For example, diagnosing malaria, meningitis, typhoid, hepatitis and relapsing fever as separate categories will be more difficult and inaccurate than diagnosing just two categories, malaria and all other infections. A classification with fewer categories will lead to causes of death with closely related symptom complexes being grouped together and this will tend to increase the validity of the VA at the

expense of less detailed information. Thus the validity of VA in the study in Yemen[59] where 8 categories of causes of death were classified would be expected to differ from that of the study in Papua New Guinea[53] which classified causes of death into 29 categories even if the cultural background and the methods used were the same.

A desirable feature of a broad mortality classification is that it could be used in different settings with minor modifications. Ideally, it should have a core that would be applicable in all settings, and it should also accommodate changes to reflect site-specific causes of death. A broad mortality classification should include all causes of death which are important public health problems and others for which there are well-recognised intervention strategies, and its disease categories should, as far as possible, have distinct and easily recognisable symptom complexes.

Knowledge of the cause structure of mortality of the population in which the VA is going to be applied would facilitate the development of a broad mortality classification according to the above criteria. However, this is unlikely to be available in most situations where VAs are needed. As an alternative, mortality and morbidity data from health facilities could be used to assist the development of an appropriate mortality classification.

Classification of causes of death can be vary between communities as there are culture specific causes of illness. In many settings in Africa one of the common causes of death is witch craft. For example a frequently reported cause of childhood death in Ghana is "spirit child" which means the ancestoral spirits were upset by an unacceptable practice in the house. It can be argued that the locally perceived causes of death should be included in the mortality classification. However, it would make the classification very complex and incomparable between settings. Furthermore the development of criteria

for reaching locally perceived causes of death will be difficult and hard to convince panel of physicians to apply those criteria. Hence it is not surprising that none of the reported studies has included the local classification of causes of death, instead the studies have focused on biomedical causes of death.

Design of VA questionnaires

VA questionnaires can have a number of different formats: open; checklist of symptoms; checklist with filter questions; or a combination of these. An open questionnaire is a blank page on which a trained interviewer enters reported signs and symptoms leading to death, and related information. A checklist is a list of signs and symptoms, for each of which the interviewer establishes their presence or absence. A checklist with filters is a list of major symptoms and signs which, if present, are followed by a list of related questions or "modules". For example, in a "cough module", a positive response to a filter question on history of cough would be followed by a module with questions on the duration and severity of cough, and the type of sputum. A module can be related not only to a symptom but also to a specific category of cause of death. In this case it will include questions on all symptoms required to diagnose the disease category in question. For example, "cough" could be a filter question for entering into a "pneumonia module" which will include questions on cough and also on symptoms such as difficulty in breathing, rapid breathing and fever, to reach or reject the diagnosis of pneumonia; while "cough for more than 4 weeks" could be a filter for entering into a "pulmonary TB" module which will include questions on symptoms such as haemoptysis, weight loss, fever and difficulty in breathing. Combinations of an open section followed by a "closed" checklist, either with or without filters, can also be used. Of the 69 published studies, 3 used an open questionnaire, 19 used a structured questionnaire (checklist with or without filters), 26 used a mixed format and 21 did not

report the format used.

The advantages and disadvantages of open or structured questionnaires for health interview surveys have been discussed.[83,84] However, the relative merits of the various formats of VA questionnaire have not been formally assessed. An open format VA questionnaire would require more skilled, and probably medically trained, interviewers and would increase inter-interviewer variability. A check list without filters would not require medically trained interviewers and would reduce interviewer bias, because interviewers are forced to consider all symptoms even if they make their own diagnosis while interviewing. However this format may not capture all details of the symptoms leading to death and may also increase the number of symptoms that are falsely reported to have been present. A checklist with filters again would not require medically trained interviewers, may be more efficient for data collection, and may reduce interviewer bias. A potential limitation of this format is that a false negative response to a filter question will result in the exclusion of a disease category and thus in lower sensitivity of the VA. Filters and modules based on a specific category of cause of death have been used in VAs of childhood deaths where only a few causes of death were studied. However this format may be less useful for VAs for adult deaths because the mortality classification is likely to have a larger number of categories of cause of death.

The importance of qualitative field research into local concepts of disease and terminology, to facilitate the process of translation and back-translation of VA questionnaires, has been described.[86-89] The presence of several languages and dialects within small populations will pose problems for the choice of language for VA questionnaires. In these situations, one could design VA questionnaires in all the local languages in the study population or in one major language with an accompanying list of symptoms translated into all other local languages. Ideally, a "model" VA questionnaire

should be adaptable for different settings by incorporating the local concepts of disease and phraseology of symptoms.

Interviewers

Twenty four of the published studies used medically trained interviewers (13 by physicians and 11 by medical assistants/nurses), 38 studies used lay interviewers and one used a combination. Four studies did not report the type of interviewer. The educational level of lay interviewers varied from 7 years of education to university degree (24 studies did not describe the level of education of the lay interviewers). It has been argued that medically trained interviewers are preferable, but the relative merits of the use of lay versus medically trained interviewers for VAs have not yet been studied. Medically trained persons are costly. They are more likely than lay interviewers to interpret the responses to reach a diagnosis during the interview and this may affect the repeatability of the diagnosis. If lay interviewers are to be used, a carefully designed, highly structured questionnaire is needed and this has several implications, which are discussed earlier (see above). The preferred age, gender and education of lay interviewers will vary between different settings and with the choice of format of VA questionnaires.

Respondents

The best respondent is obviously the person who knows the most about the final illness of the deceased. Mothers are the principal respondents for childhood deaths. However, identifying the most appropriate respondent for adult deaths may be difficult because the relationship between carers and sick adults is likely to vary in different settings. For example, a spouse may not be the best respondent for female deaths and it has been suggested in the context of studies of maternal mortality that sisters are better respondents than husbands.[87] Thus it is important to enquire about the persons who

cared for or who lived with the deceased during the illness prior to death as well as about specific relationships to identify the most appropriate choice of respondent. In some cultural settings it may not be appropriate to restrict to a single respondent.

Recall period

The recall period in the reviewed studies ranged from 1 to 52 weeks in most studies. Two studies had used 37 and 42 months respectively, in one study it was up to 10 years and in another up to 50 years. Thirty eight studies did not report the range of recall period used. Accurate reporting of illness occurs when the illness in question is salient, and social and psychological barriers to reporting absent. Severe symptoms are remembered longer than mild ones and few physicians consultations better than frequent ones. Social and personal barriers are shaped by recall period and thus levels of recall error is different for different people at different time. Recall period of illness reporting as long as 12 months or more were used until recently but this is no longer thought to be sufficiently reliable. Furthermore, illness history can be telescoped ie. past events can be brought forward in retrospective interviews. Telescoping past events into the reference period of surveys will lead to an over estimation of death rates. This can also affect cause specific mortality rates if an illness unrelated to death is telescoped and reported during VA interviews. The implications of different recall periods for verbal autopsy interviews have not been studied. It is assumed that a period exceeding 52 weeks is not advisable for childhood deaths, but there is no empirical evidence for this. Adult deaths are relatively rare events and in some societies premature death of an adult is likely to be regarded as more significant than that of a child. Therefore it may be possible to use longer recall periods for adult deaths. On the other hand, one could argue that mothers are intimately involved in the care of a sick child and so they may report the symptoms preceding death of a child more accurately than a relative caring

for an adult. This would suggest that shorter recall periods might be necessary for adult deaths. Asking about a death soon after its occurrence may cause distress and so it may be advisable to define a minimum, as well as a maximum, recall period, as in several of the studies reviewed.

Derivation of Diagnoses

Diagnoses have been derived at differing stages in the VA process and by different types of assessors. The interviewers reached a diagnosis at the stage of interview in 13 studies (by a physician or medical assistant in 10 and by a lay interviewer in 3). Assessors who were different from the interviewers derived a diagnosis at a later stage in 39 studies. Seventeen studies did not report the stage of diagnosis or the type of assessors.

The procedures used to derive a diagnosis from VAs also varied in the reported studies. In 23 studies a pre-defined algorithm was used to derive diagnosis. In these 23 studies, an algorithm was used by one assessor in 9 studies, by a panel of assessors in 7 studies and by a computer in 2 study and the number of assessors was not reported in 5 studies. Thirty three studies did not use a pre-defined algorithm or criteria for reaching a diagnosis. In these 33 studies, diagnosis was reached by one assessor in 17 studies and by a panel of assessors in 16 studies. The procedure used for deriving diagnosis was reported by13 studies.

A diagnostic algorithm consists of standard criteria based on the duration, severity and sequence of symptoms and signs used to reach a diagnosis. The specificity of an algorithm will increase, and the sensitivity will decrease as the number of symptoms and conditions included in the algorithm increase. Algorithms can be developed from text book descriptions of symptoms, from existing clinical algorithms, from local clinical experience or from a combination of these.

Derivation of a diagnosis at the stage of interview raises several problems. The validity of a diagnosis derived at the interview by lay interviewers without algorithms is likely to be poor. Although derivation of a diagnosis at this stage by medical interviewers may reduce the proportion of deaths that remain unclassified, the repeatability of the diagnosis might be low if the diagnosis is derived without algorithms. Diagnostic algorithms for mortality classifications with 20 or more categories may be too complicated to be used during interviews, even by medically trained personnel. It would thus appear that diagnoses should be derived at a later stage, not at the interview.

Diagnoses derived according to diagnostic algorithms are likely to have better repeatability compared to diagnoses derived without algorithms. Therefore deriving diagnoses according to predefined diagnostic algorithms would be preferable for inter-population comparisons and to study changes in cause specific mortality over time.

Although 20 studies reported the use of algorithms only one described the process used to define the algorithms. The validity of certain diagnostic algorithms for common causes of childhood deaths has been discussed.[88] However, the differences in the algorithms defined by different processes have not been studied. Algorithms developed from local clinical expertise may vary between different settings and may not be appropriate for international comparisons. Algorithms defined from text book descriptions may not be appropriate in some settings due to differences in cultural perceptions of symptoms and signs of diseases. It is likely that a combination of approaches would be the best way to develop a first draft of diagnostic algorithms, which could then be refined by field tests.

Single versus multiple causes of death

Classification of causes of death into underlying, immediate and associated causes, and into primary and secondary causes, is complex and it is not clear that these terms are always used consistently. The ability to distinguish between an underlying and immediate cause based on VA information is doubtful. Insistence on a single cause of death is an attractive option, which would keep the analysis and presentation simple. However, ignoring multiple causes of death could lead to misleading results. One way of handling multiple causes of death would be to treat a common combination of causes as a category in its own right (e.g. having AIDS/tuberculosis (TB) as a separate diagnosis from either AIDS or TB) and to take this into account in the analysis and presentation of data. Alternatively, analysis could be performed by individual diagnosis, so that AIDS/TB contributes once to the AIDS category and once to the TB category. The presence of multiple causes of death will have an impact on the estimated sensitivity and specificity of VA diagnoses.

2.4.1 Issues in validation of VAs

The reported validity of VAs for childhood deaths varied considerably between studies[47-51] and between different causes of death. For example, in Kenya[47] the sensitivity was 89% and specificity was 96% for malnutrition and 28% and 91% respectively for acute respiratory infections (ARI). Furthermore, the sensitivity and specificity for the same cause of death varied between different settings and tools. For example, in Philippines[48] the sensitivity of VAs for ARI was 41%-86% and the specificity was 47%-93% depending on the diagnostic algorithms. These estimates of validity of VAs for ARI are quite different from those reported from Kenya.

Before the study reported in this thesis, there was virtually no information on the validity of VAs for adult deaths. There has been only one small validation study of 10

deaths in Liberia.[52] It is likely that the validity will vary in different settings, and so tools should be tested in several settings before being used to assess cause-specific mortality rates.[89]

Reference diagnosis

In order to assess the validity of diagnoses derived from a VA it is necessary to compare them with a reference diagnosis. Validation studies will thus involve identifying deaths whose causes have been diagnosed by a procedure taken as reference standard, and subsequently subjecting these deaths to verbal autopsy and comparing the diagnoses reached by VA versus the reference diagnoses. Reference diagnoses for validation studies should ideally be accurate and reliable, and the deaths studied should ideally be representative of the distribution of causes of death in the community. The following three options have been considered for reference diagnosis: (i) diagnosis of all deaths occurring in a given community; (ii) diagnosis reached by clinical necropsy (iii) diagnosis reached by a reference standard at hospital.

The choice of diagnosis of all deaths occurring in a community as reference would be less susceptible to selection bias. However, in places where VAs are needed only a small proportion of deaths in the community are likely to be seen by a physician and it will be impossible to establish a robust procedure to reach diagnoses of reference standard for all deaths. Thus is this is not a realistic option.

Diagnosis by necropsy may be accurate, but would be very difficult to achieve in many places where only a small proportion of deaths go to necropsy, and where necropsy is not culturally accepted. This may result in a strong selection bias as the deaths that go for necropsy tend to be atypical.

Choice of hospital diagnosis as reference may also introduce selection bias due to selective access, differential treatment success and the socio-economic characteristics of those who use hospitals; and the influence of hospitalisation on respondents' perception of cause of death. The standard of hospital diagnosis depends on several factors such as the training and experience of physicians, local diagnostic preferences and availability of diagnostic facilities. Snow and colleagues have illustrated some of the inherent biases of the hospital based approach to validate Vas[47,86]. Nevertheless those studies[47-51] which have tested the validity of VAs using hospital diagnosis as reference have been valuable in illuminating the limitations of VAs for childhood deaths.

2.5. Conclusion

VAs have been widely used for childhood deaths, but adequate appraisal of their validity has not always been addressed. The marked variations and imprecise reporting of the procedures applied in the reported studies have made comparisons of results from these studies difficult. Furthermore, it can not be assumed that methods appropriate for childhood deaths are necessarily applicable for adult deaths.

A considerable amount of methodological work needs to be done before VAs can be used on a wider scale to obtain useful and comparable data on causes of adult mortality for a range of developing countries. The increasing recognition of urgent need for data on adult mortality and morbidity may require wider use of VAs for adult deaths and this highlights the need for answers to the methodological questions discussed.

The best approach and the approach used for the development and validation of the model VA tool is shown in Panel 1.

Panel 1. Key issues involved in the development and validation of VA tools

Issues	Best approach	Chosen approach
1. Restricted or ICD-10 Mortality classification?	1. unclear	1. restricted
2. Open, closed, mixed or modules format Verbal Autopsy questionnaire?	2.Probably mixed	2.mixed
3. Medically qualified or lay Interviewer?	3. Unknown	3. Lay
4. Appropriate recall period?	4. may be 2-24 months	4. 2-24 months
5. Algorithmic or physician review approach for reaching diagnosis	5. unknown	5. both approaches
6. Appropriate reference diagnosis?	6. population based medically confirmed causes of death	6. hospital based medically certified causes of death

3. Methods

3.1. Development of the VA tool

A standard VA tool consists of a mortality classification, procedures for deriving diagnoses and a VA questionnaire. The prevalence and symptomatology of different causes of death and the factors related to data collection (interviewer, respondent and recall period) would alter the validity of VAs. However, the VA tool itself plays a significant role in the validity and repeatability of diagnoses reached by VAs. For instance, in a study in the Philippines the sensitivity and specificity of VAs for selected childhood deaths varied considerably depending on the diagnostic criteria used.[48] Similarly, the repeatability of VA diagnoses reached by a panel of physicians without diagnostic algorithms was low in the Gambia. In 27% (38/141) of cases, the first and subsequent diagnoses reached through agreement of at least two physicians differed when the VAs were reviewed on two occasions by the same three physicians.[90] This highlights the need for a standard VA tool. We made an attempt to develop a standard VA tool for assessing causes of adult death and in this chapter, the process used to develop the classification of mortality, procedures for deriving diagnoses and the questionnaire are described.

3.2. Mortality classification

First some existing mortality classifications were considered whether they were applicable for VAs: the ones recommended by the WHO[91] and the ones used previously by Preston[92] and the World Bank[93]. The "core" classification of the International Classification of Diseases (ICD-10), which is the mandatory level of coding for international reporting to the WHO mortality database has 21 chapters and 2046 categories of diseases, syndromes, external causes or consequences of the external causes.[91] The ICD-10 recommends a condensed list with 103 categories of causes of

adult death and a selected list with 80 categories for international comparisons and publications. Several causes of death from these lists are unlikely to be diagnosed through VAs (e.g. leukaemia, Alzheimer's disease and rheumatic fever) and, therefore, it is clear that these lists as they stand are not suitable for VAs.

Preston has used a broad mortality classification to quantify cause specific mortality rates from vital registration data for 43 national populations. This classification has eleven categories of causes of death (respiratory tuberculosis, other infectious and parasitic diseases, neoplasm's, cardiovascular disease, influenza/pneumonia/bronchitis, diarrhoea, certain chronic diseases, maternal diseases, diseases of infancy, violence, and other/unknown). Recently, Murray and colleagues further developed this classification for analysing causes of adult mortality in selected developing and developed countries.[93] They classified the causes of death at three levels; group level, subgroup/categories level and specific causes level. They had three groups of causes of death (communicable and reproductive diseases, noncommunicable diseases, and injuries). These groups were further divided into 16 categories of causes of death. Some of these categories were further divided into specific causes and there were 25 causes/categories at this level. Although this classification would be very useful for making policy relevant statements about adult mortality, some of the causes of death at the categories level (e.g. venereal disease, helminths) and several at the specific causes level (e.g. atherosclerosis) would not be easily diagnosed through VAs.

Having considered the above mentioned classifications, the frequency distribution of the causes of adult admissions and deaths reported during 1992 from the hospitals from our study sites (Jimma, Ethiopia; Ifakara, Tanzania; Bawku, Ghana) was obtained as an example of causes of adult deaths in rural hospitals in sub-Saharan Africa. The constellation of recognisable symptoms of the causes of deaths included in the mortality

classifications discussed earlier and also of those causes reported from the study hospitals were studied.

Then the mortality classification used by Murray and colleagues was modified to be suitable for VAs of adult deaths. Our working mortality classification (Table 3) includes six groups of causes of death; subdivided into 25 subgroups/categories and some of them are further divided into specific causes. At the group level, maternal causes were separated from communicable diseases since they would be easily differentiated in VAs. A "symptoms, signs and syndromes not classified elsewhere" group was introduced in order to accommodate categories of causes of death like anaemia which could be caused by communicable and non-communicable diseases. We also introduced "undetermined" as a separate group since a certain proportion of deaths would remain undetermined at this level. At the next level certain categories were perceived as difficult to diagnose through VAs (helminths, venereal diseases, endocrine, digestive) were excluded and some of them were replaced with syndromes (e.g. acute febrile illness (AFI)) or with combined categories (TB/AIDS). Although AFI is not a specific disease category, we assumed that it would be useful to analyse AFI mortality differentials between populations and over time. We also included certain categories (AIDS, tetanus and acute abdominal conditions) because they are policy relevant and could be diagnosed through VAs. We arrived at a classification consisting of 25 categories of causes of death at this level. At the third level, some of the categories are further divided into specific-causes/sub-categories; this level would apply only to those categories, which were possible to be differentiated into certain disease categories in a VA. The sub-categories of cardiovascular diseases and injuries are similar to the one used by Murray and colleagues; the sub-categories of AFI and maternal causes are very different. Several specific causes have been added at this level

(e.g. meningitis, typhoid and hepatitis) since they have well recognised control measures although the accuracy of their diagnosis through VAs is uncertain. Congestive cardiac failure (CCF) has been included as a sub-category although it could be due to several causes because of a lack of specific symptoms to diagnose the underlying causes. Malnutrition and hypertensive heart disease were not included as specific causes due to potential lack of accuracy in the diagnosis of these causes by VAs.

3.3. Procedures to derive diagnoses

There are several methods to derive diagnoses from verbal autopsies (Figure 2). We tested the validity of physician review and a hierarchical algorithm.

Physician review

We used three physicians who applied their own diagnostic criteria and reached a diagnosis independently. A cause of death was accepted when two or three of the physicians agreed upon a cause. If there was no agreement, the three physicians reviewed the available information as a group and attempted to reach a diagnosis through consensus. As we did not use pre-defined criteria for physician review of VA questionnaires, this procedure did not involve a developmental stage.

Diagnostic Algorithms

Essex has suggested diagnostic pathways for 49 common presenting symptoms for clinical diagnosis in primary health care delivery settings.[94] The identification of a single presenting symptom is an important step for the application of these pathways. Since it would be difficult to identify a single presenting symptom from a VA we deemed this approach unsuitable for VAs. We decided to identify constellations of positive and negative symptoms as criteria for reaching certain diagnoses rather than algorithms based on a presenting symptom. An example of such an algorithm to reach a

diagnosis of pulmonary tuberculosis (PTB) could be as follows: cough with sputum for >28 days + haemoptysis + loss of weight + absence of recurrent breathlessness on exertion and wheezing = PTB.

The first step was to draft diagnostic criteria for each category of causes of death included in the mortality classification by listing all the symptoms given in the Oxford text book of medicine[95]. Then, myself and two other physicians with working experience in Ethiopia, Tanzania and Zimbabwe classified the symptoms as essential, supportive or associate for each diagnosis in the proposed classification, according to their clinical experience and the definitions mentioned below, after reviewing the symptoms recorded in the hospital notes of 361 adults who had died in Ifakara Hospital, Tanzania in 1992.

Bang and colleagues have classified symptoms as essential, confirmative and supportive to derive diagnostic criteria for childhood deaths.[85] We classified symptoms as essential, supportive, differential and associate depending on the purpose for which they are included in or excluded from the algorithm.

Essential symptoms: These are criteria, which are necessary but not sufficient to reach a diagnosis. Ideally these symptoms should be present among all the patients with the diagnosis of interest. However, usually they will be present among most of the patients with the diagnosis of interest, but they may also be present among patients with other diagnoses. For example, in the above mentioned algorithm for PTB, cough with sputum >28 days is an essential symptom because it is usually present in most of the cases of PTB, but it is also likely to be present in most cases of chronic obstructive airway disease (COAD), lung cancer and CCF. It is a prerequisite to diagnose PTB, but is not sufficient to reach this diagnosis.

Supportive symptoms: These are symptoms which if present in combination with an essential symptom(s) help to exclude false diagnoses from the diagnosis of interest. However, they may not be present among many patients with the diagnosis of interest and they may also be present in other conditions. For example, haemoptysis and loss of weight are supportive symptoms as they in combination with a history of cough for >28 days, would differentiate PTB from COAD and CCF respectively. Haemoptysis, however, may also be present in lung cancer and CCF, and loss of weight in AIDS, malignancies and certain nutritional disorders.

Differential symptoms: These are symptoms, which should be absent in order to exclude false diagnoses from the diagnosis of interest. They are typically absent among the patients with the diagnosis of interest, but present among most of the patients with the false diagnoses that are based on essential symptoms. For example for PTB, wheezing is a differential symptom as this is present in most of the patients with COAD and its absence in combination with productive cough >28 days would differentiate PTB from COAD.

Associate symptoms: These are non-specific symptoms, which are present in many seriously ill patients or too difficult to recognise. For example, loss of appetite could be added to the above algorithm for PTB. Associate symptoms, however, are not included in the algorithm since they may be present in many life threatening diseases.

The next step was to simplify the diagnostic criteria in order to start with the most sensitive criteria; in this process all associate symptoms were excluded from the criteria. If a cause of death had more than one supportive symptom, then several diagnostic criteria were drafted by including only one supportive symptom in each criterion. The next step was to identify the potential misclassifications by each diagnostic criterion and

the differentiating symptoms for those misclassifications. Then, the differentiating symptoms were added to the criteria based on essential and supportive symptoms in order to improve their specificity. Associate symptoms were left out of the algorithms because we assumed that their inclusion would not improve the sensitivity or the specificity of the criteria. The process of developing diagnostic criteria is illustrated in Figure 3 using malaria as an example. Diagnostic criteria for the causes of death included in the working classification are shown in appendix 1.

The algorithms can be used in several ways. Diagnostic criteria, which include all differentiating symptoms, could be applied in any order without terminating the algorithm once a diagnosis is reached. In this approach more than one diagnosis is likely to be reached for some cases. The diagnostic criteria could be applied in a hierarchical fashion starting with the most specific ones; once a diagnosis is reached, the algorithm is not used any further for that individual. In hierarchical algorithms the differentiating symptoms of the diagnosis appearing in a given step may not be included in the next step since most records with the first diagnosis would have been excluded from the next stage of the process of diagnosing, provided the sensitivity of the diagnostic criteria is close to 100%. The hierarchical algorithm that was used to derive diagnoses in our multi-centre validation study of VAs is shown in Figure 4.

3.4. VA questionnaire

After reviewing the content and format of several VA questionnaires, and discussing the options of the formats in an international workshop, we opted to produce a combined open/closed format VA questionnaire (appendix 2). The open section allows the interviewer to record the respondent's verbatim account of the illness and in order to facilitate this we included a table to list the reported symptoms, their duration and severity. To draft the modules of questions for the closed section, all the essential,

supportive, associate and differential symptoms which form the diagnostic criteria related to the mortality classification and also certain other symptoms which are not included in the suggested criteria were listed (e.g. paraplegia, pale looking, puffiness of face). The questions to elicit the presence or absence of these 40 symptoms form the stem questions of the modules and the questions on duration, severity and other qualities of these symptoms form the sub-questions which are to be asked only when the answer to the stem question is positive. Several questions on socio-economic and demographic information of the deceased person and the respondents, and on general circumstances and events leading to the death were also included in separate sections in order to study the influence of these factors on the validity of VAs.

The VA questionnaire was translated in the local languages spoken in our study sites (Amharic and Orominga in Jimma, Ethiopia; Kiswahili in Ifakara, Tanzania and Kusaal in Bawku, Ghana). In each site to start with several patients, traditional healers and birth attendants were asked about symptoms of illness and their descriptions were recorded. These symptoms were translated into English by three non-medical and two medical translators individually. Then, as a group, they discussed the differences in the translations and agreed on a list of symptoms (local symptoms). Following this, they incorporated the local symptoms into the proposed VA questionnaire and translated individually into the local language. Then as a group they agreed on a draft questionnaire after discussing the differences between their translations. Another group which also included three non-medical and two medical person back-translated the draft questionnaire into English. Any question, which differed from the proposed questionnaire, was discussed by both groups and the final draft was produced. Two interviewers were trained to use this questionnaire and 15 VAs were conducted to field test the questionnaire. Finally, the proposed VA questionnaires in the local languages

were produced by incorporating the changes made during the field testing.

The pilot studies showed that some of the symptoms included in the questionnaire (e.g. types of rashes, puffiness of face, pale looking) and their severity may not be recognised in certain cultures. Although the questionnaire has been carefully translated it was noted during the pilot study that many symptoms needed further explanations using certain gestures or demonstrations for the respondents to understand them. For instance, stiffness of whole body was better understood when demonstrated rather than just asked. Furthermore, the attitude and intonation of interviewers may vary and this could alter the responses to the questions. We carefully considered the issues such as the use of appropriate gestures, demonstrations, intonation and attitude while training interviewers for the validation study.

3.4. Study sites

Through the existing research links between LSHTM and local research councils, we identified one district hospital each in Ethiopia, Tanzania and Ghana for validating the VA tool. The selection of these countries were based on the assumption that the sample population would represent the population of East, South-central and west Africa and also that the a validated VA tool would be useful for the demographic surveillance systems (DSS) operating in these countries. At the time of selecting the study sites, there was a DSS in at least one district in these countries – Butajira district in Ethiopia, Hai, Morogoro and Dar es Salaam districts in Tanzania and Navrongo district in Ghana. We considered the following factors for selecting these hospitals: (i) type of catchment area should be rural village township; (ii) number of in-hospital adult deaths per year should be>150 per year; (iii) number of physicians be at least 1 physician per 50 beds, quality of the clinical laboratory services; (iv) the hospital admission and discharge registration system should be robust; (v) the VA should be local research priority. Thus

the he study was conducted in Jimma Hospital, Jimma, Ethiopia; St Francis hospital, Ifakara, Tanzania; and Bawku Hospital, Bawku, Ghana.

3.5. Recruitment of Study Subjects

All adults (Age >14 years) who died in the study hospitals were recruited into the study over a period of 18 months. The registration clerks were motivated to improve recording of addresses of patients who are admitted to the hospitals. The clerks recorded for each patient the house number, an identifiable landmark such as bus stop, shop, School etc. In addition they recorded the name of the peasants' association in Jimma and the name of the ten- household-unit leader in Ifakara. These are identifiers were very useful in Jimma and Ethiopia since they have been in use for a long time in the local administrative system. In addition to this, a surveillance system to identify all seriously ill adult patients and to improve the quality of hospital records of identification and clinical data was started in all three hospitals. Two medical assistants who were employed in the project identified and completed a proforma of identification and clinical data for all patients who were admitted to the hospitals with life threatening diseases.

3.6. Reference diagnoses

All the study hospitals had physicians with good clinical experience, and also had facilities to do X-ray investigations and essential laboratory tests including the ones for HIV. In addition Ifakara Hospital had facilities for sonography and endoscopy, and Bawku Hospital had sonography.

A local physician and I reviewed the seriously ill patient proforma and the hospital records in each site. If a certified cause of death was supported by a postmortem, surgical operation findings, laboratory tests or typical clinical signs then that

diagnosis was classified as "confirmed". If a certified cause of death was not supported by any of these criteria, but the clinical history was suggestive of the diagnosis then it was classified as "suggestive". If a diagnosis could not be reached based on the information given in the hospital notes then it was classified as "unknown". However, the suggestive and unknown categories of cases were not excluded from the reference diagnoses to estimate the sensitivity and specificity of VAs and the reasons for this are discussed in chapter 5.

3.7. VA tool and data collection:

The process which was used to develop the verbal autopsy questionnaire (VAQ), the mortality classification and the diagnostic criteria is described earlier on. We used the same VAQ, adapted and translated into the local languages after qualitative research in the three sites.

Although the advantages of lay interviewers compared to medically trained ones are debatable we opted for lay interviewers since medical personnel would be more expensive and are often not readily available in sub-Saharan Africa. The interviewers had at least 12 years of formal education but were not medically qualified. They each received ten days of training in conducting VA interviews, covering all aspects of the process.

The training aimed to equip them with appropriate knowledge, skills, attitude and practice in order to obtain accurate information from the respondents. The interviewers were made to understand the questionnaire; to anticipate and deal with difficult and different responses; to understand, translate and record accurately the responses; and to improve interviewing skills, the ability to understand and deal with difficult responses

and the team spirit. Training materials included a VA manual (Appendix 3) and teaching/learning methods included short presentations on overview of study objectives, tools and procedures, and reading, small group discussions, role-plays and practical field work under supervision. Each interviewer conducted at least 2 VA interviews in my presence during the practical fieldwork.

There were eight interviewers (7 male, 1 female) in both Ifakara and Jimma, and ten interviewers in Bawku (7 male, 3 female). The VA interviews were conducted during "home" visits in October/November 1994 in Ifakara, February/March 1995 in Jimma and May/June 1995 in Bawku. The recall period was 1-15 months in Ifakara and 1-21 months in Jimma and Bawku.

3.8. VA Interviews

The interview process had the following six steps: (i) identification of the household of the deceased/respondent; (ii) expressing sympathy for the loss of the deceased; (iii) introduction of the objectives and obtaining consent; (iv) identification of an appropriate respondent(s) (v) interviewing the respondent(s) using the VA questionnaire; (vi) closing the interview with an expression of thanks.

The interviewers were provided with a letter from the local health authorities to introduce them and the objectives of the interview. The head of household and the respondent(s) were assured that the information given by them will be confidential. The lack of information on common causes of death and the need for such information to identify appropriate interventions were explained to them. After the introduction, verbal consent was obtained from the head of household and the respondent(s) to proceed with the interview.

The appropriateness of the respondent was graded into the following two categories. (1)

Appropriate: looked after the deceased during the final illness at home and/or hospital and or lived in the same house and knows about the illness of the deceased but did not look after during the final illness. (2) **Probably appropriate:** lived at a different house but visited the deceased frequently and knows about the illness.

Whenever possible we interviewed a respondent from the appropriate category, but in situations where such a respondent did not exist or was unavailable, a person from the probably appropriate category was selected. All potential respondents were first listed in the respondent identification form (appendix 4) and, graded for their appropriateness and availability. After the best respondent was identified we established whether he or she was present at the time of visit (**present**) or away at the time of visit but could be contacted if revisited or moved house but could be reached(**absent**) or impossible to contact for some reason e.g. gone for a long trip, moved house to a far away place (**unavailable**). If the best respondent was absent the household was revisited at a later date. If the interviewer failed to contact any respondent on three occasions or the respondents refused to participate, that death was excluded from the study. In situations where more than one respondent were encountered, the additional respondents were allowed to participate in the interview.

The purpose of the study and uses of results of the study were explained to the head of the household and the selected respondents. Talking about the circumstances and illness history of a close relative or friend is sensitive. It can cause emotional and psychological stress especially when the death of young adults. The interviewers were carefully trained to cope with such situations and to provide emotional support to bereaved relatives. Only after obtaining verbal consent from the head the household and respondents verbal autopsy interviews were conducted. Surprisingly majority of the

head of households and respondents were very co-operative and willing to share any information regarding the death. Only on two occasions the respondent burst into tears and the interviews had to spend a long time to calm them down.

3.9. Reaching diagnoses from VAs:

Two methods were used to reach diagnoses from VAs. Three physicians who had worked in sub-Saharan Africa independently reviewed the completed questionnaires from all three sites and where possible assigned a primary underlying cause of death and where appropriate co-primary and immediate causes of death. The physicians were aware of the study objectives and sites, and were given a copy of the proposed mortality classification. They were not given diagnostic algorithms and they were allowed to reach diagnoses not included in the mortality classification. A diagnosis was considered to be reached if two of the three physicians agreed on the primary cause of death. If all three disagreed on the primary cause of death, the VAQ was reviewed by the panel and where possible a diagnosis was reached by consensus. Although the physicians were instructed to assign multiple causes of death if appropriate, if two physicians agreed on the primary cause of death, then the VAQ was not reviewed even if they all disagreed on the co-primary or immediate cause. We also derived primary causes of death using a computerised hierarchical algorithm based on "expert opinion" (Figure 4) discussed in section 3.3.

3.10. Sample size

Ideally the sample size for a study to validate a VA tool should be estimated to give a sufficient number of deaths due to the rarest cause of interest to provide an acceptable confidence interval around the estimated validity of the VA for that cause. If the desired confidence limits are +/-10% for a sensitivity of 80% for a diagnosis, then approximately 100 deaths due to the given cause are required. Thus if the expected

proportion of the total deaths due to that cause is 10% then 1000 deaths are required in total. The specificity will generally be estimated more precisely than the sensitivity, but will also vary with the proportional mortality of the cause in question.

The number of adult deaths in the study hospitals ranged from 200 to 250 per year and the recruitment of study subjects was planned over a period up to 18 months. A 10% loss to follow up was anticipated due to inadequate address and migration. Thus a total of 250 to 350 VAs was expected in each study site giving a total of 900-1000 VAs. This sample size will not be adequate to estimate the validity measures precisely for each and every causes of adult death. However, it would include adequate samples of common causes of death i.e. malaria, meningitis, gastro-enteritis, AIDS, and TB; also certain useful broad categories of causes ie. AFI, maternal causes, disorders of cardiovascular system, acute abdominal conditions and external causes.

3.11. Analysis

We calculated sensitivity and specificity of VA for each causes of death. We also assessed the agreement between the observed and estimated number for each cause of death by kappa statistics. For the comparison of the overall performance of VA between the three sites and for assessing the effect of the characteristics of respondents on the validity of VA, we calculated weighted sensitivity, specificity and kappa. We used the cause specific mortality fractions as weights for each cause of death and summed up the weighted measures of each cause of death for estimating the weighted sensitivity, specificity and kappa. For example the weighted sensitivity = $\sum$sensitivity of cause of death$_i$ * CSMF of cause of death$_i$ where there were *n* number of causes of death.

Initially the analysis of sensitivity, specificity and kappa was performed for six groups

of causes: (1) communicable diseases (acute febrile illness(AFI), TB/AIDS, diarrhoeal diseases, tetanus and rabies, and other specified diseases); (2)maternal causes; (3) non-communicable diseases (CVS disorders, cirrhosis of liver, acute abdominal conditions, neoplasms, renal disorders and other specified diseases), (4) non-specific signs and syndromes, (5) injuries, and (6)undetermined. Within the communicable and non-communicable diseases groups, analysis was then performed for individual causes of death.

4. Results

4.1. Characteristics of respondents and recall period

A comparison of selected characteristics of respondents and recall period that might influence the accuracy of VA between the three study sites are shown in Table 4. Nearly half of the respondents were males in Ifakara and Jimma, but the proportion of male respondents was significantly higher in Bawku (69%). There was no significant difference in the age distribution of respondents between the sites. Most of the respondents were 15 to 59 years of age. The proportion respondents who did not have any formal education at all was slightly higher in Ifakara compared to Jimma (28 vs 20%; P=.04) and was significantly higher in Bawku (81%). Most of the respondents were either spouses or close relatives (brothers, sisters, sons, daughters, or parents). The proportion of spouses was higher in Jimma compared to Ifakara (30 vs 18%: P<.001). More than 80% of respondents in all three sites were appropriate i.e. they had cared for the deceased during the illness that lead to death. However the proportion of very appropriate respondents was significantly higher in Bawku (95%) compared to Ifakara (82) and Jimma (86). The primary language of the respondents was the same as the VA questionnaire for a high proportion of respondents in Ifakara (91% spoke Kiswahili) and Jimma (86% spoke Amaringa or Orominga). However only 57% of the respondents' primary language was Kussal (the VAQ language) in Bawku. The recall period was similar between Ifakara and Jimma but the proportion of VAs with a recall period more than 13 months was higher in Bawku compared to Ifakara and Jimma.

4.2. Response rate

The response rate ranged from 76 to 85% in the three sites (Table 5). The most common cause for non-response was lack of adequate contact address. There were only four refusals 2 in Ifakara and 2 in Bawku. A comparison of the distribution of cause

specific mortality between those eligible for inclusion and those actually studied are shown in Table 6. Although we were unable to trace 22% of the eligible deaths the selection bias arising from this exclusion would minimal as there were no substantial differences in cause specific mortality fractions (CSMFs) between the eligible and the actual study populations.

4.3. Reference diagnoses

Diagnosis of the cause of death was confirmed in just under 80% of deaths overall (ie. Supported by laboratory of typical clinical signs – none these cases were confirmed by post-mortem examination): 78% of diagnoses were confirmed in Ifakara, 76% in Jimma and 79% in Bawku (Table 5). However, only 50% of deaths due to malaria were confirmed with a positive blood film in all three sites. Only 25% of deaths due to hepatitis were confirmed in Ifakara. The proportion of deaths confirmed was low for pneumonia was low in Ifakara (50%) and in Bawku (10%).

There was considerable variation in the distribution of causes of death between the sites. In Ifakara 63% of all deaths were due to communicable diseases and 24% due to non-communicable diseases, while the corresponding figures were respectively 51% and 31% in Jimma and 56% and 27% in Bawku. In Bawku there were relatively higher proportions of death from meningitis, hepatitis, and neoplasms and lower proportions from malaria, TB/AIDS and liver diseases than in the other sites. In Jimma the proportions of death from acute abdominal conditions (including strangulated hernias and gastrointestinal haemorrhages) and injuries were higher, and those from meningitis, diarrhoeal diseases and anaemia were lower, than at the other sites. In Ifakara, the proportion of deaths from diarrhoeal diseases was high, and of direct maternal causes (including abortion, obstructed labour, eclampsia, haemorrhage and puerperal sepsis)

was low, compared to Jimma and Bawku.

4.4. Effect of respondents' characteristics and recall period of VA

A comparison of the weighted sensitivity, specificity and Kappa between different classes of respondent characteristics in each site is shown in Table 8. In Ifakara there was no statistically significant difference in weighted sensitivity or specificity between different classes of characteristics. In Jimma the weighted sensitivity was higher for respondents with 7+ years education compared to respondents without any formal education (71 versus 55%; $p<.05$). In Bawku respondents with 7+ years had lower specificity compared to those without any formal education (32 versus 60%; $p<.05$). Interestingly the recall period had very little effect on the sensitivity or specificity of VA. Although the respondent characteristics and recall period had no significant effect on the sensitivity and specificity of VA, certain characteristics had an effect on the agreement between the true and estimated numbers of certain causes of death. In Ifakara kappa was low for close relatives compared to spouses (0.47 versus 0.80); for probably appropriate respondents compared to most appropriate respondents (0.39 vs 0.58); for respondents with primary language other than Kiswahili (0.44 vs 0.56) and for recall period 1-6 months compared to 7+, months (0.48 vs 0.57). In Jimma the kappa was low for 60+ year old respondents compared to 15-59 year old ones (0.53 vs 0.69); for respondents with no formal education compared to those with 7+ years of education (0.53 vs 0.72); for spouses compared to distant relatives and friends (0.60 vs 0.76). In Bawku the kappa was low for 15-59 year old respondents compared to 60+ year old ones (0.54 vs 0.64); for respondents with 7+ years of formal education compared to those with none (0.32 vs 0.60); for probably appropriate respondents compared to appropriate respondents (0.01 vs 0.59) and for respondents with primary language other than Kusaal (0.48 vs 0.61). The relationship between respondent characteristics and the

agreement between true and VA estimates of causes of death is inconsistent between sites. For example the respondents with better education had good agreement in Jimma while they had poor agreement in Bawku. This not entirely surprising since the agreement between true and VA estimates of number of each cause of death is affected by the complex relationship between prevalence of each cause of death, sensitivity, and specificity..

The over overall weighted specificity was lower in Jimma and Bawku compared to Ifakara (89 vs 94%; $p<.05$) and the Kappa was higher in Jimma (0.70) compared to Ifakara (0.55) and Bawku (0.56). These differences were not explained by the effect of any particular factor – this is an inherent operational characteristic of VA by site per se than due to any differential effect of respondent characteristics or recall period.

4.5. Validity of VAs by physician review

There was agreement between the independent diagnoses of at least two physicians for 78% of deaths in Ifakara, 74% in Jimma and 70% in Bawku. The remaining VA diagnoses were agreed by the panel after reviewing the VAs. Table 9 shows the sensitivity, specificity and Kappa for the six groups of causes of death. At all sites the specificity was greater than 85% for all groups except communicable diseases, and greater than 95% for maternal causes, non-specific syndromes and injuries. The sensitivity was always lower than specificity, but exceeded 75% for all causes except non-communicable diseases and non-specific syndromes. However the level of agreement between the true and VA estimate of number of each cause of death was variable. There was a good agreement for communicable causes of death in all three sites (Kappa ranged from 60 to 67%). For direct maternal causes there was very good agreement in Ifakara (kappa 83%) and good agreement in Jimma (76%) and Bawku

(62%). For non-communicable causes the agreement was good in Jimma (Kappa 67%) and fair in Ifakara (57%) but poor in Bawku (47%). For nonspecific syndromes the agreement was fair in Ifakara (kappa 51%) and poor in Jimma (0%) and Bawku (35%). There was very good agreement for injuries in all three sites (kappa raged from 79 to 100%).

When the individual communicable and non-communicable diseases were analysed (Table 10) the specificity fell below 95% in only a few instances: AFI in all three sites; TB/AIDS in Ifakara and Jimma; and diarrhoeal diseases in Ifakara. Sensitivity, however, varied both across the sites and between causes: sensitivity was greater than 75% for rabies, tetanus (Ifakara, Jimma), acute abdominal conditions (Ifakara), and pneumonia and neoplasms (Jimma). Sensitivity was 60-74% for diarrhoea (except Bawku), meningitis (Ifakara), TB (Jimma), AIDS (Jimma) and renal disorders (Bawku).

When malaria, meningitis, hepatitis, pneumonia and other acute febrile illness were amalgamated into a single category the sensitivity ranged between 60 and 75%. Similarly the combined category of TB/AIDS had a sensitivity above 75% in Ifakara and Jimma and 56% in Bawku. Among communicable diseases the PPV was >75% for tetanus and rabies in all three sites, for hepatitis and TB in Ifakara and Bawku, for meningitis in Ifakara, and for pneumonia in Jimma.

VA estimates of acute febrile illness as a subgroup had fair agreement with the true number of acute febrile illness deaths in Ifakara (57%) and Jimma (63%), but kappa was only 48% in Bawku. Individual febrile diseases had poor agreement with the exception of meningitis in Ifakara (68%) and Bawku (54%), hepatitis in Bawku (50%) and pneumonia in Ifakara (89%). TB/AIDS as a subgroup had good agreement in all three sites – kappa ranged from 62 to 70%. However when this subgroup was broken down

into TB or AIDS the agreement was weak. For TB the kappa was fair in Ifakara (59%) and Bawku (53%) but poor in Jimma (41%). For AIDS kappa was good only in Bawku (61%). There was fair agreement for diarrhoeal diseases in Ifakara (60%) and Jimma (52%) but this was poor in Bawku (25%). Tetanus had a perfect agreement (100%) in Ifakara and Jimma and good agreement in Bawku (66%). Rabies also had a good agreement in Ifakara (83%) and Bawku (100%).

In Ifakara, acute abdominal conditions is the only subgroup of noncommunicable causes of death that had a good agreement (61%). In Jimma, all subgroups of non-commuicable causes of death had a fair agreement (kappa 54 to 61%) with the exception of cirrhosis of liver (kappa 47%). In Bawku, CVS disorders and acute abdominal conditions are the only subgroups of non-communicable diseases that had a good agreement (kappa 62% and 51% respectively).

4.6. Validity of VAs by diagnostic algorithm

The algorithm classified 11% of VAs as unknown in Ifakara, 7% in Jimma and 10% in Bawku. The sensitivity, specificity and Kappa of VA diagnoses reached by the algorithm for the six groups of causes of death are shown in Table 11. The sensitivity was >75% for injuries in all three sites and for communicable diseases in Ifakara and Jimma. The specificity was >85% for direct maternal causes, noncommunicable causes, nonspecific syndromes and injuries and <85% for communicable diseases in all three sites. The agreement between the true and VA estimates causes of death was poor (kappa ≤50%) for communicable and noncommunicable diseases and nonspecific syndromes in all three sites. The agreement was good (kappa >60%) for direct maternal causes and injuries in all three sites.

The sensitivity, specificity and Kappa of VA diagnoses reached by the algorithm for selected communicable and noncommunicable diseases or subgroups of diseases are shown in Table 12. None of the subgroups of diseases had sensitivity more than 75%. For several communicable diseases the specificity fell below 95%: for AFI in all three sites; for malaria and meningitis in Jimma and Bawku; for hepatitis in Bawku; for TB/AIDS in Ifakara and Jimma; for TB in Jimma; for AIDS in Ifakara and Jimma. For noncommunicable diseases the specificity was >95% for all subgroups of causes except CVS disorders in Ifakara.

The agreement between the true and VA estimates of individual causes of death was low. The kappa was more than 50% for a few causes only – for unspecified febrile illness, TB/AIDS, tetanus and rabies in Ifakara and for TB/AIDS in Jimma.

4.7. Comparison of validity of physician review versus algorithm

A comparison of the validity of VAs using these two diagnostic procedures in the combined population (data from all three sites pooled together) is shown in Table 13 and 14. At the group level specificity was similar for the two methods except for communicable diseases for which the diagnoses reached by physicians had a significantly higher specificity (78% vs 68%; $p<.01$). However, the sensitivity of VA diagnoses by physicians' review was consistently higher for all groups of causes and the kappa was also higher for all groups of causes of death. Although the specificities of VA by the two methods for the individual communicable and non-communicable diseases were similar, the sensitivities of VA by physicians were consistently higher for all causes except for rabies and diarrhoeal diseases. The kappa of VA by physician was consistently higher than VA by algorithms for all communicable and noncommunicable diseases. Generally there was good agreement

between reference standard CSMFs and VA estimates reached by physician review and algorithms (Figures 6,7,8). Physician review over estimated diarrhoeal diseaes and acute abdominal conditions in Ifakara. The algorithms over estimated acute abdominal conditions in Ifakara, TB/AIDS and diarrhoea in Jimma, and underestimated acute abdominal conditions in Jimma and CVS disorders in Bawku.

4.8. Validity of VAs by physician review for maternal causes of death

For the individual direct causes of maternal deaths the specificity was 98% or higher (Table 15) except for ante/postpartum haemorrhage (97%) and the sensitivity was more than 60% except for eclampsia (40%). For common indirect causes of maternal death, the specificity was more than 98%, but the sensitivity was less than 50%. The kappa was >60% for abortion, obstructed labour and haemorrhage. For rest of the individual causes the kappa was <50%.

4.9. Validity of VAs by algorithm for maternal causes of death

When the VA diagnosis was reached by algorithm the specificities remained high but in general the sensitivities were lower. For individual direct maternal causes, the specificity was 98% or more for all causes (Table 15), but the sensitivity was generally low (>60% for ante/postpartum haemorrhage only). Similarly for individual indirect causes, the specificity was 98% or more for all causes except for acute febrile illness (95%), but the sensitivity was low (>60% for hepatitis only). Kappa was also generally lower for VA diagnoses by the algorithm than by physician review. None of the causes had a kappa >60%. Kappa was >50% for abortion, obstructed labour, haemorrhage and hepatitis.

4.10. Misclassification of causes of death by physician review of VA

The patterns of misclassification of causes of death by physician review in the three sites are shown in Tables 16, 17 and 18. There was no clear pattern of misclassification in causes of deaths in all three sites. Misclassification was observed among all causes, with the exception of injuries and to some extent, direct maternal causes. However, the false negative and false positive rates varied among causes of deaths and for any given cause of death between sites. For example, the false negative rate of AFI (the proportion of AFI cases misclassified as other causes) ranged from 0% to 9% in Ifakara (0/82 was misclassified as direct maternal causes and 7/82 was misclassified as TB/AIDS or CVS disorders); 0% to 5% in Bawku (0/93 was misclassified as injuries and 5/95 was misclassified as direct maternal causes); and 0% to 16% in Jimma as injuries (0/61 was misclassified as injuries and 10/61 was misclassified as TB/AIDS). Furthermore, the proportion of false negatives of a causes of death contributed by a given cause of death differed between the sites. For instance, the proportion AFI misclassified as TB/AIDS was 9%(7/82) in Ifakara while this misclassification was only 1%(1/93) in Bawku.

4.11 Misclassification of causes of death reached by VA algorithm

Misclassifications of causes death occurring when VA diagnoses reached by the algorithm are shown in Tables 19,20,21. Similar to the VA diagnoses by physician review all causes of death had false positive and false negative diagnoses with the exception of injuries. The differential misclassifications between causes of death and between sites observed in the VA diagnoses reached by physician review was also seen in the VA diagnoses reached by the algorithm. The level of misclassification in VA diagnoses by the algorithm was generally higher than that occurred in the diagnoses reached by physician review of VAs.

4.12. Misclassifications maternal causes of death by physician review

The misclassifications between individual causes of maternal death were mostly bi-directional and often the numbers of false positives and false negatives were similar (Table 22) . For instance 2 cases of abortion were misclassified as non-maternal causes (NMC) and 2 cases of NMC were misclassified as abortion. However, there were exceptions. For example, there was no false negative diagnosis of haemorrhage, but there were 8 cases of false positive diagnoses for cases of obstructed labour, puerperal sepsis, acute febrile illness (AFI), TB/AIDS, anaemia and other maternal causes. On the other hand, while 6 cases of AFI complicating pregnancy were misclassified as NMC, only one NMC was misclassified as AFI

4.13. Misclassifications of maternal causes of death reached by the algorithm

The pattern of misclassification of maternal causes of death by the algorithm is shown in Table 23. The number of misclassifications between individual causes was higher in the VA diagnoses reached by the algorithm than the VA diagnoses reached by physicians. For instance the following bi-directional misclassifications occurred in addition to those occurring in the VA by physicians: between obstructed labour and TB/AIDS; hepatitis and NMC; TB/AIDS and AFI; TB/AIDS and anaemia/CCF; AFI and anaemia/CCF. However, the numbers of false positives and false negatives were more balanced in the VA diagnoses by algorithm than the VA diagnoses by physicians.

5. Discussion

5.1. Reference diagnoses

Any validation study of a verbal autopsy tool faces the question of how to obtain a suitable reference diagnosis. We chose to use a population of hospital deaths and to accept the hospital diagnosis as our "gold standard". In our study population 22% of the reference diagnoses were not confirmed and had only a suggestive clinical history. These could have been classified as undetermined, or excluded from the analysis, but we included them, taking all suggestive and confirmed diagnoses as our reference. Inclusion of the unconfirmed cases into the undetermined category would distort the cause specific mortality proportions and the estimates of validity measures. Total exclusion was felt to be inappropriate since we believe that VAs would be a useful tool if the VA diagnoses could correlate with hospital diagnoses irrespective of the certainty of hospital diagnoses - in other words if the VAs give information which is as good as the hospital physicians are currently giving. As deaths due to malaria had the maximum level of unconfirmed cases we assessed the effect of inclusion of unconfirmed cases on the estimates of sensitivity, specificity and kappa by estimating these measures for confirmed cases of malaria. In this analysis, VA diagnosis reached by physician review had a slightly higher sensitivity (41 vs 33%), specificity (94 vs 93%) and Kappa (0.31 vs 0.26) than in the analysis that included both confirmed and unconfirmed cases of malaria; the VA diagnosis reached by the algorithm also had a slightly higher sensitivity (21 vs 19%); specificity (91 vs 90%) and kappa (0.10 vs 0.09). However none of these differences were statistically significant and thus we believe the effect of inclusion of unconfirmed cases in our analysis on the estimates of validity measures would be small.

Although there was no difference in the distribution of causes of death between the

eligible and the actual study populations, the observed cause specific mortality fractions may not be applicable to the overall population in the study sites because deaths from some causes may be more likely to occur in hospital than from others. The varying CSMFs observed between the sites could be due to differences in health care seeking behaviour of the study populations, quality of health services and treatment success, or to prevailing morbidity patterns. The high maternal mortality seen in Ghana and Ethiopia is consistent with previous reports[96,97] and the low mortality due to injuries in Ifakara could be due to the fact that the hospital is far away from main roads. The low mortality from maternal causes and injuries in Ifakara may partly account for the low proportion of both male and female deaths in the 15-44 year age group. The low mortality from TB/AIDS in Bawku may be due to differences in the stage of the AIDS epidemic.

One of methodological question is that can we combine the data from the three sites in order to increase the sample of deaths for specific causes. We selected the three sites on the basis that socio-cultural background and the epidemiological pattern of causes of death would be different in the east, southern and west African regions. Our data shows that the distribution of causes of death is different at rural district hospitals in these three regions. However it not clear whether this difference is due to the differential use of hospital services between the three sites or indeed due to the difference in the underlying causes of death in the community. If we assume that the distribution of causes of death in the community is similar between the three sites and the observed differences are primarily due to differences in the health services related factors then combining the data is justified. However it appears that there is a difference in the underlying morbidity and mortality in these communities and thus we decided not to combine the data for estimating the sensitivity, specificity and kappa of VA. We have

combined the data while comparing the validity of VA reached by physician review versus the algorithm. The estimates of sensitivity, specificity and kappa observed in this analysis are meaningful as a relative measure for comparing the efficiency of physician review versus the algorithm – they are not applicable to any particular population.

5.2. Characteristics of respondents

The variation in the characteristics of respondents between Ifakara and Jimma was small but the respondents in Bawku differed on several characteristics. This substantial difference in the characteristics of respondents between Bawku and the other two sites is in part due to the differences in the social structure of families in these sites. In Bawku several families live in large compounds headed by an elderly person (often a man) who was responsible for taking care of births, illness and other important events occurring in the compound. Such a system did not exist in Ifakara and Jimma. This explains why there were more male respondents with no formal education in Bawku than in the other two sites. While Tanzania (Kiswahili) and Ethiopia (Amharinga and Orominga) had their own national languages, northern Ghana, Bawku district in particular did not have a common local language. There are five different tribes (Kusassi, Mamprusi, Frafra, and Hausa) living in Bawku and English is the common language in this population. Thus it is not surprising that the proportion respondents who spoke Kusaal (the local language used for the VAQ) was small compared to the proportion of population who spoke Kiswahili in Ifakara and Amharinga or Orominga in Jimma.

5.3. Effects of characteristics of respondents and recall period on validity of VA

Within the three sites the influence of characteristics of respondents and recall period on sensitivity and specificity of VA was small. From this observation of association between length of recall period and the sensitivity and specificity of VA, we can

speculate that the memory of events leading to a death is retained for long periods, may be up to three years or so. Thus it appears that it is acceptable to extend the recall period of VAs, may be up to three years. Although the appropriateness and the primary language of respondents had very little effect on the sensitivity and specificity of VA, the kappa was considerably low for less appropriate respondents and for those whose primary language was not the same as the language of the VA questionnaire. This can be explained by the plausibility of misunderstanding of VA questions and misreporting of symptoms and signs. This highlights the point that every attempt should be made to identify the most appropriate respondent and to develop the VA questionnaire in the primary language of the respondents. However when large community based studies using VA are carried out it is inevitable that certain proportion of respondents would be less appropriate. Furthermore developing a VA questionnaire in all principal languages spoken in a region like northern Ghana is not feasible as there are too many languages. Thus we did not exclude the VAs done with less appropriate respondents and/or with non-VAQ language from the analysis.

5.4. Effect of CSMFs on sensitivity and specificity of VA

The sensitivity and specificity of VA and CSMFs differed among the three sites. The sensitivity for acute febrile illness (AFI) was lower and specificity was higher in Ifakara than in Bawku (60 vs 74% and 94 vs 75% respectively; $P<0.05$) and the CSMF of AFI also differed between these two sites (26 vs 40%; $p<0.05$). Similarly, the specificity differed significantly for TB/AIDS and direct maternal causes between Bawku and Ifakara (93 vs 99.5% and 99 vs 96% respectively; $p<0.05$) and so did their CSMFs (24 vs 8% and 3 vs 8% respectively; $p<0.05$). Between Ifakara and Jimma, the sensitivity for direct maternal causes (90 vs 77%; $p<0.05$) and the specificity for diarrhoeal diseases (94 vs 98%; $p<0.05$) differed significantly, and the CSMFs of these CODs also

differed (3 vs 9% and 10 vs 5% respectively; $p<0.05$).

Since the same VA tool and data collection method were applied in all the three sites, the effects of these factors on the validity of VA would not vary by site. Furthermore the effect of respondents' characteristics and recall period on the sensitivity and specificity of VA was small within the three sites. Thus the differences in the sensitivity and specificity of VA observed between the sites for various causes of death are unlikely to be due to the differences in the distribution of respondents' characteristics between the sites. The observed variation in the sensitivity and specificity between sites is most likely due to the underlying differences in the CSMFs between the sites.

5.5. Effects of pattern of misclassification on sensitivity and specificity

The influence of the distribution of causes of death (COD) on the specificity of VA can be explained by the following expression of specificity. Given N possible COD (COD_1 .....COD_N) then the specificity for a given COD, denoted COD_1, is = $1 - (M_2P_2 + M_3P_3 + ...M_NP_N)$, where M_i = proportion of true COD_i misclassified as COD_1 (that is false positive rates for COD_i; and P_i = proportion of true negative COD_1 that are true COD_i (that is CSMF for COD_i among the true negatives). For example, in Ifakara (Table 16) the specificity for AFI equals

$1 - \{(3/33)(33/233) + (3/75)(75/233) + (3/25)(25/233) + (0/10)(10/233) + (0/9)(9/233) + (6/81)(81/233)\}$. Thus specificity is a function not only of the cause-specific false positive rates but also of the cause-specific fraction of the true negative cases.

The misclassification error associated with TB/AIDS reduced the specificity of VA for AFI by 1.3% in Ifakara compared to 3% in Bawku. In Ifakara, only 4% (3/75) of TB/AIDS deaths were misclassified as AFI, but since 32% (75/233) of true negative cases were TB/AIDS this misclassification error reduced the specificity of VA of AFI by

1.3%. Although 22% (4/18) of TB/AIDS was misclassified as AFI in Bawku this error reduced the specificity by only 3% since TB/AIDS contributed just 13% (18/139) of the true negatives. Thus even if there are no differences in the false positive rates contributed by each COD between sites, the specificity will differ if the CSMFs vary because the total false positive rate is a weighted sum of cause-specific false positive rates, where the weights are the proportion of each COD among true negative cases.

The number of false positive and negative cases for each COD is small in our data set and thus one has to be cautious in interpreting the patterns of misclassification. Nevertheless these data show that the pattern of misclassification can be influenced by differences in the distribution of COD and thereby the sensitivity and specificity of VA.

5.6. Validity of VAs

The levels of sensitivity and specificity of VAs by physicians were found to be highest for the groups of injuries and maternal causes. The sensitivity was particularly poor for non-specific syndromes and it is not surprising since this category includes only anaemia which is diagnosed as malaria or CVS disorders. Individual causes that resulted in the highest values of sensitivity, specificity and kappa were tetanus and rabies. The specificity remained high and the sensitivity and kappa were moderate for meningitis, AFI, TB/AIDS and acute abdominal conditions.

The algorithm demonstrated high levels of validity for some causes (e.g. rabies and injuries) and moderate levels for TB/AIDS and direct maternal causes. The sensitivity of VA by algorithm was lower than that by physician diagnosis for all causes except TB+AIDS. This is not surprising, since 9.5% of cases were classified as unknown by algorithms since no diagnosis could be reached. However, it is perhaps surprising that

the specificities resulting from the algorithms were also lower or equal to those from the physicians for nearly all causes of death.

Is the validity of VA by physician review or algorithms good enough? There is no recognised cut-off point above which the levels of sensitivity, specificity or kappa are deemed to be acceptable" - the minimum levels required by anyone using results obtained by the VA method will depend on the use to which the results are put. Furthermore all three measures indicates the validity of VA at the individual level. The agreement between the true and observed CSMF of a given cause of death depends on the balance of false positive and false negative diagnoses of the given cause of death rather than on the sensitivity and specificity of VA per se. This explains our observation of robust agreement between the true and VA estimates of CSMFs for all common causes of adult deaths in spite of very low sensitivities of VA for several causes of death. For example, the sensitivity of VA for renal disorders was just 25% and the specificity was 98% in Jimma but there was a 100% agreement between the number of true and VA estimates of deaths due to renal disorders (8 vs 8).

It follows that even if VAs are unable to provide an accurate diagnosis at the individual level, they may provide a robust estimate of cause-specific mortality at the population level.

5.7. Validity of VA for maternal causes of death

Since the number of maternal deaths due to any single cause was small (range 5 to 18), the confidence intervals for the sensitivities are very wide, and therefore interpretation of the results has to be cautious. Since the CSMF is less than 5% for all individual causes of maternal death (except AFI complicating pregnancy) among all causes of

death in women of child bearing age, if the sensitivity is around 60% the specificity has to be more than 98% to avoid overestimation of CSMFs. For instance the VAs diagnoses reached by physicians review overestimated the CSMF of haemorrhage for which the specificity was <98%. Similarly VAs by the algorithm overestimated the CSMF of AFI which had specificity <98%. The effect of different levels of sensitivity on the estimates of CSMF is less striking than that of the specificity and thus a VA tool used to estimate the distribution of causes of maternal death would require higher specificity than sensitivity.

If the misclassification between two causes of death is bi-directional, the estimates of CSMF will not be affected if the numbers of false negative and false positive diagnoses are similar. For instance, in the VAs by physicians, the misclassification between abortion and NMC was bi-directional (2 cases of abortion were diagnosed as NMC and 2 NMC as abortion), and thus the estimated CSMF for abortion is unaffected. Similarly, the CSMFs estimated by algorithm were comparable to the expected CSMF because the number of false positive and false negative diagnosis was more or less equal for most causes of death. There were imbalances between false positives and false negatives for some causes of death in VAs by physicians review and this resulted in over-estimation of CSMF for haemorrhage and puerperal sepsis and under-estimation of CSMF for indirect maternal death due to AFI, TB/AIDS and hepatitis. However, since numbers of individual causes of death were small, extrapolation of the observed pattern of misclassification and the agreement between observed and expected CSMFs requires caution.

Although the estimated CSMF for individual causes of death are useful for setting priorities, it is unlikely that VAs can be used to compare these fractions between groups or to measure changes over time, because the number of maternal deaths required to

make a valid comparison is too large. However, comparison of CSMF for direct or indirect maternal causes as a group is feasible and may be adequate for the evaluation and planning of programmes. If we assume that the CSMFs of direct or indirect maternal causes are likely to be around 10%, a specificity of 95% would probably be adequate. However, since the sensitivity is likely to be higher at this level of grouping, a correspondingly higher level of specificity will be needed to produce a comparable estimates of CSMFs.

5.8. Diagnostic algorithms

We envisage several ways in which the algorithms could be used. The diagnostic criteria could be applied in a hierarchical fashion starting with the most specific ones; once a diagnosis is reached, the algorithm is not used any further for that individual. However, if there are subcategories sub-algorithms would be applied to reach those causes of death.

The application of the diagnostic criteria in a hierarchical algorithm has certain drawbacks. The likelihood of reaching a particular cause of death not only depends on the validity of the diagnostic criterion for that cause but also on its rank in the hierarchy. For example if a diagnostic criterion for PTB which misclassifies 50% of AIDS is ranked above AIDS in the hierarchy, even if the diagnostic criterion for AIDS had 100% sensitivity and specificity only 50% of AIDS cases will be diagnosed as AIDS. Furthermore, the estimates of sensitivity and specificity of a set of algorithms will vary depending on the hierarchical order of the algorithms. For instance the ranking of different causes of death in the proposed hierarchical algorithm is debatable. Nevertheless a hierarchical algorithm simulates the process of clinical judgement used by physicians to reach single causes of death from VAs and thus allows for a reasonable comparison of the validity of these two procedures to reach diagnoses from VAs.

Diagnostic criteria that include all potential differentiating symptoms could be applied in any order without terminating the algorithm once a diagnosis is reached. In this approach more than one diagnosis can be reached for some cases. If a single most probable cause of death is desired, the diagnostic criteria could then be made more specific by including certain associate symptoms or by identifying some additional differentiating symptoms. However, inclusion of too many differentiating symptoms is likely to increase the proportion of records that are unclassified since the suggested differential symptoms are not specific enough to exclude potential misclassifications only.

The performance of the opinion-based algorithm used in this study to diagnose primary cause of death was less good than diagnosis by a panel of physicians. However, algorithms for determining the cause of death from the responses on the VA questionnaire is highly desirable if VAs are to be used on a large scale, since VAs are most needed in situations where physicians are not widely available.

5.9. Adjusting the effect of misclassification error of VA

VA has been used in several settings to estimate cause-specific mortality of childhood, maternal and adult deaths. It is often the only source of cause-specific mortality in settings lacking functioning vital registration systems. The fact that VA diagnosis of causes of death can be in accurate raises the question whether misclassification error in VA can be estimated and adjusted for in VA data; and if so, how to carry out this adjustment.

The validity and reliability of VA estimates of cause-specific mortality depend on

several factors such as the 'true' underlying distribution of causes of death in the population, age and sex of the deceased, the specific VA tools used, and the data collection process. VA estimates of CSMFs can be inaccurate if sensitivity and specificity of VA are <100%.[98] One way of overcoming this problem is by adjusting the VA estimate of CSMF using the sensitivity and specificity of the VA tool. It has been proposed that VA estimates of CSMF can be adjusted for the effect of misclassification error by the following model: $Pt = \frac{(Pe + specificity - 100)}{(sensitivity + specificity - 100)}$ ❶; where *Pt* is the adjusted CSMF and *Pe* is the crude VA estimate of CSMF.[99] However, this assumes that sensitivity and specificity of VA tools obtained from particular validation studies can be extrapolated to data obtained from demographic surveys or surveillance systems.

If the sensitivity and the specificity of VA are influenced by the distribution of the causes of death then the measures obtained from a validation study are unlikely to be useful for adjusting the misclassification error of VA in settings where the underlying distribution of COD differs from that of the validation study population. Let us examine this proposition in a VA data collected through an ongoing demographic surveillance system in Tanzania.

Since 1992 the Adult Morbidity and Mortality Project (AMM P) has been collecting data on causes of death using VA in Morogoro Rural District in Tanzania.[100] In the AMMP system, VA interviews are conducted for all incident deaths in a geographically defined population of approximately 100,000. VA interviews are normally conducted within a month after death by clinical officers using a questionnaire similar to the one used in our multi-centre validation study, and the cause of death were determined by a panel of physicians on the project team. Using the above-mentioned adjustment

model,❶ let us apply the sensitivity and specificity values for six categories of causes of death from the validation study to VA data collected by the AMMP demographic surveillance system in Morogoro Rural District, Tanzania.

When we applied the sensitivity and specificity obtained from Ifakara, the difference between the adjusted and crude CSMFs ranged from -83% to +19% (Table 24). When the sensitivity and specificity obtained from Bawku were applied, the adjustment model returned spurious values for some CSMFs; adjusted AFI mortality was –16.9% and adjusted direct maternal causes was –1.7%. It is not clear whether the adjusted CSMFs are more accurate than the crude estimates. It is worth noting that Ifakara borders the area where the AMMP data were obtained (Morogoro Rural). Yet the adjusted CSMFs varied markedly even when we used the sensitivity and specificity values from Ifakara to perform the adjustment.

This shows that sensitivity and specificity of VA depend on the distribution of causes of death in the validation study population and that if the causes of death in the general population differ from the validation study population then the application of sensitivity and specificity to adjust for misclassification error can produce spurious results. All validation studies reported to date are hospital based since, community based validation studies are almost impossible in areas where only a selective proportion of population contacts health facilities for serious illness, and which, in turn, are the same areas where VAs are needed.

Furthermore, the model proposed by Kalter[99] assumes that the VA estimate of CSMF plus specificity will be more than 100 if sensitivity plus specificity is more than 100; conversely it will be less than 100 if the latter is less than 100. This assumption may not be true always. For example, the sensitivity and specificity of VA for AFI is 74% and

75% respectively in Bawku where the CSMF of AFI among the hospital population was 40%. Let us assume that a community mortality survey was carried out in Ghana with this VA tool and the VA estimate of the CSMF of AFI was 20%. If we adjust this estimate using the above sensitivity and specificity, the true CSMF will be -10% according to this model. Conversely VA estimates of the CSMF of AFI should always be >25% if this VA tool is applied to the data from Ghana.

The sensitivity and the specificity of VA depend on the distribution of cause of death. Thus the use of values of sensitivity and specificity of VA obtained from hospital based validation studies in the proposed model for adjusting the effect of misclassification error will not be appropriate in settings where the distribution of COD differs markedly from the validation study population. We argue that validation studies are useful to understand the pattern of misclassification of causes of death and to identify causes of death that are likely to have systematic or unbalanced misclassification. However, sensitivity and specificity of VA obtained from validation studies are too variable to be useful to adjust the effect of misclassification error.

CSMFs can differ dramatically across a region, between geographic regions within a single country, and between hospital user and non-user populations within a single area.[92] Thus, not only is there reason to question the validity of applying adjustment parameters derived in one location to VA data from another, the application of the estimates of sensitivity and specificity obtained from hospital based validation studies must also be used cautiously as a *de facto* 'gold standard' for adjusting the misclassification error in CSMFs derived from VA.

6. Conclusions

Sensitivity and kappa of VA for all common causes of adult death were low and this suggests that the accuracy of VA at the individual level is low. Since VA are used for assessing CSMFs or cause specific rates (CSMRs) in a given population, the agreement between the true and VA estimates of these measures are more appropriate for deeming the usefulness of VA than sensitivity, specificity and kappa. The agreement between true and VA estimates of CSMFs and CSMRs depends on a complex relationship between sensitivity, specificity and relative frequency of causes of death. This relationship and the resulting agreement between true and VA estimates of cause specific mortality fractions for any given cause of death depends on the level and pattern of misclassification of causes of death. False positive and false negative misclassification occurred for all common causes of adult death including injury and maternal causes of death. However the misclassification of causes of death was bi-directional among causes with similar symptoms and the number of false positive and false negative diagnoses for most common causes of adult death tend to be similar. Thus the agreement between the true and VA estimates of CSMFs of groups and common individual cause of adult death was robust even though the sensitivity and kappa were low.

The age, sex, relationship and language of the respondents did not have a significant effect on the sensitivity and specificity of VA. However, the agreement between the true and VA estimates of cause specific mortality fractions was better if the respondents had looked after the deceased during the final illness and if they spoke the language used for the VA questionnaire. This highlights the need for identifying appropriate respondents and for conducting VA interviews in the language spoken by the respondents. The length of recall period of VA did not affect the validity of VA significantly. It appears

that a recall period of three years would be appropriate for VA interviews.

The sensitivity and specificity of VA depends on the distribution of causes of death in the population and thus are site specific. The estimates of sensitivity and specificity of VA obtained from hospital based validation studies must be used cautiously as a de facto gold standard for adjusting the misclassification error in CSMF derived from VA. Use sensitivity and specificity estimates derived from a location specific validation study to adjust misclassification in VA data from populations with substantially different patterns of causes specific mortality will lead to erroneous results.

We conclude that VA is likely to be useful for assessing CSMFs common causes of adult death in a population for the purposes of ranking the causes of death in a given time. However its use for comparison of CSMFs or CSMRs between populations or trends over time is limited with the exception of deaths due to direct maternal causes and injuries.

Table 1. Study area, period, purpose and sample size of studies using VA

No	Study country	Study period	Age group	Main objectives of study/purpose of VAs	No. of deaths
01	India[12]	88-91	<5 yrs	to evaluate the impact of a community-based intervention for control of pneumonia	337
02	Nepal[13]	86-89	<5 yrs	"	2101
03	Tanzania[14]	83-85	<5 yrs	"	1198
04	Kenya[15]	85-88	<5 yrs	"	239
05	Papua New Guinea[16]	81-85	6-59 months	to estimate the efficacy of pneumococcal vaccine against acute lower-respiratory-tract infections	173
06	The Gambia[17]	88-90	<5 yrs	to evaluate the impact of insecticide-treated bed nets on malaria mortality	353
07	The Gambia[18]	82-83	3-59 months	to evaluate the impact of chemoprophylaxis or community-based treatment for control of malaria	241
08	Kenya[19]	81-83	<5 yrs	to evaluate the impact of a community- based malaria control programme	592
09	Ethiopia[20]	96-98	<5yrs	to evaluate the impact of home management of malaria	190
10	Ghana[21]	89-91	6-90 months	to evaluate the impact of vitamin A supplementation on all-cause child mortality and cause-specific mortality	892
11	Sudan[22]	88-90	9-72 months	"	240
12	Nepal[23]	89-90	6-60 months	"	358
13	Nepal[24]	87-89	<5 yrs	"	305
14	India[25]	NR*	<5 yrs	"	117
15	Benin[26]	86-87	4-35 months	to evaluate the impact of a primary health care project on all-cause child mortality and cause-specific mortality	284
16	Sierra Leone[27]	1990	0-7 yrs	To assess the burden of malaria mortality	37
17	Tanzania[28]	92-93	<5 yrs	„	83
18	Tanzania[29]	92-94	<5 yrs	„	118
19	Ethiopia[30]	87-88	<5 yrs	to establish the relative public health importance of causes of death	492
20	Bangladesh[31]	82-85	"	"	1349

21	Bangladesh[32]	75-77	"	"	12893
22	Bangladesh[33]	93-94	„	„	828
23	India[34]	89-94	„	„	286
24	India[35]	95-96	„	„	1171
25	Pakistan[36]	88-91	<5 yrs	"	52
26	Guinea Bissau[37]	79-80	<6 yrs	„	144
27	The Gambia[38]	82-83	<7 yrs	"	184
28	Tanzania[39]	86-87	<5 yrs	to assess the determinants of common causes of childhood deaths	610
29	Ethiopia[40]	88-89	„	"	306
30	Zaire[41]	89-92	„	"	246
31	Vietnam[42]	1992	„	„	81
32	Bangladesh[43]	91-92	<2 yrs	„	30
33	Malawi[44]	87-90	<1 yr	„	388
34	Indonesia[45]	97-98	<2yrs	"	282
35	Egypy[46]	92-96	<5 yrs	"	198
36	Kenya[47]	89-91	<5 yrs	to estimate the validity of VAs to assess causes of childhood deaths	303
37	Philippines[48]	87	<2 yrs	"	164
38	Haiti[49]	89-90	<5 yrs	"	315
39	Malawi[50]	1994	<12 yrs	„	36
40	Nicaragua[51]	95-97	<5yrs	"	445
41	Liberia[52]	87-88	all ages	to assess the safety of a community-based treatment trial for onchocerciasis control	25
42	Papua New Guinea[53]	91-94	„	To assess the burden of malaria mortality	162
43	Papua New Guinea[54]	82-85	"	to assess the relative public health importance of causes of death	407
44	Papua New Guinea[55]	77-83	"	"	1789
45	Senegal[56]	83-85	"	"	808
46	Bangladesh[57]	82-83	"	"	472
47	Nigeria[58]	77-78	"	"	228
48	Yemen[59]	NR	"	"	125

49	Tanzania[60]	92-95	"	"	4929
50	Jordan[61]	95-96	„	„	965
51	South Africa[62]	92-95	„	„	932
52	Lebenon[63]	93-94	50+ yrs	"	416
53	Jordan[64]	95-96	All ages	"	946
54	Bangla-Desh[65-67]	76-85	15-44 yrs old women	to measure maternal mortality and to establish relative importance of causes of maternal deaths	542
55	Kenya[68]	87	"	"	35
56	India[69]	84-85	"	"	134
57	Bangladesh[70]	82-83	"	"	58
58	Indonesia[71]	80-82	"	"	558
59	Egypt[71]	81-83	"	"	385
60	Egypt[72]	85-86	"	"	841
61	Bangladesh[73]	67-68	"	"	41
62	The Gambia[74]	82-83	"	"	15
63	Tanzania[75]	1993	„	„	76
64	Pakistan[76-77]	89-92	„	„	218
65	Cape Verde[78]	92-93	„	„	97
66	The Gambia[79]	98-99	"	"	18
67	Tanzania[80]	91-92	15-54 yrs	To describe symptoms and signs associated with deaths due to HIV	178
68	Tanzania[81]	1995	15+ yrs	„	51
69	Uganda[82]	90-93	13+ yrs	To assess the validity of VA for ascertaining HIV related deaths	155

* NR: not reported

Table 2. Methods used in 69 published studies using VA tools

No	Approach to mortality classification	Format of questionnaire		Interviewer		Recall period	Derivation of diagnosis	
		Open	Structured	Type	Education		Assessors	algorithm
01	Restricted	NR*	Yes	Lay	12 yrs	1-2 weeks	2 MDs	yes
02	NR	NR	NR	Lay	NR	<1 month	2MDs	yes
03	NR	NR	NR	Medical	MA	1-2 weeks	Interviewer	no
04	NR	NR	Yes	Medical	CO	1-6 weeks	Interviewer	no
05	Restricted	NR	Yes	Medical	nurse	NR	NR	yes
06	NR	NR	NR	Lay	NR	NR	3 MDs	no
07	NR	NR	NR	Medical	MD	NR	Interviewer	yes
08	NR	NR	NR	Lay	NR	NR	NR	NR
09	restricted	yes	yes	medical	MD	NR	2 MDs	no
10	Restricted	Yes	Yes	Lay	NR	0-9 months	3 MDs	no
11	NR	NR	NR	Lay	NR	NR	NR	NR
12	NR	NR	NR	Lay	NR	0-2 months	2 MDs	no
13	NR	NR	NR	Lay	NR	NR	2 MDs	yes
14	NR	NR	NR	Lay	CHW	NR	NR	NR
15	NR	NR	NR	Medical	MD	NR	Interviewer	no
16	Open	NR	NR	Medical	MD	1 month	3 MDs	no
17	Restricted	Yes	Yes	NR	NR	1 month	NR	yes
18	Open	Yes	Yes	Medical	MA	NR	2 MDs	no
19	NR	No	Yes	Lay	12 years	NR	NR	NR
20	NR	Yes	No	Lay	CHW	NR	1 MD	no
21	NR	Yes	No	Lay	12 years	NR	Interviewer	no
22	Restricted	Yes	Yes	Lay	NR	NR	No	yes
23	Open	NR	NR	Medical	MD	NR	1 MD	no
24	NR	NR	NR	NR	NR	NR	NR	NR
25	Restricted	Yes	Yes	Medical	MD	0-37 months	NR	yes
26	NR	NR	Yes	Lay	NR	NR	NR	NR
27	Restricted	NR	NR	Medical	MD	0-3 months	3 MDs	no
28	NR	NR	NR	Medical	MA	NR	Interviewer	no

No	Approach to mortality classification	Format of questionnaire		Interviewer		Recall period	Derivation of diagnosis	
		Open	Structured	Type	Education		Assessors	algorithm
29	NR	NR	Yes	Lay	NR	NR	NR	NR
30	NR	NR	NR	Lay	NR	NR	1 MD	yes
31	Restricted	No	Yes	Lay	NR	1-10 years	Interviewer	yes
32	NR	NR	Yes	Lay	Degree	6-12 weeks	2 MDs	no
33	NR	NR	Yes	NR	NR	NR	1 MD	no
34	restricted	yes	yes	medical	midwife	NR	Interviewer	yes
35	NR	NR	NR	NR	NR	NR	NR	NR
36	NR	Yes	Yes	Lay	NR	1-16 weeks	3 MDs	no
37	Restricted	Yes	Yes	Lay	Degree	1-52 weeks	1MD & computer	yes
38	Restricted	Yes	Yes	Medical	Nurse	1-42 months	3 MDs	yes
39	Restricted	Yes	Yes	Lay	NR	5-12 months	3 MDs	no
40								
41	Restricted	No	Yes	Medical	MD	1-2 weeks	3 MDs	yes
42	Restricted	Yes	Yes	Lay	NR	1-12 months	1 MD	yes
43	NR	Yes	Yes	Medical	MD	2-52 weeks	Interviewer	yes
44	NR	NR	NR	Lay	NR	NR	NR	NR
45	Restricted	Yes	Yes	Lay	9 yrs	1-8 weeks	1 MD	yes
46	Restricted	Yes	Yes	Lay	NR	1-44 weeks	1 MD	yes
47	Restricted	No	Yes	Lay	7 yrs	NR	Interviewer	yes
48	open	NR	Yes	Lay & medical	Anthropol ogist/MD	0-50 yrs	Interviewer	no
49	Restricted	Yes	Yes	Medical	MR	0-3 months	3 MD	no
50	Restricted	Yes	Yes	Medical	Nurse	2 weeks	2 MDs	yes
51	NR	Yes	Yes	Lay	NR	NR	3 MDs	no
52	Open	Yes	Yes	NR	NR	NR	1MD	no
53	restricted	Yes	Yes	Medical	Nurse	NR	2MD	yes
54	open	Yes	Yes	Lay	CHW	NR	1 MD	no
55	NR	NR	Yes	Lay	NR	NR	NR	NR

Table 2 cont...

No	Approach to mortality classification	Format of questionnaire		Interviewer		Recall period	Derivation of diagnosis	
		Open	Structured	Type	Education		Assessors	Algorithm
56	NR	NR	NR	Lay	NR	NR	NR	NR
57	NR	No	Yes	Lay	12 yrs	NR	1 MD	no
58	NR	No	Yes	Lay	NR	NR	1 MD	no
59	NR	No	Yes	Lay	NR	NR	1 MD	no
60	NR	Yes	No	medical	MD	2-6 weeks	Interviewer	no
61	NR	NR	NR	medical	MD	NR	Interviewer	no
62	Open	NR	Yes	Lay	NR	2-4 weeks	5 MDs	no
63	NR	NR	Yes	medical	MD	NR	NR	NR
64	NR	NR	Yes	medical	MD	1-3 months	2 MDs	no
65	Open	Yes	Yes	Lay	NR	3 months	2 MDs	no
66	Restricted	Yes	Yes	Lay	NR	NR	2MD	no
67	Restricted	Yes	Yes	Lay	12 years	3-8 months	No	yes
68	NR	NR	NR	NR	NR	NR	NR	NR
69	Restricted	Yes	Yes	medical	Nurse	2 months	3 MDs	no

NR: not reported
MD: Medical Doctor
MA: Medical Assistant
CHW: Community Health Worker
No: Serial numbers in Tables 1 and 2 refer to the same study; references to each study are given in Table 1.

Table 3: Working Classification of causes of adult death

Code No.	Causes of death
1.	**Communicable Diseases**
1.0.	**Unspecified communicable diseases**
1.1.	**Acute Febrile Illness**
1.1.0.	*Unspecified acute febrile illness*
1.1.1.	*Malaria*
1.1.2.	*Meningitis*
1.1.3.	*Hepatitis*
1.1.4.	*Pneumonia*
1.1.9.	*All other specified acute febrile illnesses*
1.2.	**Tuberculosis/AIDS**
1.2.0	*Unspecified TB/AIDS*
1.2.1.	*Pulmonary Tuberculosis*
1.2.2.	*AIDS*
1.2.3.	*AIDS + Pulmonary Tuberculosis*
1.2.9.	*All other forms of Tuberculosis*
1.3.	**Diarrhoeal Diseases**
1.4.	**Tetanus**
1.5.	**Rabies**
1.9.	**All other specified communicable diseases**
2.	**Direct Maternal Causes**
2.0.	**Unspecified maternal causes**
2.1.	**Abortion**
2.2.	**Eclampsia**
2.3.	**Ante/postpartum Haemorrhage**
2.4.	**Obstructed labour**
2.5.	**Puerperal Sepsis**
2.9.	**All other specified direct maternal causes**
3.	**Non-communicable diseases**
3.0.	**Unspecified non-communicable causes**
3.1.	**Cardiovascular Disorders**
3.1.0.	*unspecified cardiovascular disorders*
3.1.1.	*Congestive cardiac Failure*
3.1.2	*Ischaemic Heart Disease*
3.1.3.	*Cerebrovascular Disease*
3.1.9.	*All other specified cardiovascular disorders*
3.2.	**Chronic Obstructive Pulmonary Disease**
3.3.	**Liver cirrhosis**
3.4.	**Acute abdominal conditions**
3.5.	**Diabetes**

3.6	**Neoplasms**
3.6.0.	*Unspecified neoplasms*
3.6.1.	*Carcinoma breast*
3.6.2.	*Carcinoma cervix/uterus*
3.6.3.	*Hepatoma*
3.6.4.	*Carcinoma of gastrointestinal tract*
3.6.9.	*All other specified neoplasms*
3.7.	**Renal disorders**
3.8.	**Central Nervous System disorders**
3.9.	**All other specified noncommunicable diseases**
4.	**Symptoms, signs, syndromes not elsewhere classified**
4.1.	**Anaemia**
4.9.	**All other specified symptoms, signs and syndromes**
5.	**External Causes**
5.0.	**Unspecified external causes**
5.1.	**Unintentional Injuries**
5.1.0.	*Unspecified unintentional injuries*
5.1.1.	*Transport*
5.1.2.	*Falls*
5.1.3.	*Fires*
5.1.4.	*Poisoning*
5.1.5.	*Drowning*
5.1.9.	*All other specified unintentional injuries*
5.2.	**Intentional Injuries**
5.2.0.	*Unspecified intentional injuries*
5.2.1.	*Suicide*
5.2.2	*Homicide*
5.2.3	*War*
5.2.9.	*All other specified intentional injuries*
6.	**Undetermined**

Table 4: Characteristics of respondents and recall period

Characteristics	Ifakara n=315 (%)	Jimma n=249 (%)	Bawku n=232 (%)
Sex			
Male	153 (49)	122 (49)	161 (69)***/@@@
Female	162 (51)	127 (51)	71 (31)
Age group			
15-59 years	256 (81)	216 (87)	193 (83)
60+ years	59 (19)	33 (13)	39 (17)
Education			
None	88 (28)	51 (20)$	187 (81)***/@@@
Primary (1-6 years)	119 (38)	107 (43)	10 (4)
Secondary (7+ years)	108 (34)	91 (37)	35 (15)
Relationship to deceased			
Spouse	56 (18)	75 (30)$$$	46 (20)
Close relative	196 (62)	100 (40)	127 (55)
Distant relative/friend	63 (20)	74 (30)	59 (25)
Appropriateness			
Appropriate	259 (82)	215 (86)	221 (95)***/@@@
Probably Apropriate	56 (18)	34 (14)	11 (5)
Primary language			
VA questionnaire language	286[a] (91)	214[b] (86)	132[c] (57)***/@@@
Others	29 (9)	35 (14)	100 (43)
Recall period			
1-6 months	105 (33)	84 (34)	68 (29)**/@@
7-12 months	103 (33)	73 (29)	57 (25)
13-21 months	107 (34)	92 (37)	107 (46)

[A]Kiswahili [b]Amharic or Orominga [c] Kusaal

*** P<.001 comparison between Ifakara and Bawku

** P<.01 comparison between Ifakara and Bawku

@@@ P<.001 comparison between Jimma and Bawku

@@ P<.01 comparison between Jimma and Bawku

$$$ P <.001 comparison between Ifakara and Jimma

$ P <.05 comparison between Ifakara and Jimma

Table 5 **Response rate & reasons for non response**

	Ifakara	Jimma	Bawku	Total
Total adult deaths recorded during study period	500	519	323	1342
Deaths excluded because address is >60km	86	192	49	327
Deaths eligible for inclusion in the study	414	327	274	1015
Deaths for which a VA was completed	315	249	232	796
(Response rate)	(76%)	(76%)	(85%)	(78%)
Reasons for non response				
Address was inadequate	95 (23)	74 (23)	30 (11)	199 (20)
Appropriate respondent had travelled	2 (0.5)	4 (1)	10 (4)	16 (1.5)
Refused	2 ((0.5)	0	2 (1)	4 (0.5)

Table 6 Comparison of causes of death between eligible and actual study poulation

Causes of death	Ifakara		Jimma		Bawku	
	Eligible (%)	Actual (%)	Eligible (%)	Actual (%)	Eligible (%)	Actual (%)
Communicable diseases						
Acute febrile illness						
Malaria	43 (10.4)	36 (11.4)	43 (13.1)	39 (15.7)	11 (4.0)	10 (4.3))
Meningitis	32 (7.7)	28 (8.9)	9 (2.8)	5 (2.0)	39 (14.2)	33 (14.2)
Hepatitis	6 (1.4)	4 (1.3)	5 (1.5)	4 (1.6)	25 (9.1)	24 (10.3)
Pneumonia	11 (2.7)	8 (2.5)	7 (2.1)	5 (2.0)	11 (4.0)	10 (4.3)
Other AFI	10 (2.4)	6 (1.9)	10 (3.1)	8 (3.2)	18 (6.6)	16 (6.9)
TB/AIDS						
TB	46 (11.1)	30 (9.5)	26 (8.0)	19 (7.6)	9 (3.3)	7 (3.0)
AIDS	53 (12.8)	35 (11.4)	16 (4.9)	11 (4.4)	13 (4.7)	9 (3.9)
TB+AIDS	10 (2.4)	10 (3.2)	33 (10.1)	25 (10.0)	3 (1.1)	2 (0.9)
Diarrhoeal diseases	45 (10.9)	33 (10.5)	11 (3.4)	6 (2.4)	16 (5.8)	12 (5.2)
Tetanus	2 (0.5)	2 (0.6)	6 (1.8)	5 (2.0)	6 (2.2)	6 (2.6)
Rabies	7 (1.7)	6 (1.9)	0	0 -	1 (0.4)	1 (0.4)
Direct maternal causes	12 (2.9)	10 (3.2)	31 (9.5)	22 (8.8)	22 (8.0)	18 (7.8)
Noncommunicable diseases						
CVS disorders	35 (8.5)	25 (7.9)	19 (5.8)	16 (6.4)	30 (10.9)	24 (10.3)
Cirrhosis of liver	11 (2.7)	9 (2.9)	16 (4.9)	14 (5.6)	2 (0.7)	2 (0.9)
Acute abdominal conditions	15 (3.6)	12 (3.8)	36 (11.0)	27 (10.8)	20 (7.3)	16 (6.9)
Neoplasms	15 (3.6)	13 (4.1)	6 (1.8)	5 (2.0)	16 (5.8)	16 (6.9)
Renal disorders	11 (2.7)	8 (2.5)	10 (3.1)	8 (3.2)	6 (2.2)	5 (2.2)
Other specified diseases	12 (2.9)	9 (2.9)	11 (3.4)	8 (3.2)	1 (0.4)	0 -
Nonspecific signs & syndromes						
Anaemia	15 (3.6)	12 (3.8)	2 (0.6)	2 (0.8)	10 (3.6)	10 (4.3)
Injuries	9 (2.2)	9 (2.9)	24 (7.3)	17 (6.8)	11 (4.0)	7 (3.0)
Unknown	14 (3.4)	10 -	5 (1.5)	3 (1.2)	4 (1.5)	4 (1.7)
Total	414	315	327	249 (100)	274	232

Table 7 **Distribution of causes of death (gold standard) in the study hospitals**

Causes of death	Ifakara		Jimma		Bawku	
	No. (CSMF*)	% confirmed	No (CSMF)	% confirmed	No. (CSMF)	% confirmed
Communicable diseases						
Acute febrile illness						
Malaria	36 (11.4)	50	39 (15.7)	51	10 (4.3))	50
Meningitis	28 (8.9)	93	5 (2.0)	80	33 (14.2)	94
Hepatitis	4 (1.3)	25	4 (1.6)	75	24 (10.3)	92
Pneumonia	8 (2.5)	50	5 (2.0)	100	10 (4.3)	10
Other AFI	6 (1.9)	67	8 (3.2)	88	16 (6.9)	86
TB/AIDS						
TB	30 (9.5)	93	19 (7.6)	83	7 (3.0)	86
AIDS	35 (11.4)	87	11 (4.4)	87	9 (3.9)	100
TB+AIDS	10 (3.2)	100	25 (10.0)	80	2 (0.9)	100
Diarrhoeal diseases	33 (10.5)	85	6 (2.4)	100	12 (5.2)	58
Tetanus	2 (0.6)	100	5 (2.0)	100	6 (2.6)	83
Rabies	6 (1.9)	83	0 -	-	1 (0.4)	100
Direct maternal causes	10 (3.2)	90	22 (8.8)	91	18 (7.8)	89
Noncommunicable diseases						
CVS disorders	25 (7.9)	68	16 (6.4)	86	24 (10.3)	79
Cirrhosis of liver	9 (2.9)	78	14 (5.6)	64	2 (0.9)	50
Acute abdominal conditions	12 (3.8)	92	27 (10.8)	96	16 (6.9)	75
Neoplasms	13 (4.1)	92	5 (2.0)	100	16 (6.9)	81
Renal disorders	8 (2.5)	75	8 (3.2)	75	5 (2.2)	80
Other specified diseases	9 (2.9)	67	8 (3.2)	88	0 -	-
Nonspecific signs & syndromes						
Anaemia	12 (3.8)	92	2 (0.8)	100	10 (4.3)	100
Injuries	9 (2.9)	100	17 (6.8)	100	7 (3.0)	100
Unknown	10 -	-	3 (1.2)	-	4 (1.7)	-
Total	315 (100)	78	249 (100)	76	232 (100)	79

CSMF: cause specific mortality Fraction

Table 8: Comparison effect of respondent characteristics on validity of VA by physician review

Charactristics of respondents	Ifakara				Jimma				Ethiopia			
	n	WSen	WSpe	WKap	n	WSen	WSpe	WKap	n	WSen	WSpe	WKap
Male	153	59	95	53	122	65	87	67	161	61	89	56
Female	162	62	93	57	127	65	91	62	71	68	89	57
Age												
15-59 years	256	62	93	54	216	66	89	69	193	62	88	54
60+ years	59	54	95	53	33	58	90	**53**	39	69	92	64
Formal education												
None	88	58	92	61	51	55	90	**53**	187	67	90	60
1-6 years	119	63	93	50	107	64	86	66	10	60	96	56
7+ years	108	60	95	52	91	71*	90	72	35	49*	85	**32**
Relationship												
Spouse	56	70	97	80	75	56	85	60	46	63	91	63
Close relative	196	58	93	**47**	100	61	83	61	127	63	88	51
Distant relative/friend	63	62	94	58	74	69	93	76	59	68	90	60
Very appropriate	259	63	94	58	215	64	88	66	221	65	89	59
Probably appropriate	56	52	94	**39**	34	71	96	68	11	45	74	**01**
Primary language												
Same as VAQ	286	60	94	56	214	65	89	67	132	68	90	61
others	29	62	95	**44**	35	66	91	67	100	59	89	**48**
Recall period												
1-6 moths	105	62	94	**48**	84	60	86	63	68	57	84	55
7-12 months	103	60	93	57	73	70	91	69	57	63	90	50
13-21 months	107	60	93	57	92	66	90	67	107	66	90	58
Overall	315	61	94	55	249	65	89	70	232	64	89	56

*P<.05 comparison between different classes of characteristics with in a site

Wsen= Weighted sensitivity
Wspe= Weighted specificity
Wkap= Weighed Kappa

Table 9: Sensitivity, specificity and Kappa of VAs by physicians for groups of causes of death

causes of death	Ifakara					Jimma					Bawku				
	Rd	Vd	Sen (%)	Spe (%)	kap (%)	Rd	Vd	Sen (%)	Spe (%)	Kap (%)	Rd	Vd	Sen (%)	Spe (%)	Kap (%)
Communicable diseases	198	186	82	79	60	127	134	86	80	67`	130	128	78	74	67
Direct maternal causes	10	13	90	99	83	22	21	77	98	76	18	24	83	96	62
Noncommunic-able diseases	76	91	75	86	57	78	73	74	91	67	63	65	62	85	47
Nonspecific syndromes	12	7	42	99	51	2	0	0	100	-	10	5	30	99	35
Injuries	9	11	89	99	79	17	17	100	100	100	7	8	100	100*	93
Undetermined	10	7	0	98	0	3	4	0	98	0	4	2	0	99	0

Rd: frequency of reference diagnoses Sen: sensitivity Spe: specificity Kap: Kappa
Vd: frequency of VA diagnoses * exact values 99.5 to 99.9%

Table 10: Sensitivity, specificity and Kappa of VAs by physicians for selected communicable and non-communicable causes of death

causes of death	Ifakara					Jimma					Bawku				
	Rd	Vd	Sen (%)	Spe (%)	kap (%)	Rd	Vd	Sen (%)	Spe (%)	Kap (%)	Rd	Vd	Sen (%)	Spe (%)	Kap (%)
Communicable diseases	198	186	82	79	60	127	134	86	80	67	130	128	78	74	67
Acute Febrile Illness	82	64	60	94	57	61	54	67	93	63	93	104	74	75	48
Malaria	36	28	36	95	34	39	22	39	97	42	10	30	0	87	0
Meningitis	28	23	64	98	68	5	7	40	98	32	33	30	58	95	54
Hepatitis	4	1	25	100	40	4	0	0	-		24	13	42	99	50
Pneumonia	8	5	25	99	29	5	4	80	100	89	10	10	30	97	27
Other AFI	6	7	33	98	29	8	21	63	93	31	16	21	13	91	03
TB/AIDS	75	74	76	93	70	55	66	82	89	62	18	11	56	100*	67
TB	30	20	59	98	59	19	36	68	90	41	7	4	43	100*	53
AIDS	35	41	51	92	40	11	18	64	95	45	9	7	56	99	61
TB+AIDS	10	6	10	98	10	25	8	20	99	27	2	0	0	-	0
Diarrhoeal diseases	33	40	73	94	60	6	9	67	98	52	12	9	25	97	25
Tetanus	2	2	100	100	100	5	5	100	100	100	6	3	50	100	66
Rabies	6	6	83	100*	83	0	0	-	-	-	1	1	100	100	100
Noncommunicable diseases	76	91	75	86	57	78	73	74	91	67	63	65	62	85	47
CVS disorders	25	25	40	95	35	16	13	50	98	55	24	19	54	97	62
Cirrhosis of liver	9	13	33	97	25	14	14	50	97	47	2	2	0	99	0
Acute abdominal conditions	12	21	92	97	61	27	28	67	96	61	16	16	56	97	51
Neoplasms #	13	14	46	97	42	5	9	80	98	56	16	13	44	97	45
Renal disorders	8	8	25	98	23	8	3	38	100	54	5	11	60	97	35
Other specified diseases	9	10	44	98	43	8	6	50	99	60	0	4	-	-	-

Rd: frequency of reference diagnoses Sen: sensitivity Spe: specificity Kap: Kappa
Vd: frequency of VA diagnoses * exact values 99.5 to 99.9%

Table 11: Sensitivity, specificity and Kappa of VAs by algorithm for groups of causes of death

causes of death	Ifakara					Jimma					Bawku				
	Rd	Vd	Sen (%)	Spe (%)	kap (%)	Rd	Vd	Sen (%)	Spe (%)	Kap (%)	Rd	Vd	Sen (%)	Spe (%)	Kap (%)
Communicable diseases	198	194	76	64	41	127	137	80	70	50	130	123	71	70	40
Direct maternal causes	10	6	50	100*	62	22	18	64	98	67	18	23	78	96	65
Noncommunic-able diseases	76	64	54	90	47	78	55	54	92	50	63	48	46	89	38
Nonspecific syndromes	12	3	25	100	39	2	2	0	99	0	10	4	0	98	3
Injuries	9	14	89	98	68	17	19	100	99	94	7	10	86	98	70
Undetermined	10	34	20	89	4	3	18	0	3	0	4	24	25	90	4

Rd: frequency of reference diagnoses Sen: sensitivity Spe: specificity Kap: Kappa
Vd: frequency of VA diagnoses * exact values 99.5 to 99.9%

Table 12: Sensitivity, specificity and Kappa of VAs by algorithm for selected communicable and non-communicable causes of death

causes of death	Ifakara					Jimma					Bawku				
	Rd	Vd	Sen (%)	Spe (%)	kap (%)	Rd	Vd	Sen (%)	Spe (%)	Kap (%)	Rd	Vd	Sen (%)	Spe (%)	Kap (%)
Communicable diseases	198	194	76	64	41	127	137	80	70	50	130	123	71	70	40
Acute Febrile Illness	82	74	49	86	37	61	51	51	91	46	93	85	58	74	35
Malaria	36	21	17	95	14	39	22	20	93	17	10	41	20	82	1
Meningitis	28	27	46	95	42	5	16	20	94	7	33	25	33	93	29
Hepatitis	4	0	0	100	0	4	7	0	97	0	24	17	21	94	17
Pneumonia	8	7	12	98	11	5	2	20	100*	28	10	6	0	97	0
Other AFI	6	19	17	94	94	8	4	0	98	0	16	4	6	98	7
TB/AIDS	75	85	70	86	54	55	74	75	82	50	18	18	47	96	45
TB	30	17	32	97	32	19	34	53	90	31	7	8	43	98	38
AIDS	35	35	34	92	26	11	20	27	93	14	9	7	22	98	22
TB+AIDS	10	33	50	90	19	25	20	32	95	29	2	0	0	100	0
Diarrhoeal diseases	33	27	48	96	48	6	12	67	97	43	12	7	17	98	18
Tetanus	2	2	50	100*	50	5	0	0	100	0	6	8	33	97	26
Rabies	6	6	67	100*	66	0	0	-	-	-	1	0	0	100	0
Noncommunic-able diseases	76	64	54	90	47	78	55	54	92	50	63	48	46	89	38
CVS disorders	25	22	20	94	15	16	13	40	97	40	24	13	23	96	23
Cirrhosis of liver	9	5	22	98	27	14	14	36	96	32	2	4	0	98	0
Acute abdominal conditions	12	24	75	95	47	27	14	30	97	34	16	19	50	95	41
Neoplasms #	13	3	7	99	11	5	6	20	98	16	16	2	0	99	1
Renal disorders	8	8	38	97	36	8	5	13	98	13	5	9	40	97	27
Other specified diseases	9	2	11	100*	17	8	3	13	99	17	0	-	-	-	-

Rd: frequency of reference diagnoses Sen: sensitivity Spe: specificity Kap: Kappa
Vd: frequency of VA diagnoses * exact values 99.5 to 99.9%

Table 13:

Comparison of validity of VA by physician review versus algorithm: groups of causes of death

causes of death	Rd (n=796)	VAs by physicians				VAs by algorithms			
		Vd	Sen (CI)	Spe (CI)	Kappa	Vd	Sen (CI)	Spe (CI)	Kappa
Communicable diseases	455	448	82 (78-86)	78 (74-83)	60	456	76 (72-80)	68 (63-73)**	44
Direct maternal causes	50	58	82 (69-91)	98 (96-99)	75	47	68 (53-80)	98 (97-99)	66
non-communicable diseases including neoplasms	217	229	71 (64-77)	87 (84-90)	58	166	52 (45-58)**	91 (88-93)	45
non-specific signs & syndromes	24	12	33 (16-55)	100* (99-100)	44	9	17 (5-37)	99 (99-100)	18
Injuries	33	36	97 (84-100)	100* (99-100)	92	43	94 (80-99)	99 (97-99)	80
Unknown	17	13	0	98 (97-99)	0	75	18 (4-43)	91 (89-93)	3

Rd: frequency of reference diagnoses Sen: sensitivity CI: 95% confidence interval
Vd: frequency of VA diagnoses Spe: specificity
* exact values 99.5 to 99.9% ** P<.01

Table 14: Comparison of validity of VA by physician review versus algorithm: specific communicable and non-communicable causes of death

causes of death	Rd	VAs by physicians				VAs by algorithms			
		Vd	Sen (CI)	Spe (CI)	Kappa	Vd	Sen (CI)	Spe (CI)	Kappa
Communicable diseases									
Acute Febrile Illness	236	222	67(61-73)	89(86-91)	57	218	55(48-61)	84 (81-87)	39
Malaria	85	80	33(23-43)	93(91-95)	26	84	19(12-29)	90 (88-92)	09
Meningitis	66	60	59(46-71)	97(96-98)	59	68	38(26-51)	94 (92-96)	32
Hepatitis	32	14	34(19-53)	100*(99-100)	47	24	16(5-33)	98 (96-99)	15
Pneumonia	23	19	39(18-61)	99(98-99)	41	15	9(1-28)	98 (97-99)	08
Other AFI	30	49	30(15-49)	95(93-96)	19	27	7(1-22)	97 (95-98)	04
TB/AIDS	148	151	76(68-82)	94(92-96)	68	174	68(60-76)	89 (86-91)	53
TB	56	60	59(45-72)	96(94-97)	50	59	38(25-52)	95 (93-96)	34
AIDS	55	66	58(44-71)	94(92-96)	45	62	31(19-45)	94 (92-96)	23
TB+AIDS	37	14	8(2-21)	99(98-100)	22	53	35(20-53)	95 (93-96)	13
Diarrhoeal diseases	51	58	61(46-74)	96(95-98)	53	46	43(29-58)	97 (95-98)	42
Tetanus	13	10	77(46-95)	100	87	9	23(5-54)	99 (98-100)	25
Rabies	7	7	86(42-99)	100*	86	9	100	100*	61
NonCommuni-cable diseases									
CVS disorders	65	57	48(35-60)	96(95-98)	49	48	25(15-37)	96 (94-97)	24
Cirrhosis of liver	25	29	40(21-61)	98(96-99)	37	23	28(12-49)	98 (97-99)	27
Acute abdominal conditions	55	65	69(55-81)	97(95-98)	59	57	46(32-59)	96 (94-97)	40
Neoplasms	34	36	50(32-68)	98(96-99)	46	11	6(1-20)	99 (98-100)	07
Renal disorders	21	22	38(19-62)	98(97-99)	35	22	29(11-52)	98 (97-100)	26
other specified diseases	17	20	47(23-72)	99(97-99)	46	6	12(1-36)	100*(99-100)	16

Rd: frequency of reference diagnoses Sen: sensitivity CI: 95% confidence interval
Vd: frequency of VA diagnoses Spe: specificity * exact value 99.5 to 99.9%

Table 15: **Validity of Verbal Autopsy to Diagnose selected Causes of Maternal Death**

Causes of death	Reference diagnoses n [%] 266 [100]	VA diagnoses reached by panel of physicians				VA diagnoses reached by algorithms			
		VA Diagnoses n [%]	Sensitivity (%)	Specificity (%)	Kappa (%)	VA Diagnoses n [%]	Sensitivity (%)	Specificity (%)	Kappa (%)
Direct maternal causes									
Abortion	11 [4]	11 [4]	64	98	62	11 [4]	56	98	53
Eclampsia	5 [2]	4 [2]	40	99	44	5 [2]	20	99	18
Obstructed labour	13 [5]	10 [4]	62	99	68	13 [5]	54	98	51
Ante/postpartum haemorrhage	10 [4]	18 [7]	100	97	70	10 [4]	60	98	40
Puerperal sepsis	6 [2]	10 [4]	67	98	49	4 [2]	33	99	39
Other direct maternal causes	6 [2]	6 [2]	17	98	21	12 [5]	50	97	31
Indirect maternal causes									
Hepatitis	6 [2]	3 [1]	50	100	49	8 [3]	67	99	56
Acute Febrile Illness	18 [7]	12 [5]	39	98	44	20 [8]	39	95	32
TB/AIDS	7 [3]	3 [1]	14	99	19	8 [3]	57	99	52
Anaemia/CCF	6 [2]	3 [1]	17	99	21	5 [2]	33	99	35
non-maternal causes	178 [67]	186 [70]	97	84	84	171 [64]	93	94	84

Table 16: **Patterns of misclassification error of verbal autopsy by physician review in Ifakara**

Cause of death (VA diagnosis)	Causes of death (reference diagnosis)							Total (VA diagnosis)
	Acute febrile illness	Diarrhoeal diseases	TB/AIDS	CVS disorders	Direct maternal causes	Injuries	All other and undetermined causes	
Acute febrile illness	**49**	3	3	3	0	0	6	64
Diarrhoeal diseases	6	**24**	3	3	0	0	4	40
TB/AIDS	7	2	**57**	1	0	0	7	74
CVS disorders	7	0	4	**10**	0	0	4	25
Direct maternal causes	0	0	2	0	**9**	1	1	13
Injuries	1	0	1	1	0	**8**	0	11
all other and undetermined causes	12	4	5	7	1	0	**59**	88
Total (reference diagnosis)	82	33	75	25	10	9	81	315

Table 17: **Patterns of misclassification error of verbal autopsy by physician reivew in Jimma**

Causes of death (VA diagnosis)	Causes of death (reference diagnosis)							Total (VA diagnosis)
	Acute febrile illness	Diarrhoeal diseases	TB/AIDS	CVS disorders	Direct maternal causes	Injuries	All other and undetermined causes	
Acute febrile illness	**41**	1	3	2	3	0	4	54
Diarrhoeal diseases	0	**4**	1	0	2	0	2	9
TB/AIDS	10	0	**45**	3	0	0	8	66
CVS disorders	1	0	1	**8**	0	0	3	13
Direct maternal causes	2	0	0	0	**17**	0	2	21
Injuries	0	0	0	0	0	**17**	0	17
all other and undetermined causes	7	1	5	3	0	0	**53**	69
Total (reference diagnosis)	61	6	55	16	22	17	72	249

Table 18: **Patterns of misclassification error of verbal autopsy by physician review in Bawku**

Causes of death (VA diagnosis)	Causes of death (reference diagnosis)							Total (VA diagnosis)
	Acute febrile illness	Diarrhoeal diseases	TB/AIDS	CVS disorders	Direct maternal causes	Injuries	All other and undetermined causes	
Acute febrile illness	**69**	7	4	6	2	0	16	104
Diarrhoeal diseases	3	**3**	0	0	0	0	3	9
TB/AIDS	1	0	**10**	0	0	0	0	11
CVS disorders	4	1	0	**13**	0	0	1	19
Direct maternal causes	5	0	1	2	**15**	0	1	24
Injuries	0	0	0	1	0	**7**	0	8
all other and undetermined causes	11	1	3	2	1	0	**39**	57
Total (reference diagnosis)	93	12	18	24	18	7	60	232

Table 19: **Patterns of misclassification error of verbal autopsy by algorithm in Ifakara**

Cause of death (VA diagnosis)	Causes of death (reference diagnosis)							Total (VA diagnosis)
	Acute febrile illness	Diarrhoeal diseases	TB/AIDS	CVS disorders	Direct maternal causes	Injuries	All other and undetermined causes	
Acute febrile illness	**41**	6	6	5	3	1	12	74
Diarrhoeal diseases	6	**16**	3	0	0	0	2	27
TB/AIDS	9	4	**53**	5	1	0	13	85
CVS disorders	10	0	2	**5**	0	0	5	22
Direct maternal causes	0	0	1	0	**5**	0	0	6
Injuries	2	0	2	1	0	**8**	1	14
all other and undetermined causes	14	7	8	9	1	0	**48**	87
Total (reference diagnosis)	82	33	75	25	10	9	81	315

Table 20: **Patterns of misclassification error of verbal autopsy by algorithm in Jimma**

Causes of death (VA diagnosis)	Causes of death (reference diagnosis)							Total (VA diagnosis)
	Acute febrile illness	Diarrhoeal diseases	TB/AIDS	CVS disorders	Direct maternal causes	Injuries	All other and undetermined causes	
Acute febrile illness	**33**	0	4	2	3	0	9	51
Diarrhoeal diseases	4	**4**	2	0	0	0	2	12
TB/AIDS	10	1	**41**	3	1	0	18	74
CVS disorders	4	0	0	**6**	0	0	3	13
Direct maternal causes	1	0	2	1	**14**	0	0	18
Injuries	0	0	1	0	1	**17**	0	18
all other and undetermined causes	9	1	5	4	3	0	**40**	62
Total (reference diagnosis)	61	6	55	16	22	17	72	249

Table 21: **Patterns of misclassification error of verbal autopsy by algorithm in Bawku**

Causes of death (VA diagnosis)	Causes of death (reference diagnosis)							Total (VA diagnosis)
	Acute febrile illness	Diarrhoeal diseases	TB/AIDS	CVS disorders	Direct maternal causes	Injuries	All other and undetermined causes	
Acute febrile illness	**55**	8	4	6	3	1	16	93
Diarrhoeal diseases	4	**2**	1	0	0	0	0	7
TB/AIDS	4	0	**7**	1	0	0	3	15
CVS disorders	4	1	0	**5**	0	0	3	13
Direct maternal causes	5	0	1	2	**14**	0	1	23
Injuries	1	0	0	0	0	**6**	3	10
all other and undetermined causes	20	1	5	10	1	0	**34**	71
Total (reference diagnosis)	93	12	18	24	18	7	60	232

Table22: Pattern of misclassification of Verbal Autopsy by physician review for maternal causes of death

VA Diagnoses	Reference Diagnoses											Total (VA)
	Abo-rtion	Ecla-mpsia	Obstructed labour	Haemo-rrhage	Puerperal sepsis	Hepa-titis	Ac. febrile illness	TB/ AIDS	Anaemia /CCF	O/UM C	Non-MC	
Abortion	**7**	-	-	-	-	1	-	-	1	-	2	11
Eclampsia	-	**2**	-	-	-	-	1	-	-	1	-	4
Obstructed labour	-	1	**8**	-	-	-	-	-	-	1	-	10
Ante/postpartum haemorrhage	_	-	3	**10**	1	-	1	1	1	1	-	18
Puerperal sepsis	_	-	1	-	**4**	1	3	-	1	-	-	10
Hepatitis	_	-	-	-	-	**3**	-	-	-	-	-	3
Acute Febrile Illness	2	1	-	-	1	-	**7**	-	-	-	1	12
TB/AIDS	-	-	-	-	-	-	-	**1**	1	-	1	3
Anaemia/CCF	-	-	-	-	-	-	-	1	**1**	-	1	3
Other/unspecified maternal causes	-	1	1	-	-	-	-	1	1	**1**	1	6
Non-maternal causes	2	-	-	-	-	1	6	3	-	2	**172**	186
Total (expected)	11	5	13	10	6	6	18	7	6	6	178	266

Table 23: Pattern of misclassification of Verbal Autopsy by algorithm for maternal causes of death

VA Diagnoses	Reference Diagnoses											Total (VA)
	Abo-rtion	Ecla-mpsia	Obstructed labour	Haemo-rrhage	Puerperal sepsis	Hepa-titis	Ac. febrile illness	TB/ AIDS	Anaemia /CCF	O/U MC	Non-MC	
Abortion	**6**	-	-	-	-	1	-	-	1	-	3	11
Eclampsia	-	**1**	-	1	-	-	2	-	-	-	1	5
Obstructed labour	-	-	**7**	1	-	1	-	1	1	2	-	13
Ante/postpartum haemorrhage	_	-	2	**6**	1	-	-	-	1	-	-	10
Puerperal sepsis	_	-	-	-	**2**	-	2	-	-	-	-	4
Hepatitis	_	-	-	-	-	**4**	4	-	-	-	-	8
Acute Febrile Illness	-	2	2	-	3	-	**7**	1	1	1	3	20
TB/AIDS	1	-	1	-	-	-	1	**4**	-	-	1	8
Anaemia/CCF	-	-	-	-	-	-	1	-	**2**	-	1	4
Other/unspecified maternal causes	-	2	1	2	-	-	-	1	-	**3**	3	12
Non-maternal causes	4	-	-	-	-	-	1	-	-	-	**166**	171
Total (expected)	11	5	13	10	6	6	18	7	6	6	178	266

Table 24:
Comparison of cause specific mortality fractions unadjusted and adjusted for misclassification error

Causes of death	Total (N)	Unadjusted CSMF*	CSMF adjusted to Ifakara	CSMF adjusted to Jimma	CSMF adjusted to Bawku
Acute febrile illness	1193	16.7	19.8 (+19)	14.1 (-15)	-16.9
Diarrhoeal diseases	1065	14.9	13.3 (-11)	19.9 (+33)	54.3 (+260)
TB/AIDS	1486	20.8	20.1 (-3)	13.9 (-33)	36.7 (+76)
CVS disorders	378	5.3	0.9 (-83)	6.9 (+30)	4.5 (-15)
Direct maternal causes	190	2.7	1.9 (-29)	0.9 (-66)	-1.7
Injuries	436	6.1	5.8 (-5)	6.1 (0)	5.7 (-7))
All other & undetermined causes	2380	33.4	35.1 (+5)	37.5 (+13)	42.5 (+28)

* CSMF: cause-specific mortality fractions expressed in %
( ) Figures in parenthesis are the difference between adjusted and crude CSMFs expressed as % of crude CSMFs; adjusted CSMFs do not add up to 100% due to the differences in CSMFs between Morogro district population and the validation study population

Figure 1: **Determinants of Validity of Verbal Autopsies**

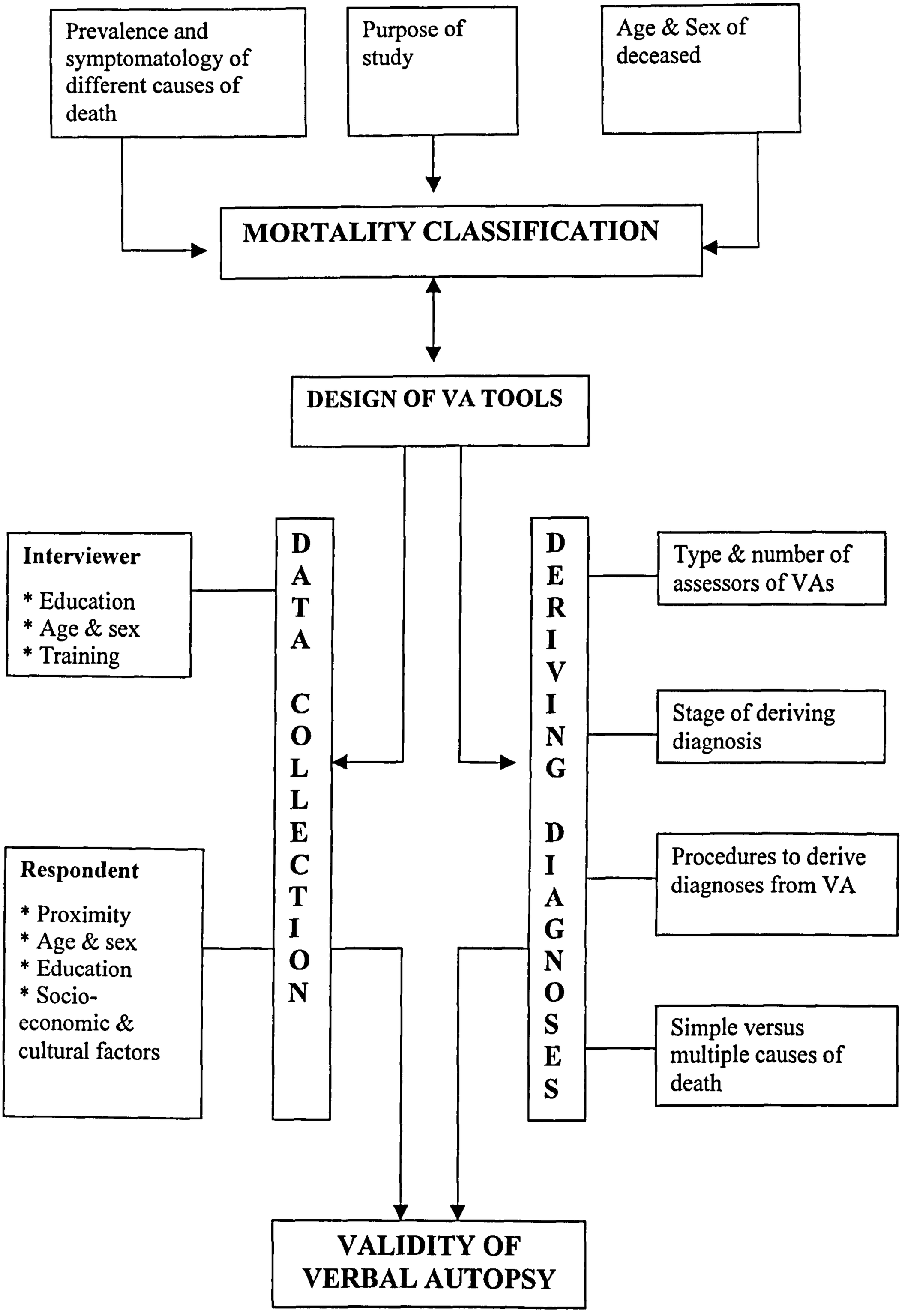


Figure 2: **Methods for reaching diagnoses from VA**

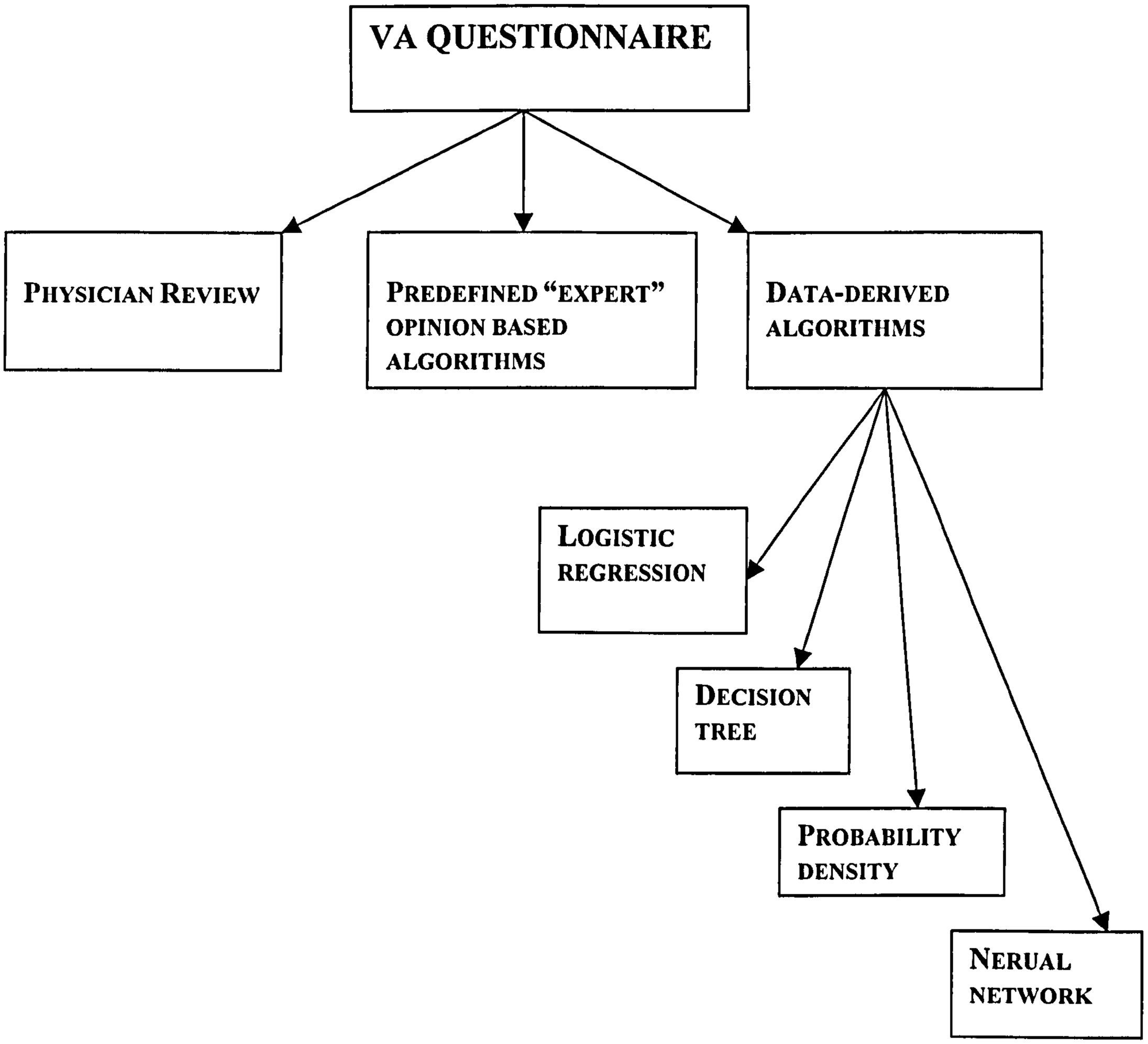


Figure 3: **The process of deriving diagnostic criteria for malaria**

List all symptoms	headache, malaise, myalgia, loss of appetite, rigor, fever, vomiting, sweating, early onset (within 2-4 days of onset of fever) unconsciousness, convulsions, black urine, low urine output

↓

Classify symptoms	essential: fever supportive: early onset unconsciousness, black urine associate: headache, malaise, myalgia, loss of appetite, rigor, vomiting, sweating, convulsions, low urine output

↓

Draft simple diagnostic criteria including all essential symptoms and one supportive symptom	(1)fever <21 days + early onset unconsciousness or (2) fever <21 days + black urine

↓

Identify potential misclassifications and their differential symptoms	(1) meningitis* (neck pain/stiffness of neck)# (1) ARI* (cough with sputum and chest pain)# (1) Typhoid (none) (2) hepatitis@ (pain in the upper abdomen)#

↓

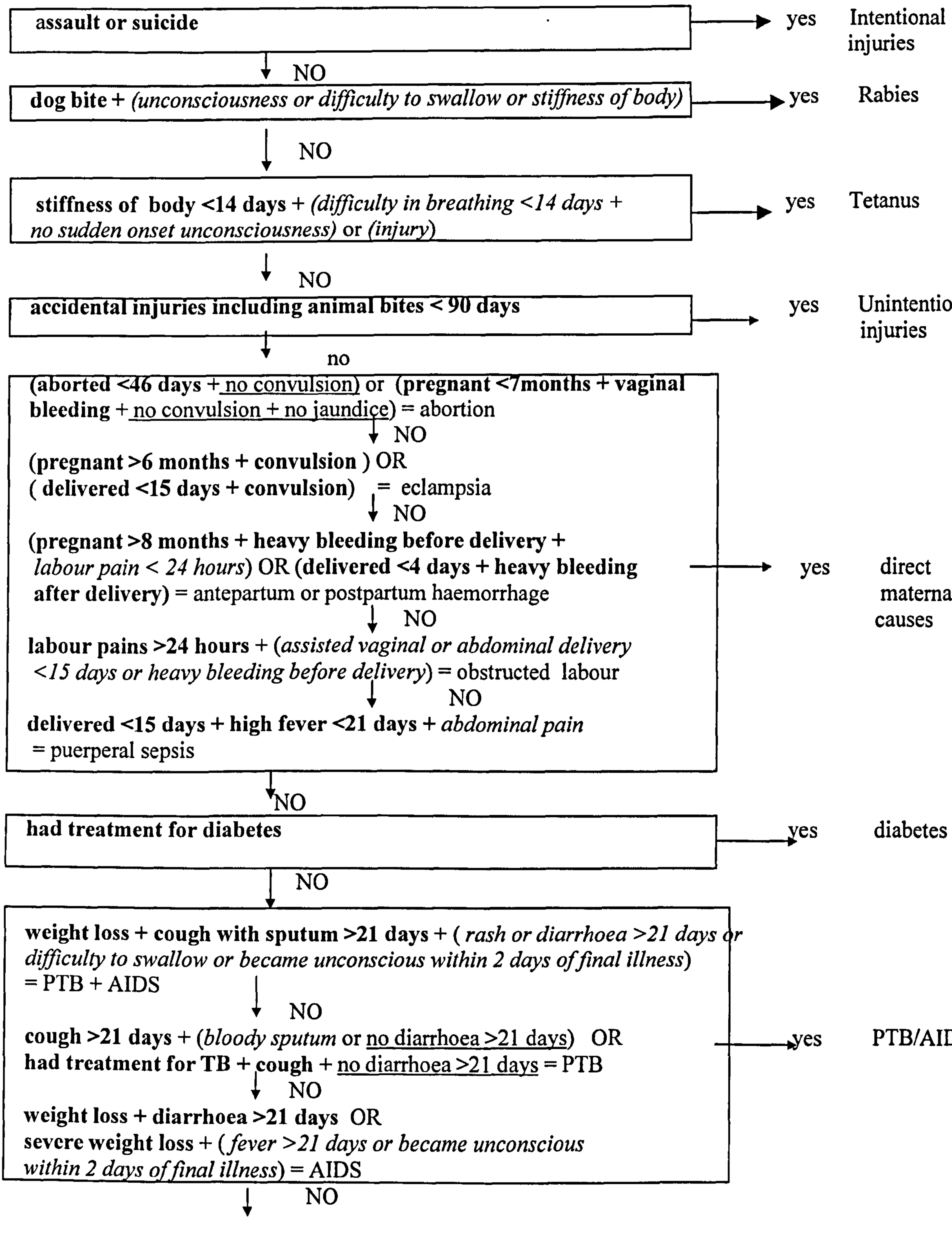
Include differential symptoms to the diagnostic criteria	(1)fever <21 days + early onset unconsciousness + absence of (neck pain/stiffness of neck, cough with sputum and chest pain) (2) fever <21 days + black urine + absence of pain in the upper abdomen

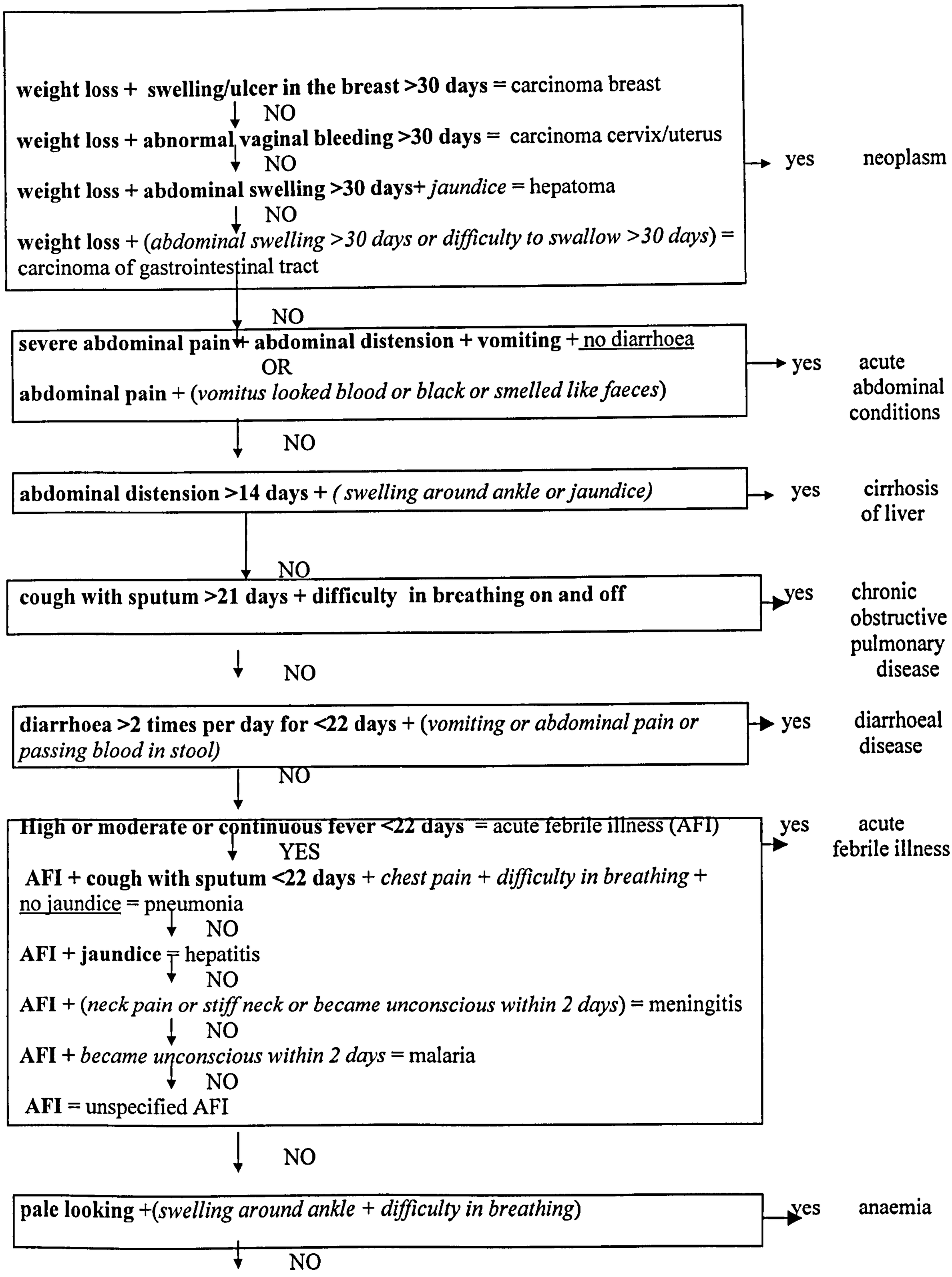
* potential misclassifications for criterion 1

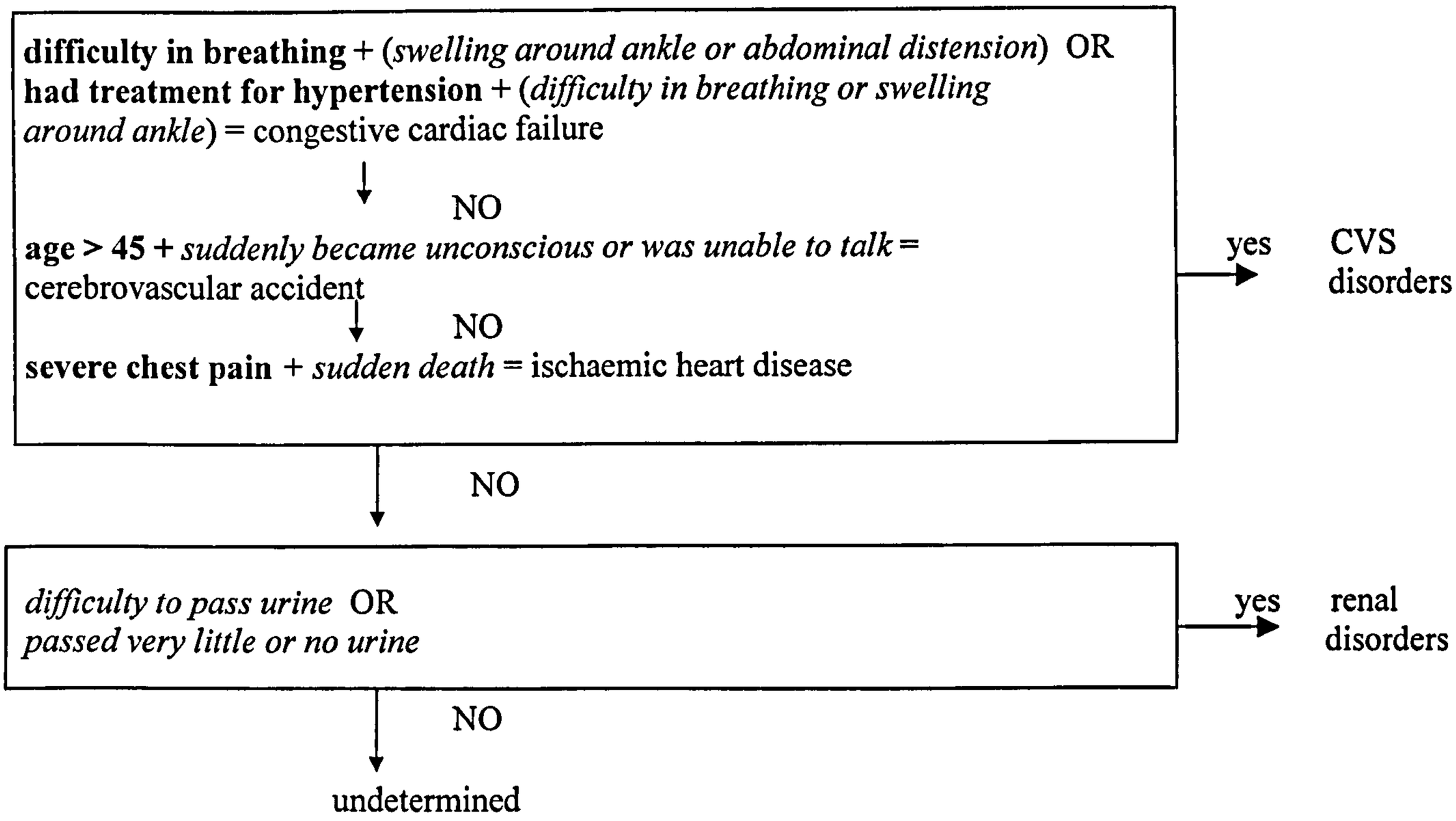
@ potential misclassification for criterion 2

differentiating symptoms for respective misclassifications

Figure 4: "opinion based" hierarchical algorithm to reach single (primary) causes of adult death




weight loss + swelling/ulcer in the breast >30 days = carcinoma breast
NO
weight loss + abnormal vaginal bleeding >30 days = carcinoma cervix/uterus
NO
weight loss + abdominal swelling >30 days+ jaundice = hepatoma
NO
weight loss + (abdominal swelling >30 days or difficulty to swallow >30 days) = carcinoma of gastrointestinal tract
yes
neoplasm
NO
severe abdominal pain + abdominal distension + vomiting + no diarrhoea
OR
abdominal pain + (vomitus looked blood or black or smelled like faeces)
yes
acute abdominal conditions
NO
abdominal distension >14 days + (swelling around ankle or jaundice)
yes
cirrhosis of liver
NO
cough with sputum >21 days + difficulty in breathing on and off
yes
chronic obstructive pulmonary disease
NO
diarrhoea >2 times per day for <22 days + (vomiting or abdominal pain or passing blood in stool)
yes
diarrhoeal disease
NO
High or moderate or continuous fever <22 days = acute febrile illness (AFI)
YES
AFI + cough with sputum <22 days + chest pain + difficulty in breathing + no jaundice = pneumonia
NO
AFI + jaundice = hepatitis
NO
AFI + (neck pain or stiff neck or became unconscious within 2 days) = meningitis
NO
AFI + became unconscious within 2 days = malaria
NO
AFI = unspecified AFI
yes
acute febrile illness
NO
pale looking +(swelling around ankle + difficulty in breathing)
yes
anaemia
NO



symptoms shown in bold scripts are essential, those in italics are supportive and those underlined are differential symptoms. Detailed classification of symptoms and further criteria to reach each ause of death included in the mortality classifications are available on request

Figure 5: **An opinion-based algorithm to reach causes of maternal death**

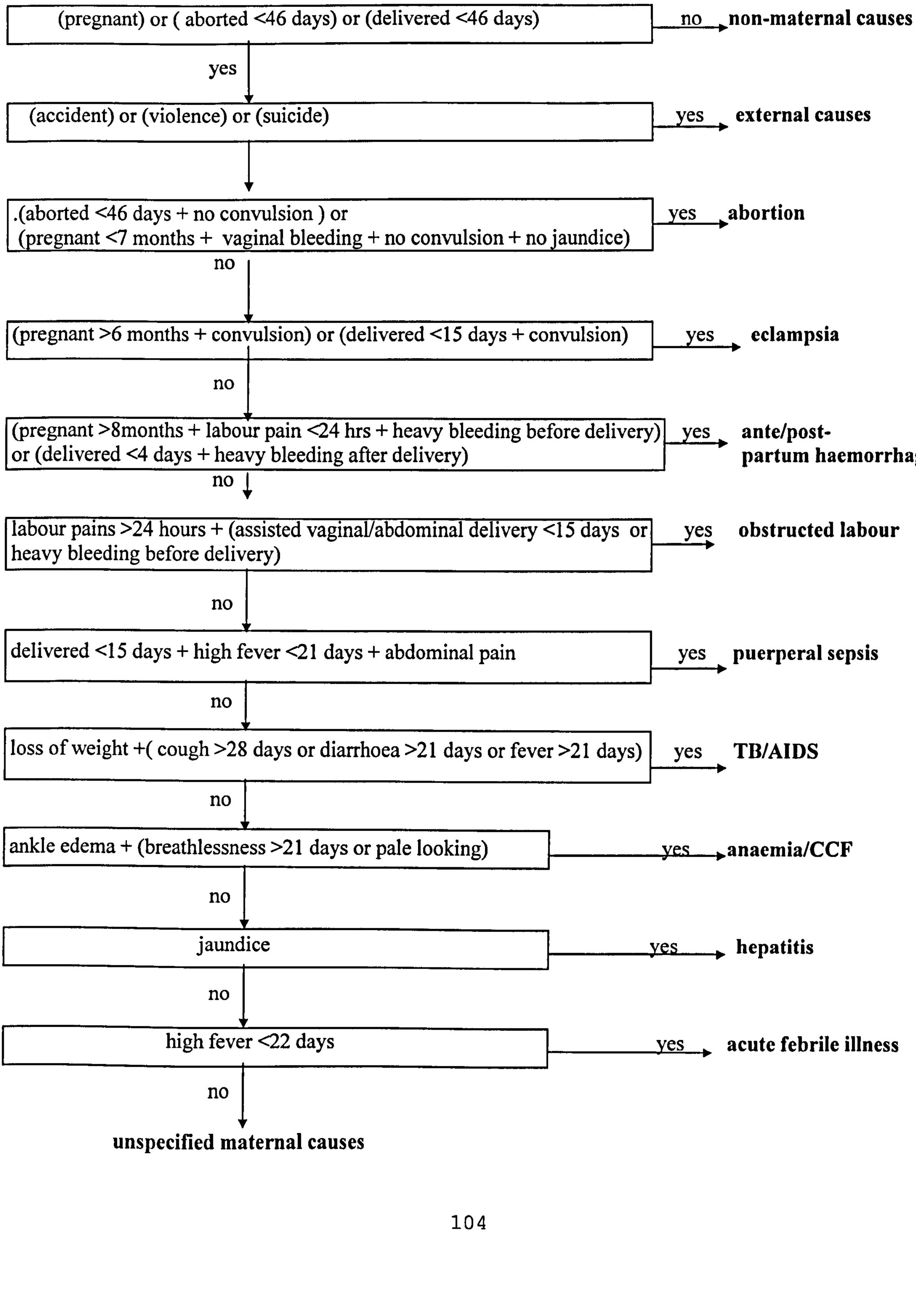


FIGURE-6

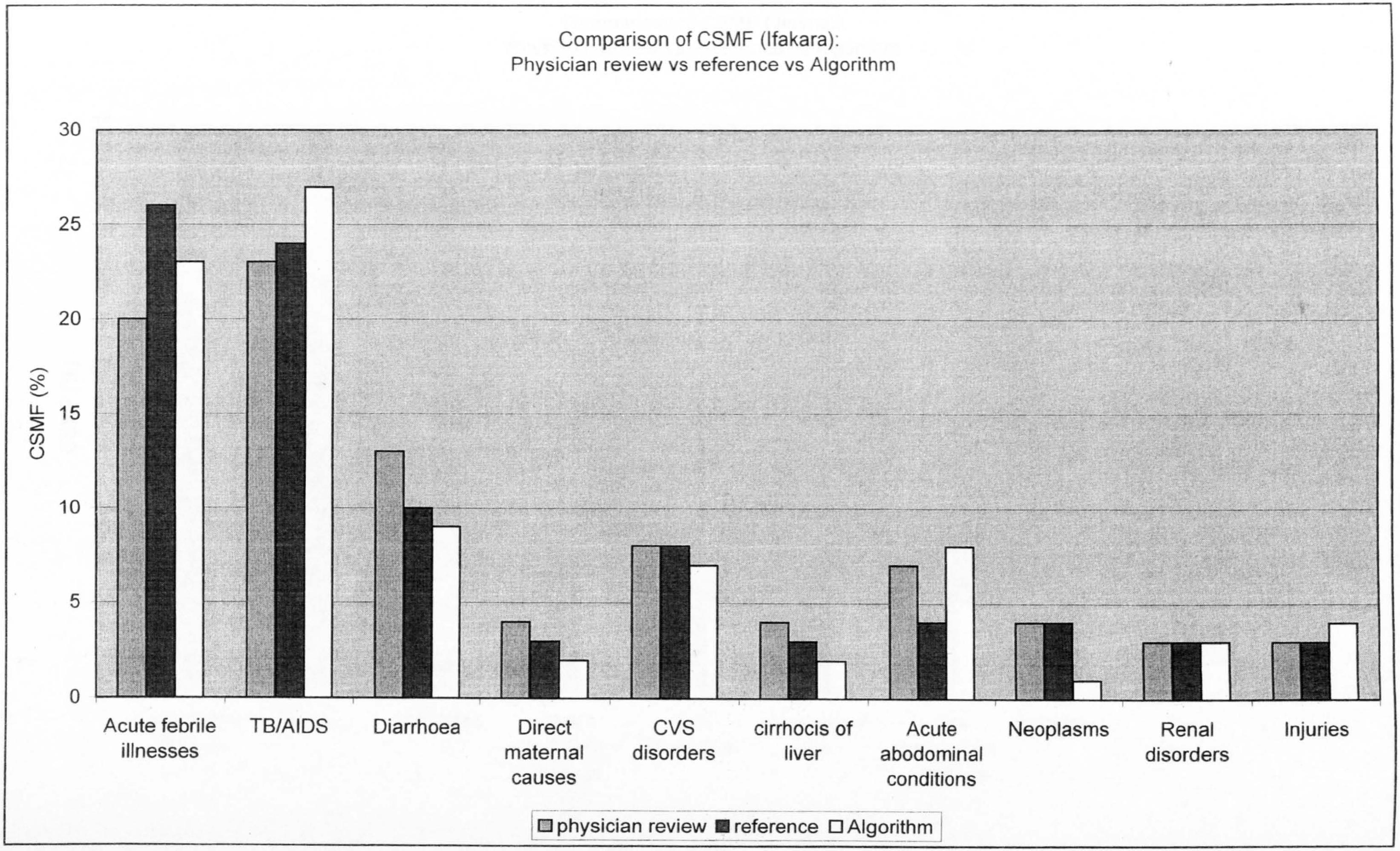

Comparison of CSMF (Ifakara):
Physician review vs reference vs Algorithm
CSMF (%)
30
25
20
15
10
5
0
Acute febrile illnesses
TB/AIDS
Diarrhoea
Direct maternal causes
CVS disorders
cirrhocis of liver
Acute abodominal conditions
Neoplasms
Renal disorders
Injuries
physician review
reference
Algorithm

FIGURE-7

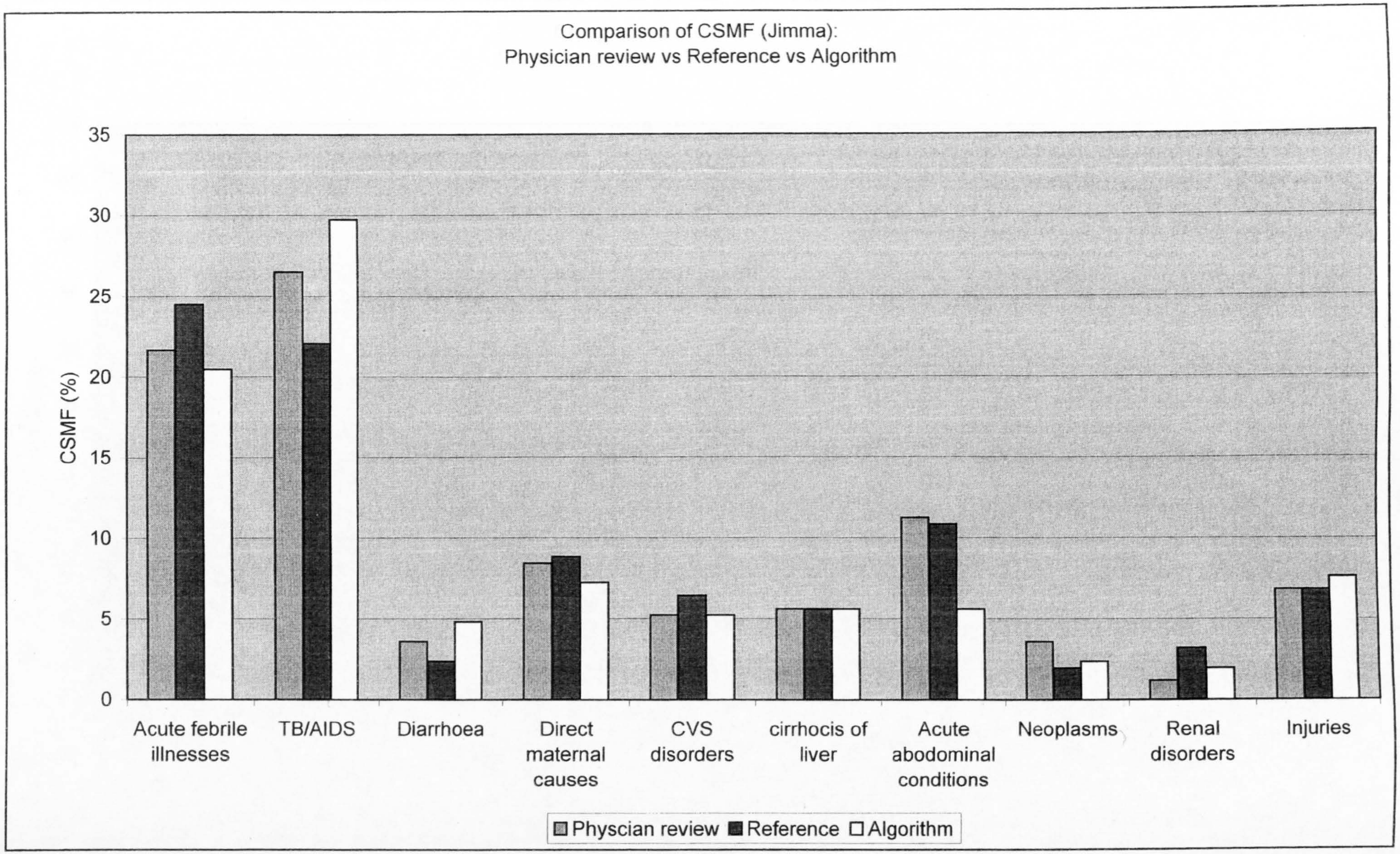
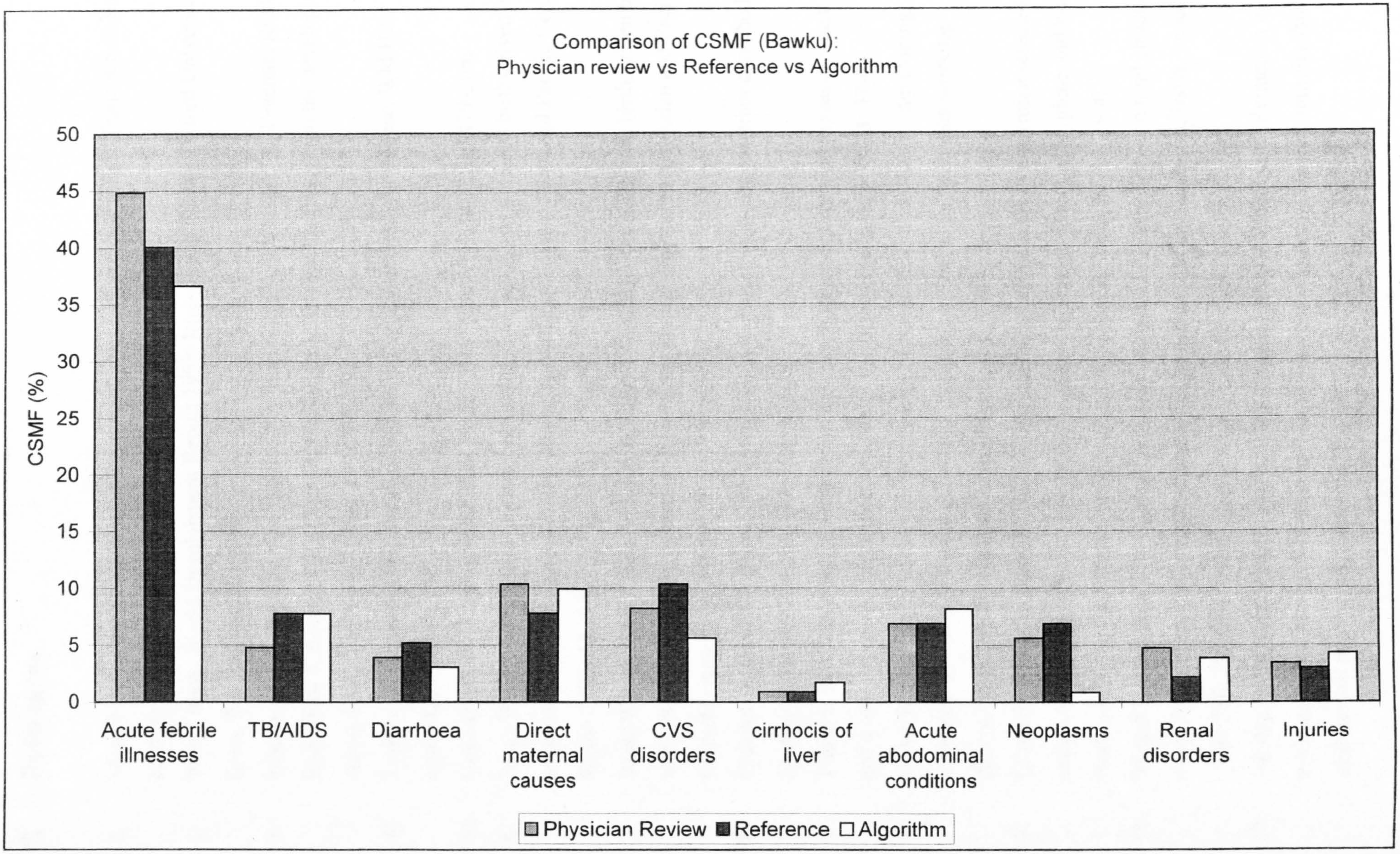

Comparison of CSMF (Jimma):
Physician review vs Reference vs Algorithm
CSMF (%)
35
30
25
20
15
10
5
0
Acute febrile illnesses
TB/AIDS
Diarrhoea
Direct maternal causes
CVS disorders
cirrhocis of liver
Acute abodominal conditions
Neoplasms
Renal disorders
Injuries
Physcian review
Reference
Algorithm

FIGURE 7


Comparison of CSMF (Bawku):
Physician review vs Reference vs Algorithm
CSMF (%)
50
45
40
35
30
25
20
15
10
5
0
Acute febrile illnesses
TB/AIDS
Diarrhoea
Direct maternal causes
CVS disorders
cirrhocis of liver
Acute abodominal conditions
Neoplasms
Renal disorders
Injuries
Physician Review
Reference
Algorithm

7. References

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8. List of Publications from the VA mutli-centre validation stduy

1. **Chandramohan D**, Maude G, Rodrigues L, Hayes R. Verbal autopsies for adult deaths: issues in their development and validation. International Journal of Epidemiology 1994; 23:213-222.
2. **Chandramohan D**, Greenwood BM. Is there an interaction between Human Immunodeficiency Virus and Plasmodium Falciparum? International Journal of Epidemiology 1998; 27:296-301.
3. **Chandramohan D**, Maude G, Rodrigues L, Hayes R. The validity of verbal autopsies for assessing causes of institutional maternal deaths. Studies in Family Planning 1998; 29:414-422
4. **Chandramohan D**, Setel P, Quigley M. Effects of misclassification of causes of death in verbal autopsy: can it be adjusted? International Journal of Epidemiology 2001; 30: 509-514.
5. Quigley M, **Chandramohan D**, Rodrigues L. Diagnostic accuracy of physician review, expert algorithms, and data-derived algorithms in adult verbal autopsies. International journal of epidemiology 1999; 28:1081-1087.
6. Quigley M, **Chandramohan D**, Setel P, Binka F, Rodrigues L. Validity of data-derived algorithms for ascertaining causes of adult deaths in two African sites using verbal autopsy. Tropical Medicine and International Health 2000; 5:33-39.
7. Andrew B, **Chandramohan D,** Weller P. A case study of mortality classification by neural network. International Journal of Epidemiology; 2001; 30: 515-520.

Appendix 1: Suggested Criteria for reaching diagnosis from VAs

1.1. **Acute Febrile Illness**: fever <21 days (E)[1] + absence of {cough with sputum >28 days (D; PTB)[2] and chronic loss of weight (D; AIDS), severe watery or bloody diarrhoea (D; Gastroenteritis/dysentery), stiffness of whole body (D; Tetanus), severe abdominal pain & distension (D; Acute abdomen), and abortion or delivery with in 45 days & distension of abdomen (D; septic abortion/puerperal sepsis)}.

1.1.1. **Malaria**: fever <21 days (E) + early onset unconsciousness (S)[3] or black urine (S) + absence of {neck pain/stiff neck (D; meningitis), pain in the right upper abdomen (D; hepatitis), and cough with sputum and chest pain (D; ARI)}.
... head ache (A)[4], shivering (A) and jaundice (A)

1.1.2. **Meningitis**: fever <14 days + rapid onset unconsciousness + neck pain/stiff neck (E) + absence of black urine (D; malaria), cough with sputum and chest pain, black urine (D; ARI) and jaundice (D; hepatitis and malaria).
... head ache, vomiting, convulsions (S)

1.1.3. **Hepatitis**: fever <14 days + severe jaundice (E) + absence of cough with sputum and chest pain (D; ARI). pain and/or swelling in the right side of abdomen (S)

1.1.4. **Pneumonia**: fever <14 days + cough with sputum + difficulty in breathing (E) + absence of diarrhoea or constipation (D; typhoid), jaundice (D; hepatitis), black urine (D; malaria) and neck pain (D; meningitis).
... chest pain (S)

1.2.1. **Pulmonary Tuberculosis**: cough with sputum >28 days (E) + absence of diarrhoea >21 days (D; AIDS), slow onset breathlessness (D; CHF), and wheezing(D; COPD). loss of weight, blood in sputum and fever on and off (S)

1.2.2 **AIDS**: loss of weight + diarrhoea >21 days or neck swelling, or fever >28 days (E). age <65, partner died recently, repeated episodes of illnesses(S)

1.3. **Gastroenteritis/Dysentery**: severe diarrhoea <21 days or bloody diarrhoea and abdominal pain <21 days (E). fever, vomiting (S)

1.4. **Tetanus**: generalised stiffness of body <14 days + difficulty in breathing <14 days (E) + absence of rapid onset unconsciousness (D; meningitis).

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[1] (E) essential symptoms; all of them should be present

[2] (D;...) differentiating symptom(s) for the diagnosis given within the parenthesis; all of them should be absent

[3] Supportive symptoms; any one of them should be present

[4] Associate symptoms; not included in the suggested criteria, but could be useful

difficulty to open the mouth, fever, recent injury (S)

2.1. **Abortion**: abortion + severe vaginal bleeding (E) or abortion + fever + lower abdominal pain (E).

2.2. **Eclampsia**: (2.2.) + swelling around ankles + convulsion (E) + absence of generalised stiffness of body (D; Tetanus, high fever or stiff neck (D; malaria/meningitis).

2.3. **Antepartum Haemorrhage**: (2.2) + severe vaginal bleeding during the early stage of labour (E) + absence of prolonged labour (D; ruptured uterus).

2.3. **Postpartum Haemorrhage**: (2.2) + severe vaginal bleeding after delivery of fetus (E). retained placenta (S)

2.4. **Obstructed labour/ruptured uterus**: (2.2) + labour >24 hours + retained fetus or abdominal delivery (E). vaginal bleeding, abnormal presentation of fetus(S)

2.5. **Puerperal Sepsis**: (2.2) + fever + lower abdominal pain or abdominal distension (E) + absence of black urine or rapid onset unconsciousness (D; malaria), stiff neck (meningitis), severe jaundice (D; hepatitis).
... labour >24 hours, assisted/operative delivery, still birth/neonatal death (S)

3.1.1. **Congestive heart Failure**: slow onset breathlessness + swelling around ankles (E) + absence of cough with sputum >60 days (D; COPD).
hypertension, swelling in the right upper abdomen (S)

3.1.2. **Ischaemic heart disease**: sudden onset continuous, severe central chest pain (E) + absence of cough with sputum (D; ARI).

3.1.3. **Cerebrovascular disease**: sudden onset unconsciousness or paralysis of one side of body (E) + absence of high fever (D; AFI), delivery with in 2 weeks (D; Eclampsia) and injuries.

3.2. **Chronic obstructive pulmonary Disease**: cough with sputum >60 days + wheezing + recurrent breathlessness (E) + absence of swelling around ankles (D; CHF). known asthmatic, smoker (S)

3.3. **Liver cirrhosis**: Slow onset distension of abdomen + swelling around ankles + loss of weight (E) + absence of severe abdominal pain (D; Acute abdomen).
vomiting blood, jaundice, slow onset unconsciousness, alcoholism (S)

3.4 **Acute abdomen**: severe abdominal pain + rapid distension of abdomen (E) + absence of swelling around ankles (D; Cirrhosis).
constipation, vomiting, swelling in the groin (S)

3.5. **Diabetes**: known diabetic + rapid onset unconsciousness or gangrene of lower limb (E).

3.6. **Neoplasms**: Fast growing ulcers or swellings + loss of weight, or post menopausal irregular vaginal bleeding or difficulty in swallowing >1 month (E).

3.6.1. **Carcinoma breast**: swelling or ulcer in the breast (E).

3.6.2. **Carcinoma cervix/uterus**: post menopausal irregular vaginal bleeding (E).

3.6.3. **Hepatoma**: jaundice + swelling in the right side of abdomen > 2 months (E).

5. **Injuries**: categories of cause of death in this group are self-explanatory for the criteria of their diagnosis.

VERBAL AUTOPSY QUESTIONNAIRE FOR ADULT DEATHS

I:Identification & Demographic Data of Deceased

Q1. Name _____ **Q2.IDNO** |_|_|_|_| IDN

Q3. Address _____

Q4. Age of deceased ..... |_|_| AOD

Q5. Sex of deceased (*male=1; female=2*)..... |_| SXD

Q6. Marital status of deceased ..... |_| MSD

(*single=1; married=2; divorced/separated=3; widowed=4*)

Q7. Years of formal education of deceased..... |_|_| YED

Q8. Occupation of deceased _____ |_| OCC

II:Circumstance of Death

Q9. For how many days was s/he ill before s/he died? (*DK=999*) |_|_|_| DID

Q10. Date of death (*dd/mm/yy*) ..... |_|_|/|_|_|/|_|_| DOD

Q11· Place of death (*home=1; hospital/clinic=2; others=3*)..... |_| POD

(IF THE ANSWER IS HOME OR OTHERS PROCEED TO Q12)

a. Name of the hospital where s/he died_____

b. Did anyone from the hospital tell you why s/he died? ..... |_| RIF

(*no=0;yes=1; not sure(NS)=9*)

Q12. Do you know the cause(s) of his/her death? (*no=0; yes=1; NS=9*) |_| RKC

a. **IF THE ANSWER IS YES PROBE TO SPECIFY THE CAUSE(S)**

cause (1)_____ |_|_|_| RD1

cause (2)_____ |_|_|_| RD2

Q13. (ASK WHETHER S/HE HAD ANY OF THE FOLLOWING ILLNESS)

Hypertension...(*no=0; yes=1; NS=9*)..... |_| HYP

Diabetes .....(*no=0; yes=1; NS=9*)..... |_| DIA

Epilepsy .....(*no=0; yes=1; NS=9*)..... |_| EPI

TB .....(*no=0; yes=1; NS=9*)..... |_| TB

HIV/AIDS .....(*no=0; yes=1; NS=9*)..... |_| HIV

IDNO: |_|_|_|_|

III: Respondents Account of Final Illness

Summary of symptoms & signs reported by Respondent

Symptoms	duration	Severity
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

IDNO: |_|_|_|_|_| IDN

IV: Specific questions to elicit symptoms & signs of the final illness

S1. **Did s/he have fever?** (*no=0; yes=1; don't know(**DK**)=9*)..... |_| FEV

(IF THE ANSWER IS NO OR **DK** PROCEED TO **S2**)

a. How many days s/he had fever? (*DK=999*)..... |_|_|_| DFE

b. Was the fever severe? *(severe=1; mild=2; DK=9)*..... |_| SFE

c. Was the fever present continuous or on and off?..... |_| TFE
(*continuous=1; on and off =2; DK=9*)

S2. **Did s/he have a rash?** (*no=0; yes=1; DK=9*)..... |_| RAS

(IF THE ANSWER IS NO OR **DK** PROCEED TO **S3**)

a. How many days did s/he have the rash? (*DK=999*) ..... |_|_|_| DRA

b. What did the rash look like? (*measles rash=1; rash with clear fluid=2; rash with pus=3; others*=4; DK=9)..... |_| TRA

c. Did s/he have sore eyes? (*no=0; yes=1; DK=9*)..... |_| SEY

d. Did s/he have itching of skin? (*no=0; yes=1; DK=9*)..... |_| ITC

S3. **Had s/he lost weight recently before death?**(*no=0; yes=1;DK=9)* |_| LOW

(IF THE ANSWER IS NO OR **DK** PROCEED TO **S4**)

a. Was the loss of weight severe? *(severe=1; moderate=2; DK=9)*.. |_| SLW

S4. **Did s/he have swelling around ankles?** (*no=0; yes=1; DK=9*)... |_| SAA

(IF THE ANSWER IS NO OR **DK** PROCEED TO **S5**)

a. How many days s/he had the swelling? *(DK=999)*..... |_|_|_| DSA

S5. **Did s/he have puffiness of the face?** *(no=0; yes=1; DK=9)*.... |_| PUF

S6. **Did s/he look pale (anaemic)?** (*no=0; yes=1; DK=9*) ..... |_| PAL

S7. **Did s/he have yellow discoloration of the eyes?**..... |_| JAU
(*no=0; yes=1; DK=9*)

S8. **Did s/he have swelling in the neck?** (*no=0; yes=1; DK=9*)..... |_| SWN

S9. **Did she have swelling in the axilla?** (*no=0; yes=1; DK=9*)... |_| SWA

S10. **Did s/he have swelling in the groin?** (*no=0; yes=1; DK=9*)... |_| SWG

S11. **Did s/he have any other swelling or ulcers?** (IF THE ANSWER IS YES PROBE FOR THE SITE AND DURATION) _____

_____

S12. Did s/he have cough? (*no=0; yes=1; DK=9*)..... |_| COU
(IF THE ANSWER IS NO OR DK PROCEED TO S13)

a. How many days s/he had cough? (*DK=999*) ..... |_|_|_| DCO

b. Was the cough productive (sputum)? (*no=0; yes=1; DK=9*)..... |_| PCO

c. Did s/he cough blood (*no=0; yes=1; DK=9*)..... |_| BCO

S13. Did s/he have shortness of breathing? (*no=0; yes=1; DK=9*).... |_| DIB
(IF THE ANSWER IS NO OR DK PROCEED TO S14)

a. Was the shortness of breathing continuous or on and off?..... |_| TDB
(*continuous=1; on and off=2; DK=9*)

b. How many days s/he had breathlessness? (*DK=999*)..... |_|_|_| DDB

c. Did s/he have wheezing? (*no=0; yes=1; DK=9*)..... |_| WHE

S14. Did s/he have chest pain? (*no=0; yes=1; DK=9*)..... |_| CHP
(IF THE ANSWER IS NO OR DK PROCEED TO S15)

a. Where was the pain? ..... |_| SCP
(over the sternum=1; over the heart=2; others=3; DK=9)

b. Was the pain continuous(*=1*) or on and off (*=2*)? (*DK=9*) ..... |_| TCP

c. When s/he had an attack of severe pain, how long did it last? |_| DCP
(*<30min=1; >30min but <24hrs=2; >24 hrs=3; DK=9*)

S15. Did s/he have diarrhoea? (*no=0; yes=1; DK=9*)..... |_| DI
(IF THE ANSWER IS NO OR NS PROCEED TO S16)

a. How many days s/he had diarrhoea? (*DK=999*) ..... |_|_|_| DDI

b. Was the diarrhoea continuous (*=1*) or on and off (*=2*)? (*DK=9*). |_| TDI

c. When the diarrhoea was severe, how many times did s/he
pass stool in a day? (*DK=99*)..... |_|_| FDI

d. What did the stool look like? ..... |_| TST
(*watery=1; loose but not watery=2; bloody=3; DK=9*)

S16. Did s/he pass blood in the stool? (*no=0; yes=1; DK=9*)..... |_| BST

S17. Did s/he have vomiting? (*no=0; yes=1; DK=9*)..... |_| VOM
(IF THE ANSWER IS NO OR NS PROCEED TO S18)

a. How many days s/he had vomiting? (*DK=999*).....|_|_|_| DVO

b. Was the vomiting continuous (*=1*) or on and off (*=2*)? (*DK=9*).. |_| TVO

c. When the vomiting was severe, how many times did s/he
vomit in a day? (*DK=99*) ..... |_|_| FVO

d. What did the vomitus look like? ..... |_| CVO
(*watery fluid=1; yellowish fluid=2; coffee coloured fluid=3;*
*blood=4; faecal matter=5; other=6*_____; *DK=9*)

S18. Did s/he have abdominal pain? (*no=0; yes=1; DK=9*) ..... |_| ABP
(IF THE ANSWER IS NO OR DK PROCEED TO S19)

a. What was the type of pain? ..... |_| CAP
(*cramps=1; dull ache=2; burning pain=3; others=4; DK=9*)

b. How many days s/he had the pain? (*DK=99*) ..... |_|_|_| DAP

c. Where exactly was the pain? ..... |_| SAP
(*lower abdomen=1; upper abdomen=2; all over the abdomen=3;*
others=4; DK=9)

d. What was the severity of the pain? ..... |_| TAP
(*severe=1; moderate=2; mild=3; DK=9*)

e. Was s/he unable to pass stool for some days before death?.... |_| CON
(*able to pass=0; unable to pass=1; DK=9*)

S19. Did s/he have distension of abdomen? (*no=0; yes=1; DK=9*)..... |_| ABD
(IF THE ANSWER IS NO OR DK PROCEED TO S20)

a. How many days s/he has abdominal distension? (*DK=999*).... |_|_|_| DAD

b. Did the distension develop rapidly with in days or
slowly over weeks? (*rapid=1; slow=2; DK=9*) ..... |_| TAD

S20. Did s/he have difficulty in swallowing? (*no=0; yes=1; DK=9*).. |_| DSW
(**IF THE ANSWER IS NO OR DK PROCEED TO S21**)

a. How many days s/he had difficulty in swallowing?(*DK=999*) |_|_|_| DDS

S21. Did s/he have any mass in the abdomen? (*no=0; yes=1; DK=9*) .. |_| ABM
(IF THE ANSWER IS NO OR DK PROCEED TO S22)

a. Where exactly was the mass? ..... |_| SAM
(*Rt upper abdomen=1; Lt upper abdomen=2; Lower abdomen=3;*
others (specify_____= 4; DK=9)

b. How may days s/he had the mass? (*DK=999*)..... |_|_|_| DAM

S22. Did s/he have headache? (*no=0; yes=1; DK=9*) ..... |_| HEA

S23. Did s/he have stiff neck? (*no=0; yes=1; DK=9*)..... |_| STN
(IF THE ANSWER IS NO OR DK PROCEED TO S24)

a. If yes, for how many days (*DK=999*) ..... |_|_|_| DSN

S24. Did s/he have any change in the level of consciousness?..... |_| LUC
(*no=0; yes=1; DK=9*) **(IF THE ANSWER IS NO OR DK PROCEED TO S25)**

a. What was the level of his/her consciousness? ..... |_| TUC
(*confused=1; unconscious=2; others_____=4; DK=9*)

b. If confused or unconscious, for how many days ? (*DK=999*) |_|_|_| DUC

c. How did it start?..... |_| OUC

(*suddenly=1; rapidly within a day=2; slowly over few days=3;DK=9*)

S25. Did s/he have fits? *(no=0; yes=1; DK=9)*..... |_| FIT

(IF THE ANSWER IS NO OR DK PROCEED TO S26)

a. How many days s/he had fits? (*DK=999*) ..... |_|_|_| DFI

b. (**ASK THE RESPONDENT TO DESCRIBE THE FITS**)..... |_| TFI

*(repetetive jerking of whole body=1; others*_____

_____*=2; DK=9)*

c. When fits were most frequent, how many per day?(*DK=99*)..... |_|_| FFI

d. Between fits was s/he awake (*=1*) or unconscious (*=2*)? (*DK=9*). |_| BFA

S26. Did s/he have difficulty in opening the mouth?..... |_| LOC

(*able to open=0; unable to open=1; DK=9*)

S27. Did s/he have stiffness of the whole body? (*no=0; yes=1;DK=9*).|_| OPI

(IF THE ANSWER IS NO OR DK PROCEED TO S28)

a. How many days s/he had the stiffness? (*DK=999*)..... |_|_|_| DOP

S28. Did s/he have paralysis of one side of the body? ..... |_| HEM

(*no=0; yes=1; DK=9*) **(IF THE ANSWER IS NO OR DK PROCEED TO S29)**

a. How many days s/he had the paralysis? (*DK=999*)..... |_|_|_| DHE

S29. Did s/he have paralysis of lower limbs? (*no=0; yes=1; DK=9*).. |_| PAR

(IF THE ANSWER IS NO OR DK PROCEED TO S30)

a. How many days s/he had the paralysis? (*DK=999*)..... |_|_|_| DPA

S30. Was there any change in the colour of urine? ..... |_| CCU

(*no=0; yes=1; DK=9*) **(IF THE ANSWER IS NO OR DK PROCEED TO S31)**

a. What was the colour of urine?..... |_| TCC

(*dark yellow=1; coffee like=2; blood stained=3; DK=9*)

b. How many days s/he had the change in colour? *(DK=999)*.... |_|_|_| DCC

S31. Was there any change in the amount of urine s/he passed daily?|_| CQU

(*no=0; yes=1; DK=9*) **(IF THE ANSWER IS NO OR DK PROCEED TO S32)**

a. How much urine did s/he pass in a day? ..... |_| AQU

(*too much=1; too little=2; no urine at all=3; DK=9*)

b. How many days s/he had the change in amount of urine?) *999* |_|_|_| DQU

S32. Did s/he have difficulty in passing urine? (*no=0; yes=1; DK=9*) .|_| DPU
(IF THE ANSWER IS NO OR DK PROCEED TO S33)

a. What type of difficulty did s/he have? ..... |_| TDP

(*unable to pass urine=1; continuous dribbling of urine=2; burning sensation while passing urine=3; others=4; DK=9*)

S33. Did s/he have any operation before death? (*no=0; yes=1; DK=9*) |_| HOP
(IF THE ANSWER IS NO OR DK PROCEED TO S34)

a. How many days before death s/he had the operation?(*DK=999*)|_|_|_| OPD

b. (ASK FOR THE SITE OF OPERATION) ..... |_| OPS

(*abdomen=1; others=2* _____ *DK=9*)

IF THE DECEASED IS A FEMALE AND >50 YERS OLD PROCEED TO S37

IF THE DECEASED IS A MALE PROCEED TO S39

S34. Was she pregnant at the time of death? *(no=0; yes=1; DK=9)*... |_| PRE
(IF THE ANSWER IS NO OR DK PROCEED TO S35)

a. How many months was she pregnant? *(DK=99)* ..... |_|_| MPR

S35. Did she deliver within 45 days before death?(*no=0; yes=1;DK=9)*|_| DEL
(IF THE ANSWER IS NO OR DK PROCEED TO S36)

a. How many days before her death did she deliver? (*DK=99*).....|_|_| EDD

b. Where did she deliver? *(home=1;clinic=2;hospital=3;DK=9)*..... |_| PDE

c. How long was she in labour?(*<24 hrs=1;>24hrs=2;DK=9)*..... |_| DDE

d. Did she have too much bleeding during delivery?..... |_| BDE

(no=0; yes=1; DK=9)

e. (IF YES, PROBE TO FIND OUT WHETHER THE BLEEDING STARTED BEFORE

OR AFTER THE DELIVERY OF FOETUS) ..... |_| HDE

f. What was the mode of delivery? ..... |_| MDE

(vaginal delivery=1; vacuum or forceps delivery=2;

abdominal operative delivery=3;DK=9)

g. Is the baby alive? (IF NO PROBE FOR THE TIME OF DEATH)..... |_| PNC

(*alive=1; still born=2; died within 7 days=3; died after 7 days=4*)

h. Did she have any previous complicated delivery? ..... |_| PCD
(*no=0; yes=1; DK=9*)

S36. Did she have an abortion within 45 days of death?..... |_| ABO

(no=0; yes=1; NS=9)

S37. Did she have irregular bleeding per vagina? ..... |_| ABV

(no=0; yes=1; NS=9)

S38. Did she have any swelling or ulcer in the breast?..... |_| BT

(no=0; yes=1; NS=9)

S39. Did s/he sustain any injury which lead to his/her death?..... |_| INJ

(no=0; yes=1; NS=9) (**IF THE ANSWER IS NO OR DK PROCEED TO S40**)

a. (**IF THE ANSWER IS YES, PROBE FOR THE TYPE OF INJURY**) ...\.... |_| TIN

(assault=1; road traffic accident=2; war injury=3; animal bite=4; fire accident=5; accidental poisoning=6; others=7 (specify) _____)

b. How many days before death s/he had the injury? (NS=999) |_|_|_| DIN

S40. Do you think that s/he committed suicide? (no=0; yes=1; NS=9) |_| SUI

(**IF THE ANSWER IS NO OR DK PROCEED TO NEXT SECTION**)

a. How did s/he commit suicide? ..... |_| TSU

(hanging=1; poisoning=2; burns=3; others=4 _____)

V.Interviewer's comments and observations

Interviewer's assessment of cause of death

Cause of death 1 _____

Cause of death 2 _____

Interviewer's IDNO ..... |_|_| IID

Date of Interviewe .....(dd\mm\yy) |_|_|/|_|_|/|_|_| DOI

APPENDIX-3

LONDON SCHOOL OF HYGIENE & TROPICAL MEDICINE

INSTRUCTION MANUAL FOR VERBAL AUTOPSIES FOR ADULT DEATH

Instruction Manual for Verbal Autopsies for adult deaths

Contents **Page**

Appendix

4

Introduction

Verbal Autopsy (VA) is an indirect method to find out the cause of death of a deceased person in the absence of a medical diagnosis. A close relative or associate of the deceased is interviewed using a Verbal Autopsy Questionnaire (VAQ) to obtain information on symptoms, signs and circumstances of the illness which lead to the death, from which a cause of death is then assigned. Before undertaking a VA survey it is essential that permission and support from the local political and traditional leaders is obtained, and that care is taken to acknowledge the sensitive nature of the interviews. Some families may not wish to talk about the death of a close relative, and the way in which an interviewer approaches the head of the family is likely to play a major role in keeping refusal rates low.

The interview process has the following six steps:

1. Identification of the household of the deceased/respondent
2. Expressing sympathy for the loss of the deceased
3. Introduction of the objectives and obtaining consent
4. Identification of an appropriate respondent(s)
5. Interviewing the respondent(s) using the VAQ
6. Closing the interview with an expression of thanks

All of these steps are important and should be carried out each time a VA is conducted.

1. Identification of the household of the deceased/respondent

The addresses and other identification landmarks to locate the household of the deceased/respondent will be provided by your supervisor. There may be situations in which the given address is inadequate and help from community members should be sought. Interviewers may need to walk long distances and to withstand frustrations in searching for an appropriate respondent, particularly, if the deceased's relatives have moved house.

* **Seek help from the local community & use the information given to you, to locate the households**
* **If the information is inadequate or incorrect conduct further enquiries to identify the household of interest**
* **Be prepared to walk long distances and to withstand the hardships which may arise while searching for the households of interest**

2. Expressing sympathy for the loss of the deceased

Since the nature of the interview is highly sensitive and may touch on the grief of the bereaved, it is essential to approach each interview with a sympathetic attitude. Do not forget to express sympathy for the loss of the deceased person, before introducing the objectives of the interview.

* **Express sympathy for the loss of the deceased before starting the interview**

3. Introduction of the objectives and obtaining consent

The interviewers will be provided with an introduction letter from the local health authorities to introduce themselves and the objectives of the interview. It is important to explain to the head of household and the respondent(s) that the information given by them will be confidential. It may be useful to explain in general the lack of information on common causes of death and the need for such information to identify appropriate interventions. After the introduction, verbal consent should be obtained from the head of household and the respondent(s) to proceed with the VAQ.

* **Approach with a sympathetic attitude**
* **Explain the need for information on common causes of death to identify control programmes**
* **Reassure that the information obtained from the interview will be confidential**
* **Obtain verbal consent before proceeding with the VAQ**

4. Identification of an appropriate respondent(s)

4.1. Appropriateness of respondents

The responsibility of caring for seriously ill patients may vary between different cultural and socio-economic groups. Thus it may not be appropriate to identify the respondent by their relationship to the deceased, and a detailed enquiry about the persons who looked after the deceased during his/her illness should be carried out to identify the appropriate respondent(s).

The most appropriate respondent is a person who had cared for the deceased during his/her final illness and who can remember, recollect and give an accurate account of the circumstances leading to the death and the signs and symptoms of the illness. The appropriateness of the respondent is graded into the following four categories: (1) looked after the deceased during the final illness at home and/or hospital (**very appropriate**); (2) lived in the same house and knows about the illness of the deceased but did not look after during the final illness (**appropriate**); (3) lived at a different house but visited the deceased frequently and knows about the illness (**probably appropriate**); (4) had heard about the illness but only visited occasionally or did not see at all (**may be appropriate**)

We aim to interview a respondent from the very appropriate category, but there may be situations where such a respondent does not exist or is unavailable. In such situations, we have to select a person from the next highest category.

4.2. Availability of respondents

The respondents may be present at the time of your visit (**present**); may be away at the time of your visit but could be contacted if revisited or moved house but could be reached(**absent**); may be impossible to contact for some reason eg. gone for a long trip, moved house to a far away place (**unavailable**).

4.3. Identifying the best respondent

The respondent identification form (**RIF**) should be used to list all potential respondents and to select the best respondent.

* **List the names, age, sex and relationships of all potential respondents including the ones who are absent at the time of your visit in the RIF**
* **Enter the grades of appropriateness according to your assessment**
* **Enter the categories of availability according to your assessment**
* **If you categorize any respondent as unavailable, note the reason(s) in the remark section of the RIF**
* **If the best respondent refused to participate note in the remark section**
* **If the best respondent is present, enter his/her identification and demographic data and continue with the interview**
* **If the best respondent is absent fix an appointment**
* **Do not interview a less appropriate respondent because the best respondent was absent!**
* **If failed to contact the best respondent on three occasions or the respondents refused to participate, report to your supervisor to select an alternative respondent**
* **After completing the VAQ tick all the respondents who participated in the interview in the RIF**

4.4. Number of respondents

Often you will come across situations where more than one respondent participate in the interview. Do not discourage the additional respondents even if they are not the best ones because the information given by them could be complementary and important.

5. Interviewing the respondent(s) using the VAQ

The VAQ is a tool to collect in-depth information from a close relative(s) or associate(s) of a deceased about the illness which lead to the death. The data from VAQs will be analyzed by a panel of physicians and/or by computer algorithms to ascertain the cause(s) of death.

The VAQ has five sections: (I) Identification & demographic data of deceased; (II) Circumstance of death; (III) Respondents account of final illness; (IV) Specific questions to elicit symptoms & signs of the final illness; (V) Interviewer's comments & observations. The information entered in all these sections should be accurate and complete to derive valid

diagnoses from the VA. The general and specific instructions given below should be adhered to in order to improve the consistency between VAs.

5.1. General Instructions

5.1.1. Attitude, Language and Gestures: Maintain a sympathetic attitude throughout the interview. The language used in the VAQ has been field tested, and should be adhered to as much as possible for the sake of consistency between the interviews. Some of the questions may require certain demonstration/gestures to make them understandable and these gestures will be shown to you during the training. In certain situations you may have to change the language or use different gestures to make the question understandable. Should such a situation arise, make a note of the changes made and report to your supervisor. This would allow your supervisor to inform the other interviewers about the necessary changes and to improve the VAQ.

5.1.2. The sequence of the sections in the VAQ: The sequence of the sections in the VAQ can be altered if necessary. However, once a section is started it should be completed before moving to another section. For example, it is possible that the respondent may narrate the history of illness of the deceased as soon as you start the interview. In such instances complete the section on the respondents account of final illness (section III) first and then come back to the section I.

5.1.3. Questions and Codes of Responses: The VAQ has 13 stem questions in the first two sections and 40 stem questions in the section IV. The stem questions are followed by several sub-questions which could be skipped if the answer for the stem question is "no" or "not sure/ don't know". Most of the questions have limited number of possible responses which are given. However you may come across some responses which are not included in the coded responses. Record such responses by the side of the respective question and report to the supervisor. The coding scheme for questions with yes/no answers are as follows: "no" or "absent" = 0, "yes" or "present" = 1 and "not sure" or "don't know" = 9.

5.1.4. **Reporting to the supervisor:** If you have any doubts or comments (including the questions which were difficult, modified or produced answers different from those coded) write in the comments section and report to your supervisor. **Your comments and observations are vital to improve the VAQ!**

* **Maintain a sympathetic attitude through out the interview**
* **Adhere to the language used in the VAQ as much as possible for the sake of consistency between the interviews (The questions are carefully translated and field tested)**
* **Should you change the translations or the format of questions, make a note and inform your supervisor**
* **Be consistent if you give demonstrations or use gestures (You will be given specific instructions during the training)**
* **Should you modify or use additional gestures/demonstrations, inform your supervisor**
* **You can alter the sequence of the sections of VAQ if necessary, but complete the section once it is started**
* **Skip the sub-questions if the response to the stem question is "no" or "not sure"**
* **Should you come across responses which are not given in the VAQ, record them and report to your supervisor**
* **Verify the codes of responses before entering. It is easy to make an error!**

5.2. Instructions related to specific questions of the VAQ

(The comments and instructions given below are numbered according to the question number in the VAQ; since most of the questions and responses are self explanatory, many of them are not explained further in this manual)

I. Identification and demographic data of deceased

Names, IDNO, Address, Age and Sex of the deceased person will be filled in by your supervisor.

* **Verify that Names, IDNO, Address, Age and Sex of the deceased are filled in when you receive the VAQ, and that the information given is correct .**

Q7. Years of formal education:

*	**Enter the number of years of schooling. eg. never went to school=0, went up to grade VI=6, not sure=99.**

Q8. Occupation:

*	**Record the reported occupation (eg. housewife, trader, driver etc)** (*the responses to this question will be coded at a later stage*)

II. Circumstances of death

Q9. This question aims to find out the duration of the illness which lead to the death of a deceased. Respondents may not have difficulties in reporting the duration of a short fatal illness. However, some diseases may have very long and recurrent episodes and respondents may have difficulties in reporting the duration of such an illness. In such circumstances, use of important local events as an aide memoir may be helpful. If there is a long history of illness with illness free periods in between, probe and note the duration of illness free periods. If the illness free period exceeds 3 months, consider the illness prior to this period as past history and the illness after this period as the final illness. Usually respondents will report the duration of illness in weeks or months or years. Convert these units into days and record in the boxes eg. one year of illness will be recorded as |3|6|5|. If they do not know the duration of illness record as |9|9|9|. It is assumed that the duration of a final illness is unlikely to be >3 years. If you come across >3 years record the number of years and report to your supervisor.

*	**Record the duration of the illness which lead to the death**
*	**Record the duration of the illness in days**
*	**If the duration is more than 3 years record the number of years (eg.|4|y|r|) and report to your supervisor**
*	**Use important local events as aide memoir**
*	**If there is any doubts about the duration of illness, record reasons for doubt in the comments section (section VI)**

Q10. Date of Death:

* **Probe for the date of death using local events as aide memoir** * **Record the date in the first two boxes, the month in the next two boxes and the year in the last two boxes (eg. 2 May 94 will be |0|2|0|5|9|4|** * **Do not waste time in probing for the exact date; month or year of death would be adequate if day is not known**

Q11. Place of death:

b. "Any one from the hospital" refers to doctors and nurses.

If the respondent cannot recollect whether they were told about the cause of death, then the response is recorded as "not sure |9|".

Q12. Cause of death:

* **Probe gently to specify the cause(s) of death** * **Do not ask "Why did s/he die?"; Always ask "What disease caused the death?" (this would minimize the reports of non-medical causes such as witch crafts)** * **If more than two causes are reported, record all of them and report to your supervisor** (*No codes are given for the possible responses; the recorded responses will be coded by your supervisor at a later stage*)

Q13. This question is to elicit whether the deceased was known to have been suffering from hypertension, diabetes, epilepsy, TB or AIDS. Some respondents may report that the deceased had the disease (eg.TB) a few years ago but was cured after treatment. Even if it is reported as cured, the response should be recorded as "yes" (=1). In some areas

asking about AIDS may not be acceptable and in such areas you should ask about AIDS at the end of the interview. Never fill in no or not sure without asking the question!

* **Record the response as "yes", if the deceased had Hypertension, Diabetes, Epilepsy, TB or AIDS at any time, even if they are reported as "cured"**
* **Delay the question about AIDS until the end of the interview if it is sensitive to talk about AIDS**
* **Never enter "no" or "not sure" without asking the question**

III. Respondents' account of final illness

This section has two parts: (i) an open space to record the respondent's verbatim account of the final illness of the deceased; (ii) A table to summarise the reported symptoms and signs, and their duration and severity.

* **Record the verbatim account of the illness and circumstance of death as complete as reported**
* **You may probe to elicit the sequence of the reported symptoms, but do not probe for additional symptoms**
* **List the symptoms mentioned in the order reported by the respondent**
* **Ask for the duration and severity of each symptom individually before recording**

IV. Specific questions to elicit symptoms and signs of final Illness

S1. **Fever**: Although the symptom fever is carefully translated, in some settings you may have to demonstrate fever or "hot body" using gestures (to be shown during training).

c. **Type of fever**: It is assumed that the respondents should be able to judge whether the fever was "continuous" or "on and off". If the respondent is unable to report the type of fever, probe to find out whether it was a low grade fever with fever free periods in between (on and off) or a high fever which was continuous from the onset to death (continuous).

S2. **Rash**: Rash is a raised skin lesion which may or may not be itching. In the context of VAs we are really interested to know about measles and herpes zoster rashes.

*	**Use gestures to demonstrate rashes**

b. **Type of rash**: measles rash, rash with clear fluid and rash with pus are given as possible responses. If the description of rash was different from these three, then enter "4" and record the description of the rash.

c. **Sore eyes**: this refers to red eyes (conjunctivitis) which is often present in patients with measles

S3. **Recent loss of weight**: Patients suffering from certain diseases like TB, AIDS and cancer, may begin to lose weight before the onset of other symptoms. Therefore, "recent" refers not only to the final stages but also to the earlier stages of the illness.

a. **severity**: Difficult to standardize the severity of loss of weight. Accept the respondent's judgement.

S4. **Swelling around ankle**: Fluid collects around ankles and feet in certain conditions such as heart failure. This is not a swelling of the ankle joint but around the ankle.

*	**Demonstrating "pitting" to clarify this symptom** (*to be shown during the training*).

a. **Duration of the swelling**: swelling around the ankles could have appeared on and off, particularly if the patient was on treatment.

*	**If the swelling was on and off record the duration from the time of the first episode and also make a remark that it was on and off.**

S5. **Puffiness of the face**: a swollen appearance of the face especially around the eye lids

*	**Use gestures to explain puffiness of face** (*to be shown during the training*)

S6. Pale (anaemia): often noticed as pallor of face

*	**Use gestures to explain pallor** (*to be shown during the training*)

S7. Yellow discolouration of the eyes: jaundice

*	**Use gestures to explain jaundice**

S8,S9 & S10. Swelling in the neck, axilla (arm pit) and groin: refers to glandular swelling in these areas of the body.

*	**Show the area and demonstrate the swelling**

S11. Any other swelling and ulcers: refers to all kinds of swelling in the body including hernias.

*	**probe by showing the site and appearance of certain swellings and ulcers** (*to be shown during training*)
*	**record the verbatim account of the type, site and duration** (*this will be coded at a later stage*)

S13. Shortness of breathing: difficulty in breathing or breathlessness usually happens after mild exertion but in severe forms even at rest.

*	**Demonstrate of shortness of breathing** (*to be shown during training*)

a. Duration: breathlessness often occurs intermittently.

*	**Record the time since the first episode**

b. Wheezing: difficulty in breathing associated with musical noise during expiration.

*	**Demonstrate wheezing** (*to be shown during training*)

S14. Chest pain: aims to elicit chest pain associated with myocardial infarction and pneumonia.

a. site of pain:

*	**Probe by showing the breast bone, the heart and the lateral aspect of chest**

S19. Distension of abdomen: refers to abdominal distension occurring in ascites (chronic liver disease) and acute abdominal conditions

b. Type of distension: the distension related to acute abdominal conditions occur rapidly within few days (rapid); the distension develop gradually over weeks or months in ascites

*	**Use gestures to explain rapid and slow onset distension of abdomen**

S20. Difficulty in swallowing: this refers to mechanical obstruction due to diseases such as tumours, but not to the inability or difficulty in swallowing due to weakness (eg. unconscious state).

*	**Give a demonstration of difficulty in swallowing**

S21. Abdominal mass: refers to any mass including the enlargement of organs such as the liver and spleen.

a. site:

*	**Show the right and left upper abdomen and the lower abdomen to elicit the site**

S23. Stiff neck: refers to the neck pain and stiff neck occurring in meningitis. In some areas this question may have to be changed to elicit neck pain rather than stiffness.

*	**Demonstrate stiff neck** (*to be shown during the training*)

S24. Level of consciousness: this refers to restless, confused, drowsy or unconscious state, but not to the behavioural changes related to mental disorders.

*	**Explain the levels of consciousness using gestures** (*to be shown during the training*)

S25. Fits: refers to convulsions, but not to rigor associated with fever

*	**Demonstrate fits and rigor** (*to be shown during the training*)

S26. Difficulty in opening the mouth: refers to the difficulty occurring in tetanus, due to the spasm of certain buccal muscles.

*	**Give a demonstration of difficulty in opening the mouth and probe to differentiate this condition from severe weakness and drowsiness.**

S27. Stiffness of body: refers to the muscular spasm which occurs in tetanus.

*	**Give a demonstration of stiffness of the body**

S28. Paralysis of one side of the body:

*	**Give a demonstration of hemiplegia**

S29. Paralysis of lower limbs:

*	**Give a demonstration of paraplegia**

S30. Colour of urine: Gentle probing is needed since many respondents are likely to answer "don't know".

S31. Amount of urine: Gentle probing is needed since many respondents are likely to answer "don't know".

S33. Operations: Refers to any operation which was associated with or lead to the death.

* **If you are in doubt whether an operation was associated with the death, record it and discuss with your supervisor**

S34. Duration of pregnancy:

* **If the number of months of pregnancy is unknown, probe and record whether she was in early or later stages of pregnancy**

S37. Irregular bleeding: refers to any bleeding other than normal menstruation

S39. Injuries: refers to any injury associated with or lead to the death.

* **If you are in doubt whether an injury was associated with the death, record it and discuss with your supervisor**

V. Interviewer's comments and observations

Your comments and observations would be very useful for revising the VAQ and for training interviewers. Therefore, record everything that is worth mentioning, in your opinion, in this section.

* **Write your comments regarding the selection of respondent(s), the degree of cooperation and understanding of the respondents, the problems with specific questions etc.** * **If you have formed an opinion as to the cause of death, record it in the space given**

6. Closing the interview with an expression of thanks

* **Do not forget to thank the respondent(s) for their time and help, after completing the interview**

ATTENDANT

Respondent Identification Form

Name of the deceased _____ **IDNO** |_|_|_|.

I. List of potential respondents

Names of potential respondents	Age	Sex	Relationship to deceased	Appropriateness	Availability	Participation

Relationship to deceased: RECORD THE RELATIONSHIP OF THE RESPONDENT TO THE DECEASED (*eg. If the deceased is a man and the respondent is his daughter, then tl relationship is daughter not father*)

Appropriateness: REFER TO THE INSTRUCTION MANUAL FOR DEFINITIONS (very *appropriate appropriate; probably appropriate; may be appropriate*)

Availability: REFER TO THE INSTRUCTION MANUAL FOR DEFINITIONS (*present; absent unavailable*)

Participation: TICK AT THE END OF THE INTERVIEW IN THE BOXES OF THOSE WHO PARTICIPATED

II. Identification & Demographic Data of Principal Respondent

Q1. Name of the respondent _____

Q2. Age of respondent ..... |_|_| AOR

Q3. Sex of respondent (*male=1; female=2*) ..... |_| SXR

Q4. Relationship of respondent to the deceased ..... |_| ROR

(*spouse=1; daughter=2; son=3; mother=4; father=5;*

others=6 (specify) _____)

Q5. Years of formal education of respondent ..... |_|_| YER

Q6. First language of the respondent _____

III. Information about the visits

7. **Date of first Visit** |_|_|/|_|_|/|_|_|
8. **Date of second Visit** |_|_|/|_|_|/|_|_|
9. **Date of third Visit** |_|_|/|_|_|/|_|_|
10. **Reason(s) for abandoning the interview** (IF YOU COMPLETE THIS SECTION, DISCUS WITH YOUR SUPERVISOR)

APPENDIX-5

VERBAL AUTOPSY QUESTIONNAIRE FOR ADULT DEATHS

I:Identification & Demographic Data of Deceased

Q1. Jina la marehemu_____ **Q2.IDNO** |_|_|_|_| IDN

Q3. Anwani _____

Q4. Umri wa marehemu..... |_|_| AOD

Q5. Jinsia (*me=1; ke=2*)..... |_| SXD

Q6. Ndoa ..... |_| MSD

(*hajaoa/hajaolewa=1; ameoa/ameolewa=2; talaka/achana=3; mjane=4*)

Q7. Kiwango cha elimu ya marehemu..... |_|_| YED

Q8. Kazi ya marehemu_____ |_| OCC

II:Circumstance of Death

Q9. Marehemu alikuwa mgonjwa kwa muda gani kabla ya kufariki? |_|_|_| DID

(*Sijui (SI)=999*)

Q10. Tarehe ya kufariki (*dd/mm/yy*) ..... |_|_|/|_|_|/|_|_| DOD

Q11. Mahali alipofariki ..... |_| POD

(*nyumbani=1; hospitali/kliniki=2; penginepo=3*)

(KAMA JIBU NI NYUMBANI AU PENGINEPO ENDELEA NA SWALI LA Q12)

a. Jina la hospitali alikofia _____

b. Je kuna mganga yeyote wa hospitali aliyewajulisha sababu ya kifo chake? (*hapana(HA)=0;ndiyo(ND)=1; sina hakika(SH)=9*)..... |_| RIF

Q12. Je unajua sababu ya kifo chake? (*HA=0; ND=1; SH=9*).....|_| RKC

a. **KAMA JIBU NI NDIYO, ULIZA KUJUA SABABU**

sababu (1)_____ |_|_|_| RD1

sababu (2)_____ |_|_|_| RD2

Q13. (ULIZA KAMA ALIWAHI KUWA NA MAGONJWA YAFUATAYO)

Musukumo wa damu (BP).....(*HA=0; ND=1; SI=9*)..... |_| HYP

Kisukari .....(*HA=0; ND=1; SI=9*)..... |_| DIA

Kifafa .....(*HA=0; ND=1; SI=9*)..... |_| EPI

Kifua kikuu (TB).....(*HA=0; ND=1; SI=9*)..... |_| TB

Ukimwi (AIDS).....(*HA=0; ND=1; SI=9*)..... |_| HIV

2.IDNO: |_|_|_|_|

III: Respondents Account of Final Illness

Summary of symptoms & signs reported by Respondent

Symptoms	duration	Severity
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

IDNO: |_|_|_|_| IDN

IV: Specific questions to elicit symptoms & signs of the final illness

S1. Je aliwahi kuwa na homa ya kuchemka mwili? (*HA=0; ND=1; SI=9*) |_| FEV
(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S2**)

a. Alikuwa anachemka mwili kwa muda gani? (*SI=999*)..... |_|_|_| DFE

b. Joto hilo ilikuwa kali?(*kali sana=1; wastani=2;kawaida=3;SI=9*)|_| SFE

c. Jota hilo ilikuwa la mfululizo (=*1*) au ya vipindi (=*2*)? ... |_| TFE

S2. Je alikuwa na vipele? (*HA=0; ND=1; SI=9*)..... |_| RAS
(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S3**)

a. Alikuwa na vipele kwa muda gani? (*SI=999*) ..... |_|_|_| DRA

b. Vipele vilikuwa vya namna gani? (*surua=1; upele wenye maji=2; upele wenye usaha=3; mengineyo=4; SI=9*)..... |_| TRA

c. Alikuwa na macho mekundu? (*HA=0; ND=1; SI=9*)..... |_| SEY

d. Alilkuwa anawashwa ngozi na kujikuna? (*HA=0; ND=1; SI=9*).... |_| ITC

S3. Je alikuwa amekonda kabla ya kufariki? (*HA=0; ND=1; SI=9*).... |_| LOW
(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S4**)

a. Je alikonda sana (=*1*) au wastani (=*2*)? (*SI=9*)..... |_| SLW

S4. Je alikuwa amevimba miguu? (*HA=0; ND=1; SI=9*)..... |_| SAA
(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S5**)

a. Alikuwa amevimba kwa muda gani? (*SI=999*)..... |_|_|_| DSA

S5. Je uso wake ulikuwa umevimba? (*HA=0; ND=1; SI=9*)..... |_| PUF

S6. Je alikuwa anaonekana kuwa na upungufu wa damu? ..... |_| PAL
(*HA=0; ND=1; SI=9*)

S7. Je macho yake yalikuwa na rangi ya njano? (*HA=0; ND=1; SI=9*) |_| JAU

S8. Je shingo yake ilikuwa na uvimbe? (*HA=0; ND=1; SI=9*)..... |_| SWN

S9. Je alikuwa na uvimbe kwapani? (*HA=0; ND=1; SI=9*)..... |_| SWA

S10. Je alikuwa na uvimbe sehemu za siri (mtoke)?(*HA=0; ND=1; SI=9*)|_| SWG

S11. Je alikuwa na uvimbe wowote mwingine au kidonda sehemu nyingineyo
(**KAMA JIBU NI NDIYO ULIZA SEHEMU NA MUDA**) _____

_____

S12. Je alikuwa na kikohozi? (*HA=0; ND=1; SI=9*)..... |_| COU

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S13)

a. Alikuwa na kikohozi kwa muda gani? (*SI=999*) ..... |_|_|_| DCO

b. Alikuwa anakohoa na kutema makohozi? (*HA=0; ND=1; SI=9*)... |_| PCO

c. Aliwahi kukohoa damu? (*HA=0; ND=1; SI=9*)..... |_| BCO

S13. Je alikuwa akipumua kwa shida? (*HA=0; ND=1; SI=9*)..... |_| DIB

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S14)

a. Alikuwa akipuma kwa shida mfululizo (=1) au kwa vipindi (=2)? |_|TDI

a. Alikuwa akipumua kwa shida kwa siku ngapi? (*SI=999*) .....|_|_|_| DDB

b. Je kifua kilikuwa kinatoa mlio wakati wa kupumua? ..... |_| WHE

(*HA=0; ND=1; SI=9*)

S14. Je alikuwa na maumivu ya kifua? (*HA=0; ND=1; SI=9*)..... |_| CHP

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S15)

a. Maumivu yalikuwa sehemu gani ya kifua?..... |_| SCP

(*katikati ya kifua=1; upande wa moyo=2; nyingine=3; SI=9*)

b. Maumivu yalikuwa ya mfululizo(=1) au ya vipindi(=2)? (*SI=9*).. |_| TCP

c. Maumivu makali yalipomjia yalichukua muda gani?..... |_| DCP

(*nusu saa=1; zaidi ya nusu saa lakini chini ya saa 24=2;*

zaidia ya siku=3; SI=9)

S15. Je alikuwa anaharisha? (*HA=0; ND=1; SI=9*)..... |_| DIA

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S16)

a. Aliharisha kwa siku ngapi? (*SI=999*) ..... |_|_|_| DDI

b. Kuharisha kulikuwa kwa mfululizo(=1) au kwa vipindi(=2)?(*SI=9*)|_| TDI

c. Alipoharisha sana, aliharisha mara ngapi kwa siku? (*SI=99*). |_|_| FDI

d. Choo chake kilikuwaje? ..... |_| TST

(*maji maji=1; laini lakini si maji maji=2; damu=3; SI=9*)

S16. Je choo kilikuwa na damu? (*HA=0; ND=1; SI=9*)..... |_| BST

S17. Je alikuwa anatapika? (*HA=0; ND=1; SI=9*)..... |_| VOM

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S18)

a. Alitapika kwa siku ngapi? (*SI=999*).....|_|_|_| DVO

b. Alikuwa anatapika mfululizo(=1) au kwa vipindi(=2)? (*SI=9*).. |_| TVO

c. Alipotapika sana, alitapika mara ngapi kwa siku? (*SI=99*) .. |_|_| FVO

d. Matapishi yalikuwaje? ..... |_| CVO

(*maji maji=1; njano=2; kahawia=3; damu=4; kama choo=5;*

*mengineyo=6*_____; *SI=9*)

S18. Je alikuwa na maumivu ya tumbo? (*HA=0; ND=1; SI=9*) ..... |_| ABP

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S19)

a. Maumivu yalikuwa ya namna gani? ..... |_| CAP

(kunyonga=1; maumivu ya kawaida=2; maumivu yanayo choma=3; kuwaka moto=4; mengineyo=5; SI=9)

b. Alikuwa na maumivu hayo kwa muda gani? (*SI=99*) ..... |_|_|_| DAP

c. Ni sehemu gani iliyokuwa na maumivu hayo? ..... |_| SAP

(chini ya kitovu=1; juu ya kitovu=2; tumbo lote=3; mengineyo=4; SI=9)

d. Ukali wa maumivu ulikuwaje? (*sana=1; wastani=2; SI=9*)..... |_| TAP

e. Je alikuwa hawezi kwenda choo kwa siku kadhaa kabla ya kufariki? (*alikuwa anaweza=0; alikuwa hawezi=1; SI=9*)..... |_| CON

S19. Je tumbo lilikuwa limevimba? (*HA=0; ND=1; SI=9*)..... |_| ABD

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S20)

a. Tumbo lilivimba kwa muda gani? (*SI=999*)..... |_|_|_| DAD

b. Je kuvimba kwa tumbo kulitokea kwa muda mfupi(*=1*) au taratibu kwa muda mrefu(*=2*)..... |_| TAD

S20. Je alikuwa na matatizo katika kumeza chakula?(*HA=0;ND=1;SI=9*). |_| DSW

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S21)

a. Alikuwa hawezi kumeza chakula kwa muda gani?(*SI=999*) ... |_|_|_| DDS

S21. Je alikuwa na uvimbe wowote tumboni? (*HA=0; ND=1; SI=9*) ... |_| ABM

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S22)

a. Uvimbe huo ulikuwa sehemu gani? ..... |_| SAM

(kulia kwa tumbo=1; kushoto kwa tumbo=2; chini ya kitovu=3; nyingineyo_____= 4; SI=9)

b. Alikuwa na uvimbe huo kwa muda gani? (*SI=999*)..... |_|_|_| DAM

S22. Je alikuwa na maumivu ya kichwa? (*HA=0; ND=1; SI=9*) ..... |_| HEA

S23. Je shingo ilikuwa imekakamaa? (*HA=0; ND=1; SI=9*)..... |_| STN

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S24)

a. Shingo ilikuwa imekakamaa kwa muda gani? (*SI=999*) ..... |_|_|_| DSN

S24. Je kulikuwa na mabadiliko katika akili yake?(*HA=0; ND=1; SI=9*)|_| LUC

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S25)

a. Ili badilika ikawaje? ..... |_| TUC

(alichanganyikiwa=1; alikuwa hatulii=2; alipoteza fahamu=3; mengineyo_____=4; SI=9)

b. Mabadiliko yalikuwa ya muda gani ? (*SI=999*)..... |_|_|_| DUC

c. Yalianzaje? ..... |_| OUC

(*ghafla=1; katika siku moja=2; kwa siku kadhaa=3; SI=9*)

S25. Je alikuwa na hali ya kushtuka (kama degedege)?..... |_| FIT

(*HA=0; ND=1; SI=9*)

(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S26**)

a. Alishtuka kwa muda gani? (*SI=999*) ..... |_|_|_| DFI

b. (**ULIZA ALIKUWA ANASHTUKAJE**)..... |_| TFI

(*mwili mzima=1; nyingineyo*_____*=2;SI=9*)

c. Alikuwa akishtuka mara ngapi kwa siku?(*SI=99*)..... |_|_| FFI

d. Je kati ya kushtuka alikuwa akipata fahamu?(*HA=0; ND=1; SI=9*) |_| BF

S26. Je alikuwa hawezi kufungua mdomo? (*HA=0; ND=1: SI=9*)..... |_| LOC

S27. Je mwili wote ulikuwa unakakamaa? (*HA=0; ND=1; SI=9*)..... |_| OPI

(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S28**)

a. Ulikuwa unakakamaa kwa muda gani? (*SI=999*)..... |_|_|_| DOP

S28. Je alikuwa amepooza upande mmoja wa mwili? ..... |_| HEM

(*HA=0; ND=1; SI=9*)

(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S29**)

a. Alipooza kwa muda gani? (*SI=999*)..... |_|_|_| DHE

S29. Je alikuwa amepooza miguu? (*HA=0;ND=1;SI=9*)..... |_| PAR

(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S30**)

a. Alipooza kwa muda gani? (*SI=999*)? ..... |_|_|_| DPA

S30. Kulikuwa na mabadiliko yoyote katika rangi ya mkojo?..... |_| BIU

(*HA=0; ND=1; SI=9*)

(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S31**)

a. Mkojo ulikuwa wa rangi gani? ..... |_| UCO

(*njano nzito=1; kahawia=2; mchanganyiko na damu=3; SI=9*)

b. Mabadiliko ya mkojo yaliendelea kwa muda gani? (*SI=999*)...|_|_|_| DBU

S31. Kulikuwepo na mabadiliko yoyote ya kiasi cha mkojo wa kila siku? (*HA=0; ND=1; SI=9*).....|_| CQU

(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S32**)

a. Kiasi gani cha mkojo kilitolewa kwa siku? ..... |_| AQU

(*mwingi=1; kidogo sana=2; hakuna kabisa=3; SI=9*)

b. Mabadiliko ya kiasi cha mkojo yaliendelea kwa muda gani?..|_|_|_| DQU

S32. Je alikuwa anakojoa kwa shida? (*HA=0; ND=1; SI=9*)..... |_| DPU

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S33)

a. Ni shida ya aina gani aliyokuwa nayo? ..... |_| TDP

(*Kutoweza kutoa mkojo=1; mkojo kutoka mfululizo=2; alikojoa kwa maumivu makali kama moto=3; nyingineyo=4; SI=9*)

S33. Je aliwahi kupasuliwa (operesheni) kabla ya kufariki?..... |_| HOP

(*HA=0; ND=1; SI=9*)

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S34)

a. Alipasuliwa siku ngapi kabla ya kufariki?(*SI=999*)..... |_|_|_| OPD

b. (**NI SEHEMU IPI YA MWILI ILIYOPASULIWA**) ..... |_| OPS

(*tumbo=1; nyingineyo=2* _____ *SI=9*)

KAMA MAREHEMU NI MWANAMKE ZAIDI YA MIAKA 50 ENDELEA NA SWALI LA S37

KAMA MAREHEMU NI MWANAUME ENDELEA NA SWALI LA S39

S34. Alikuwa mjamzito wakati wa kufariki? (*HA=1; ND=0; SI=9*)..... |_| PRE

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S35)

a. Alikuwa na mimba ya miezi mingapi? (*SI=99*) ..... |_|_| MPR

S35. Je alijifungua siku 45 kabla ya kufariki? (*HA=0; ND=1; SI=9*). |_| DEL

(KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S36)

a. Alijifungua siku ngapi kabla ya kufariki? (*SI=99*).....|_|_| EDD

b. Alijifungulia wapi? (*nyumbani=1;kliniki=2;hosipitali=3;SI=9*). |_| PDE

c. Alishikwa na uchungu kwa muda gani?..... |_| DDE

(*chini ya siku=1; zaidi ya siku=2; SI=9*)

d. Je alitokwa na damu nyingi sana wakati wa kujifungua?..... |_| BDE

(*HA=0; ND=1; SI=9*)

e. (**KAMA NI NDIYO, ULIZA ALIANZA KUTOKUWA DAMU KIPINDI GANI**)... |_| HDE

(*alipoanzwa na uchungu=1; baadye wahati wa uchungu lakini kabla ya kujifungua=2; Baada ya kujifungua=3*)

f. Alijifunguaje ? ..... |_| MDE

(*kawaida=1; mtoto kuvutwa=2; kupasuliwa=3; SI=9*)

g. Je mtoto yuko hai? (**KAMA HAPANA ULIZA NI LINI ALIFARIKI**)..... |_| PNC

(*hai=1; alizaliwa amekufa=2; alikufa katika juma moja=3; alikufa baada ya juma moja=4*)

h. Je aliwahi kuwa na matatizo ya uzazi hapo nyuma? ..... |_| PCD

(*HA=0; ND=1; SI=9*)

S36. Je mimba iliharibika katika siku 45 kabla ya kufariki?..... |_| ABO
(HA=0; ND=1; SI=9)

S37. Je alipata kutokwa na damu bila mpangilio sehemu za siri? ... |_| ABV
(HA=0; ND=1; SI=9)

S38. Je alikuwa na uvimbe au kidonda katika maziwa?..... |_| BT
(HA=0; ND=1; SI=9)

S39. Je aliwahi kuumia kabla ya kifo chake? *(HA=0; ND=1; SI=9)*.... |_| INJ
(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA KWA SWALI LA S40**)

a. (**KAMA JIBU NI NDIYO, ULIZA KUJUA AINA YA JERAHA**) ..... |_| TIN
(kupigwa=1; ajali ya barabarani=2; jeraha la vita=3; kuumwa na mnyama=4; ajali ya moto=5; kunyweshwa sumu=6; mengineyo=7
_____)

b. Aliumia siku ngapi kabla ya kufariki? *(SI=999)*..... |_|_|_| DIN

S40. Je unadhani alijiua? *(HA=0; ND=1; SI=9)*..... |_| SUI
(**KAMA JIBU NI HAPANA AU SIJUI ENDELEA NA SEHEMU INAYOFUATA**)

a. Alijiuaje? ..... |_| TSU
(kujinyonga=1; kunywa sumu=2; kujichoma moto=3; mengineyo=4
_____)

VI. Interviewer's comments and observations

41. Interviewer IDNO ..... |_|_| IID
42. Interviewed on .....(dd\mm\yy) |_|_|_|_|_|_| DOI

Interviewer's assessment of cause of death

Cause of death 1 _____

Cause of death 2 _____

APPENDIX - 6

Verbal Autopsy Questionnaire for Adult Deaths

I. የሟች ማንነት ዝርዝር መረጃ

Q1. ስም_____ Q2.. IDNO |__|__|__|__| IDN

Q3. አድራሻ _____

Q4. የሟች ዕድሜ _____ |__|__| AOD

Q5. የሟች ጾታ /ወንድ=1 ሴት =2..... |__| SXD

Q6. የሟች የጋብቻ ሁኔታ ..... |__| MSD

ያላገባች/ባ =1፤ ያገባ/ባች =2፤ የፈታ/ች/ የተለያዩ =3

የሞተበት/ባት =4/

Q7. የሟች የመደበኛ ትምህርት ደረጃ ..... |__|__| YED

Q8. የሟች ሥራ ..... |__| OCC

III. አ ሟ ሟ ት

Q9. ከመሞታቸው በፊት ለምን ያህል ቀናት ታመው ነበር?/አላው = 999/ |__|__|__| DID

Q10. መቼ ነው የሞቱት/ያረፉት?/ (dd/mm/yy)..... |__|__|/|__|__|/|__|__| DOD

Q11. የት ነው/ የሞቱት/ ያረፉት?/ቤት=1፤ ሆስፒታስ/ክሊኒክ =2፤ ሌላስ= 3/ .. |__| POD

(If the answer is home or others proceed to Q12)

a. የትኛው ሐኪም ቤት ውስጥ ነው የሞቱት? .....

b. ሟች ለምን እንደሞተ ከሐኪም ቤት ሠራተኞች ተነግሮት ነበር?

/የለም =0 ፤ አዎ =1 ፤ እርግጠኛ አይደለሁም =9/ ..... |__| RIF

Q12. የሞቱበትን ምክንያት ያውቃሉ? / የለም =0፤ አዎ =1፤

እርግጠኛ አይደለሁም =9/..... |__| RKC

a. If the answer is yes probe to sepcify the cause(s)

cause (1)_____ |__|__|__| RD1

cause (2)_____ |__|__|__| RD2

Q13. (Ask whether s/he had any of the following illness)

a. ደም ብዛት (hypertension)....(no.=0; yes=1; DK=9)... |__| HYP

b. ስኳር በሽታ (diabetea)....(no=0; yes=1; DK=9)..... |__| DIA

c. የሚጥል በሽታ (epilepsy)...(no=0; yes=1; DK=9)..... |__| EPI

d. ሣንባ ነቀርሳ (TB)...(no=0; yes=1; DK=9)..... |__| PTB

e. ኤድስ (AIDS)....(no=0; yes=1; DK=9)..... |__| HIV

IDNO: |__|__|__|

IV. Respondent's account of final illness of the deceased

Summary of symptoms & signs reported by Respondent

Symptoms	Duration	Severity
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

IDNO: |__|__|__|__| IDN

V. questions to probe for symptoms & signs of final illness of deceased

S1. ትኩሣት ነበረቸው ወይ? ..... |__| FEV

/አልነበራቸም «አለነ» =0፤ ነበራቸው «ነበ» =1 አላውቅም «አላው» =9/

(If the answer is no or DK proceed to S2.)

a. ትኩሣቱ ምን ያህል ቀናት ነበራቸው? /አላው = 999/..... |__|__|__| DEF

b. ትኩሣቱ ሀይለኛ ነበር? /አልነ =0፤ ነበ =1፤ አላው= 9/..... |__| SFE

c. ትኩሣቱ ያለማቋረጥ ነበር ወይስ አልፎ አልፎ ነበር? ..... |__| TFE

/ያለማቋረጥ =1 ፤ አልፎ አልፎ= 2 አላው =9/

S2. ሰውነታቸው ላይ ሽፍታ ነበራቸው? /አልነ =0፤ ነበ=1፤ አለው=9/..... |__| RAS

(If the answer is no or DJ proceed to S3)

a. ሽፍታው ምን ያህል ቀናት ነበረባችው? /አላው =999/.....|__|__|__| DRA

b. ሽፍታው ምን ይመስል ነበር? ..... |__| TRA

የኩፍኝ አይነት ሽፍታ =1 ፤ ውሀ የቋጠረ ሽፍታ =2 ፤ መግል የያዘ

ሽፍታ=3 ሌላ ዓይነት ሽፍታ /ይገለጽ/_____=4፥አላው=9/

c. ዓይናቸው ቀልቶ ነበር/ /አልነ =0፤ ነበ =1፤ አላው =9/..... |__| SEY

d. ያሳከካቸው ነበር? /አልነ =0፥ ነበ =1 አላው =9/..... |__| ITC

S3. ከመሞታቸው በፊት ጥቂት ቀደም ብሎ ከስተው ነበር?..... |__| LOW

/አልነ =0፤ ነበ =1 ፤ አላው =9/

(If the answer is no or DK proceed to S4.)

a. ከሳታቸው እንዴት ነበር? ..... |__| SLW

/በጣም =1 መካከለኛ =2 ፤ አላው =9/

S4. እግራቸው አብጦ ነበር? /አልነ=0፤ ነበ =1፤ አላው =9/..... |__| SAA

(If the answer is no or DK proceed to S5)

a. ለምን ያህል ቅናት አብጦ ነበር? /አላው=9/.....|__|__|__| DSA

S5. ፊታቸው አብጦ ነበር? /አልነ = 0 ፤ ነበ =1፤ አላው =9/..... |__| PUF

S6. ፊታቸው ነጥቶ ነበር ወይ? /አልነ =0፤ ነበ=1፤ አላው =9/..... |__| PAL

S7. ዓይናቸው ወደ ብጫነት ተለውጦ ነበር? /አልነ =0፤ ነበ =1፤ አላው=9/ ..... |__| JAU

S8. አንገታቸው ላይ እብጠት ነበር? /አልነ =0፤ ነበ =1፤ አላው =9/..... |__| SWN

S9. ብብታቸው ላይ እብጠት ነበር? /አልነ =0 ፤ነበ =1፤ አላው =9/..... |__| SWA

S10. ንፊፊታቸው ላይ እብጠት ነበር? /አልነ =0፤ ነበ =1፤ አላው =9/..... |__| SWG

S11. ሌላ እብጠት ወይም ቁስል በሰውነታቸው ላይ ነበር?

(If the answer is yes probe for the site and duration)

S12. ሳል ነበራቸው? /አልነ =0፤ ነበ =1፤ አላው =9/..... |__| COU

(If the answer is no or DK proceed to S13)

a. ለምን ያህል ቀናት ሳል ነበራቸው? / አላው =9/.....|__|__|__| DCO

b. ሲያስላቸው አክታ ይወጣቸው ነበር? / አልነ =0፤ ነበ =1፤ አላው=9/... |__| PCO

c. አክታቸው ደም ነበረው? /አልነ =0፤ ነበ =1፤አላው=9/..... |__| BCO

S13. ትንፋሽ ያጥራቸው ነበር? /አልነ =0 ፤ ነበ =1፤ አላው=9/..... |__| DIB

(If the answer is no or DK proceed to S14)

a. ትንፋሽ ያጥራቸዋል፤ ያለማቋረጥ ነበር፤ ወይስ አልፎ አልፎ ነበር

/ያለማቋረጥ =1፤ አልፎ አልፎ =2፥ አላው =9/..... |__| TDB

b. ምን ያህል ቀናት ትንፋሽ ያጥራቸው ነበር? /አላው =999/..... |__|__|__| DDB

c. ሲተነፍሱ ትንፋሻቸው የፉጭት ድምጽ ይወጣው ነበር? ..... |__| WHE

/አልነ =0፤ ነበ =1፤ አላው =9/

S14. ደረታቸው ላይ ሕመም ወይም ውጋት ይሰማቸው ነበር?..... |__| CHP

/አልነ =0 ፤ ነበ =1፤ አላው =9/

(If the answer is no or DK proceed to S15)

a. ሕመሙ በደረታቸው ላይ በየትኛው አካባቢ ይሰማቸው ነበር?..... |__| SCP

/መሀል ደረታቸው ላይ =1፤ ልባቸው ላይ =2፤ ሌላ አካባቢ =3፤

አላው =9/.

b. ሕመሙ ባለማቋረጥ ይሰማቸው ነበር ወይስ አልፎ አልፎ ይሰማቸው ነበር?..... |__| TCP

/ያለማቋረጥ ነው =1፤ አልፎ አልፎ =2፥ አላው =9/

c. በጣም ታመው በነበር ጊዜ ሕመም ለምን ያሕል ጊዜ ነበር የቆየባቸው? ..... |__| DCP

/30 ደቂቃ =1 ፤ 30 ደቂቃ ግን 24 ስዖት =2፥ 24 ሰዓት =3

አላው =9/

S15. ተቅማጥ ነበራቸው? /አልነ =0፤ ነበ =1፤ አላው =9/..... |__| DI

(If the answer is no or DK proceed to S16)

a. ለምን ያህል ቀናት ተቀማጥ ነበራቸው? /አላው =999/.....|__|__|__| DDI

b. ተቅማጡ ባለሟቋረጥ ነበር ወይስ አልፎ አልፎ ነበር?..... |__| TDI

/ባለማቋረጥ =1፤ አልፎ አልፎ =2፥ አላው =9/

c. ተቅማጡ በበረታባቸው ወቅት በቀን ምን ያህል ጊዜ ያስቅምጣችው ነበር? ... |__|__| FDI

/አላው =99/

d. ተቅማጡ ምን ይመስል ነበር?..... |__| TST

/ቀጭን እንደውሃ =1 ፤ ቀጠን ያለ =2 ፤አላው =9/

S16. ደም ያስቀምጣቸው ነበር? /አልነ=0፥ ነበ =1 ፤ አላው =9/..... |__| BST

S17. ያስታውካቸው ነበር? /አልነ =0፤ ነበ =1 ፤ አላው =9/..... |__| VOM

(If the answer is no or DK proceed to S18)

a. ለምን ያህል ቀናት ያስታውካቸው ነበር? /አላው =999/.....|__|__|__| DVO

b. ተውካቱ ባለሟቋረጥ ነበር ወይስ አልፎ አልፎ ነበር?..... |__| TVO

/ባለማቋረጥ =1 ፤ አልፎ አልፎ =2፥ አላው =9/

c. ትውከቱ በበረታባቸው ወቅት በቀን ምን ያህል ጊዜ ያስታውካቸው ነበር?

/አላው =99/ .....|__|__| FVO

d. ትውከቱ ምን ይመስል ነበር?..... |__| CVO

/ቀጭን አንደ ውሃ=1፤ ቢጫ መሰል ፈሳሽ =2፤

ቡናማ ፈሳሽ =3 ፤ ደም ቅልቅል =4 ሠገራ መሰል =5 ፤ ሌላ መልክ

ከነበረው ግለጽ =6 _____፤ አላው =9/

S18. ሆዳቸውን ያማቸው ነበር? /አልነ=0፤ ነበ =1 ፤ አላው =9/..... |__| ABP

(If the answer is no or DK proceed to S19)

a. ሕመሙ እንዴት ነበር? ..... |__| CAP

/እንደቁርጠት =1ውጋት =2 ፥ማቃጠል =3፥ ሌላ ዓይነት =4፤

አላው =9/._____

b. ለምን ያህል ቀናት ሆዳቸውን ያማቸው ነበር? /አላው =999/..... |__|__|__| DAP

c. ሕመሙ በሆዳችው ላይ በየትኛው አካባቢ ይሰማቸው ነበር?..... |__| SAP

/ከእምብርታእችው በታች =1፤ ከእምብርታቸው በላይ =2፤

መላ ሆዳቸውን =3 ሌላ ካለ ይገለጽ _____ =4 ፤አላው =9/

d. የሆዳቸው ሕመም ብርታት ምን ያህል ነበር? ..... |__| TAP

/በጣም =1፥ መካከለኛ =2፤ መጠነኛ =3 ፤ አላው =9/

e. ከመሞታቸው በፊት ጥቂት ቀደም ብሎ ሰገራ የመውጣት ችግር

ነበረባቸው?..... |__| CON

/አልነ =0፤ ነበ =1 ፤ አላው =9/

S19. ሆዳቸው ተነፍቶ ነበር? /አልነ =0፤ ነበ=1፤ አላው=9/..... |__| ABD

(If the answer is no or DK proceed to S20)

a. ለምን ያህል ቀናት ሆዳቸው ተነፍቶ ነበር? /አላው =999/..... |__|__|__| DAD

b. የሆዳቸው መነፋት ወዲያውኑ በአጭር ጊዜ ውስጥ ጨመረ ወይስ ቀስ

በቀስ በረዥም ጊዜ አደገ? ..... |__| TAD

/ውዲያው ባጭር ጊዜ=1፥ ቀስ በቀስ በረዥም ጊዜ=2፥ አላው=9/

S20. ምግብ ለመዋጥ ይከለከላቸው ነበር? / አልነ=0፤ ነበ=1፤ አላው =9/..... |__| DSW

(If the answer is no or DK proceed to S21)

a. ለምን ያህል ቀናት ምግብ ለመዋጥ ይከለከላቸው ነበር?/ አላው=999/..... |__|__|__| DDS

S21. በሆዳቸው ውስጥ እብጠት ነበራቸው ወይ? / አልነ=0፤ ነበ=1፤

አላው =9/..... |__| ABM

(If the answer is nor or DK proceed to S22)

a. በሆዳቸው ውስጥ እብጠቱ የት አካበቢ ነበር?..... |__| SAM

/በቀኝ በኩል/በጉበት አካባቢ/ =1፤ በግራ በኩል=2፤ ከእምብርት

በታች= 3፤ በሌላ አካባቢ ከሆነ ግለጽ= 9/

b. ለምን ያህል ቀናት እብጠቱ ነበረባቸው? /አላው =999/..... |__|__|__| DAM

S22. ራስምታት ነበራቸው? /አልነ=0፤ ነበ=1፤ አላው =9/..... |__| HEA

S23. ማጅራታቸውን ገትሮ ይዝዋቸው ነበር? /አልነ=0፤ ነበ=1፤ አላው =9/..... |__| STN

(If the answer is no or DK proceed to S24)

a. ለምን ያህል ጊዜ ማጅራታቸውን ገትሮ ይዝዋቸው ነበር? /አላው =999/. |__|__|__| DSN

S24. ሕሊናቸው ተለውጦ ነበር?/ አልነ =0፤ ነበ =1፤ አላው=9/..... |__| LUC

(If the answer is no or DK proceed to S25/

a. የሕሊናቸው መለወጥ በምን ሁኔታ ላይ ነበር?..... |__| TUC

/መዘባረቁ =1፤ ራሳቸውን ሥተው ነበር =2፤ ሌላ ከሆነ ግለጽ=3፤__=9/.

b. ለምን ያህል ቀናት ህሊናቸው ተለውጦ ነበር? /አላው =99/.....|__|__|__| DUC

c. እንዴት ጀመራቸው? /በድንገት =1፥ በአንድ ቀን ውስጥ=2፤ በቀናት

ውስጥ =3፤ አላው =9/..... |__| OUC

S25. ያንቀጠቅጣቸው ነበር? /አልነ=0 ፤ ነበ =1፤ አላው =9/..... |__| FIT

(If the answer is no or DK proceed to S26)

a. ለምን ያህል ቀናት ያንቀጠቅጣቸው ነበር? /አላው =999/.....|__|__|__| DFI

b. እንዴት ያንቀጠቅጣቸው እንደነበረ ይግለጹ/ መላ ሰውነታቸውን =1፤ እጃቸውን

ወይንም እግራቸውን ብቻ =2፤አላው =9/..... |__| TFI

c. በጣም ሲደጋግምባቸው በቀን ምን ያህል ጊዜ ይመጣባቸው ነበር?

አላው =99/.....|__|__| FFI

d. በየመንቀጥቀጡ መሃል ራሳቸውን ያውቁ ነበር? /አልነ=0፤ ነበ=1፤ አላው =9/... |__| BFA

S26. አፋቸውን መክፈት ይከለከላቸው ነበር? //አልነ=0፤ ነበ=1፤ አላው 9/..... |__| LOC

S27. መላ ሰውነታቸውን ገትሮ ይዝዋቸው ነበር? //አልነ=0፤ ነበ=1፤ አላው =9/..... |__| OPI

(If the answer is nor or DK proceed to Q28)

a. ለምን ያህል ቀናት ሰውነታቸውን ገትሮ ይዟእችው ነበር? /አላው =999/.....|__|__|__| DOP

S28. ግማሽ ሰውነታቸውን ሽባ ሆኖ ነበር?/አልነ=0፤ ነበ=1፤ አላው =9/..... |__| HEM

(If the answer is nor or DK proceed to S29)

a. ለምን ያህል ቀናት ሽባነት ነበራቸው?/አላው=999/..... |__|__|__| DHE

S29. ከወገብ በታች ሽባ ሆነው ነበር? //አልነ=0፤ ነበ=1፤ አላው =9/..... |__| PAR

(If the answer is no or DK proceed to S30)

a. ለምን ያህል ቀናት ከወገብ በታች ሽባ ሆነው ነበር? /አላው =999/..... |__|__|__| DPA

S30. የሽንታቸው መልክ ተቀይሮ ነበር? //አልነ=0፤ ነበ=1፤ አላው =9/..... |__| CCU

(If the answer is no or DK proceed to S31)

a. ሽንታቸው ምን ይመስል ነበር? ..... |__| TCC

/ብጫ =1 ብናማ =2 ደም ቅልቅል =3 አላው =9/

b. ለምን ያህል ቀናት የሽንታቸው መልክ ተቀይሮ ነበር? /አላው =999/ ..... |__|__|__| DCC

S31. በየቀኑ የሚሸኑት ሽንት የመጠን ለውጥ ነበረው?/አልነ=0፤ ነበ=1፤ አላው =9/.. |__| CQU

(If the answer is no or DK proceed to S32)

a. በየቀኑ የሚሸኑት የሽንት መጠን ምን ያህል ነበር?..... |__| AQU

/በጣም ብዙ =1 በጣም ትንሽ =2 ምንም =3 አላው =9/

b. ለምን ያህል ቀናት የሽንት መጠን ለውጥ ነበር? /አላው =999/..... |__|__|__| DQU

S32 ሽንት መሽናት ይከለክላቸው ነበር?/አልነ=0፤ ነበ=1፤ አላው =9/..... |__| DPU

(If the answer is no or DK proceed to S33)

a. እንዴት መሽናት ይከለክላቸው ነበር? ..... |__| TDP

/ መሽናት አይችሉም ነበር =1፤ ያለማቋረጥ ይንጠባጠባባቸው ነበር =2፤

ያቃጥላቸው ነበር =3፤ አላው =9/

S33. ከመሞታቸው ቅርብ ጊዜ በፊት አፕራሲዮን ተደርጎላቸው ነበር?..... |__| HOP

/አል=0፤ ነበ =1፤ አላው=9፤/

(If the answer is no or DK proceed to S34)

a. ከመሞታቸው ስንት ቀን በፊት ነበር አፕራሲዮን የተደረገላቸው? /አላው =999/..|__|__|__| OPD

b. ከሰውነታቸው ላይ አፕራሲዮን የተደረጉበት የት አካባቢ ነው? ..... |__| OPS

/ ሆዳቸው =1፤ ሌላ ቦታ ከሆነ ግለጽ _____ =2/

IF THE DECEASED IS A FEMALE AND > 50 YRS OLD PROCEED TO S37
IF THE DECEASED IS A MALE PROCEED TO S39

S34. በአረፋበት ጊዜ ነፍሰጡር ነበሩ? አልነ=0፤ ነበ=1፤ አላው=9/..... |__| PRE

(If the answer is no or DK proceed to S35)

a. የስንት ወር ነፍሰጡር ነበሩ? /አላው =99/.....|__|__| MPR

S35. ከመሞታቸው 45 ቀናት በፊት ወልደው ነበር?..... |__| DEL

/አልነ=0፤ ነበ=1፥ አላው=9/.....

(If the answer is no or DK proceed to S36)

a. ከመሞታቸው ስንት ቀናት በፊት ነበር የወለዱት? /አላው =99/.....|__|__| EDD

b የት ነበር የወለዱት?..... |__| PDE

/ቤት =1 ፤ ከሊኒክ =2 ፤ ሆስፒታል =3፤ ሌላ ቦታ =4፤ አላው=9/

c. ምጡ ለምን ያህል ጊዜ ቆየባቸው?..... |__| DDE

/አንድ ቀን =1፤ ከአንድ ቀን በላይ=2 ፤ አላው =9/

d. ሲወልዱ ብዙ ደም ይፈሳቸው ነበር?..... |__| BDE

/ አልነ=0፤ ነበ=1፤ አላው=9/.....

e. ደም ይፈሳቸው የነበረው ልጅ ከወለዱ በፊት ነው ወይስ በኋላ ነው?..... |__| HDE

/ በፊት=1፤ በኃላ =2፤ አላው=9/.....

f. አወላለዱ አንዴት ነበር? ..... |__| MDE

/በትክክለኛ ብልት =1፤ በመጣሪያ =2 በአፕራሲዮን =3 አላው =9/

g. ሕጻኑ ደህና ነው? (If no, probe for the time of death) |__| PNC

/ ደህና =1፤ ሞቶ ተወለደ =2 በተወለደ በ7 ናት ውስጥ ሞተ =3

ከተወለደ ከ7 ቀናት በኋላ ሞተ =4 ፤ አላው =9/

h. ከዛ በፊት ሲወልዱ የወሊድ ችግር ነበራቸው? አልነ=0፤ ነበ=1፤ አላው=9/..... |__| PCP

S36. በመሞታቸው 45 ቀናት ውስጥ አስወርዱቸው ነበር? ..... |__| ABO

/ አልነ=0፤ ነበ=1፤ አላው=9/

S37. አልፎ አልፎ በብልታቸው ደም ይፈስሳቸው ነበር? ..... |__| ABV

/ አልነ=0፤ ነበ=1፤ አላው=9/

S38. ጡታቸው ላይ እብጠት ወይም ቁስል ነበር? ..... |__| BT

/ አልነ=0፤ ነበ=1፤ አላው=9/

S39. አደጋ ደርሶባቸው ነው የሞቱት? ..... |__| INJ

/ አልነ=0፣ ነበ=1፣ አላው=9/

(If the answer is no or DK proceed to S40)

a. (If the answer is yes, probe for the type of injury). |__| TIN

/በደብዳባ = 1 ፣ በመኪና አደጋ = 2፥ በጦር ጉዳት = 3፥ በአውሬ በመነከስ =4v
በእሳት አደጋ = 5፥ በመርዝ = 6፣ በሌላ ዓይነት አደጋ ከሆነ ይገለጽ =7_____ አላው =9/

b. ከስንት ቀን በፊት ነው አደጋ የደረሰባቸው?..... |__|__|__| DIN

S40. ራሳቸውን በራሳቸው የገደሉ ይመስሎታል? / አልነ=0፣ ነበ=1፣ አላው=9/..... |__| SUI

(If the answer is no or DK proceed to next section)

a. እንዴት ነው ራሳቸውን የገደሉት?..... |__| TSU

/በመስቀል=1 ፣ በመርዝ =2፣ በእሳት በመቃጠል =3፥ በሌላ ሁኔታ ከሆነ ይግለጹ =4

_____ አላው =9/

VI. Interviewer's Comments and Observations

Interviewer's assessment of cause of death

Cause of death 1. _____

Cause of death 2. _____

Cause of death 3. _____

42. Interviewer IDNO .....|__|__| IID

43. Date of Interview ..... dd/mm/yy |__|__|/|__|__|/|__|__| DOI

APPENDIX-7

VERBAL AUTOPSY QUESTIONNAIRE FOR ADULT DEATHS

I:Eenyummaan namicha isa du'ee

1. **Maqaa** _____ **2.IDNO..**|_|_|_| IDN

3. **Teessoo** _____

4. **Umrii namichi du'ee** ..... |_|_| AOD

5. **Saala** *(dhiira=1; dubartii=2)* ..... |_| SXD

6. **Waayii fudhaf heruma namicha isa du'ee**..... |_| MSD

   (qeerroo=1; kam fudhee/herumee=2; kan hiikee/gargar bahe=3;

   kan jalaa du'ee=4)

7. **Namicha du'ee sun waggaa hammami barachusa**..... |_|_| YED

8. **Hojii namicha du'ee** _____ |_| OCC

II:Akkaataa du'aa namicha

9. **Otuu hindu'iin dura guyyaa meeqaa dhukubsatani turan?**.....|_|_|_| DID

   (hin beekne (DK)=999)

10. **Yoom du'an? (dd/mm/yy)** ..... |_|_|/|_|_|/|_|_| DOD

11. **Eessatti du'an?** *(home=1; hospital/clinic=2; others=3)*..... |_| POD

(IF THE ANSWER IS HOME OR OTHERS PROCEED TO 12)

a. Maqaa hospitala isaani keessati du'an? _____

b. Dunni isaani maalif akka ta'ee namooni hospitala keessa isintti himaniru? *(miti (no)=0; eeyye (yes)=1; DK=9)*..... |_| RIF

12. **Dhiibeen isaan ittin du'an beekta?** *(no=0; yes=1; DK=9)* ..... |_| RKC

a. **IF THE ANSWER IS YES PROBE TO SPECIFY THE CAUSE(S)**

cause (1)_____ |_|_|_| RD1

cause (2)_____ |_|_|_| RD2

13. **(ASK WHETHER S/HE HAD ANY OF THE FOLLOWING ILLNESS)**

a. Ba'yeena dhiga (Deembiizaati) .....*(no=0; yes=1; DK=9)*.... |_| HYP

b. Dhukkuba shukkaaraa (diabeteesi)....*(no=0; yes=1; DK=9)*.... |_| DIA

c. Dhukkuba gaggabduu (maraanmartoo; Epilepsy)*(no=0; yes=1; DK=9)* |_| EPI

d. Dhukkuba sombaa (TB)..... *(no=0; yes=1; DK=9)*... |_| PTB

e. Eedsii (AIDS) ..... *(no=0; yes=1; DK=9)*... |_| HIV

2.IDNO: |_|_|_|_|

IV: Respondent's account of final illness of the deceased

Summary of symptoms & signs reported by Respondent

Symptoms	duration	Severity
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

2. IDNO: |_|_|_| IDN

V. Specific questions to elicit symptoms & signs of final illness

S1. Jismi (dhaqna gubaa) qabu turee? .....|_| FEV
(miti (no)=0; eeyye (yes)=1; hin beknee (DK)=9)
(IF THE ANSWER IS NO OR DK PROCEED TO S2)

a. Jismi kun guyyaa meeqaa isaan irra turee? *(DK=999)*..... |_|_|_| DFE

b. Baayy'ee cima turee? *(no=0; yes=1; DK=9)*..... |_| SFE

c. Jismi guba sun walit-fufee (waluma galaa) irra turee ra moo darbe darbetu? *(walit-fufee=1; darbe darbe=2)*..... |_| TFE

S2. Dhaqna isaani irratti shiffiittoo qabatani turee?..... |_| RAS
(no=0; yes=1; DK=9)
(IF THE ANSWER IS NO OR DK PROCEED TO S3)

a. Guyya meeqaa shiffiitto irra turee? *(DK=999)*..... |_|_|_| DRA

b. Shiffiittoo sun mal fakkata turee? ..... |_| TRA
(shiffiittoo kan gifiraa=1; shiffiittoo bishan qabu=2; shiffiitoo malaa qabu=3; kan bira (ibsi) _____=4; DK=9)

c. Ijii namichaa du'e diimaatee turee? *(no=0; yes=1; DK=9)*..... |_| SEY

d. Dhaqna isaani hoqsisaa turee? *(no=0; yes=1; DK=9)*..... |_| ITC

S3. Osoo hindu'iin dura huqqatani turani? *(no=0; yes=1; DK=9)*..... |_| LOW
(IF THE ANSWER IS NO OR DK PROCEED TO S4)

a. Huqqachu isaani bayy'ee cima turee?..... |_| SLW
(bayy'ee cima=1; giddu geleessa=2; DK=9)

S4. Milli isaani dhita'ee turee? *(no=0; yes=1; DK=9)*..... |_| SAA
(IF THE ANSWER IS NO OR DK PROCEED TO S5)

a. Guyya meeqaa dhita'ee turee? (DK=999)..... |_|_|_| DSA

S5. Fuulii isaani bookokee (dhita'ee) turee? *(no=0; yes=1;DK=9)*... |_| PUF

S6. Fuulii isaani addatee (daalacha'ee) turee? *(no=0; yes=1; DK=9)* |_| PAL

S7. Ijii isaani keelloottii geeddaramee turee? *(no=0; yes=1; DK=9)* |_| JAU

S8. Mormii isaani dhita'ee (xannachee) turee? *(no=0; yes=1; DK=9)* |_| SWN

S9. Boobaan isaani dhita'ee turee? *(no=0; yes=1; DK=9)* .....|_| SWA

S10. Mudamudhin isaani dhita'ee turee? *(no=0; yes=1; DK=9)*.....|_| SWG

S11. Dhita'aa ykn madaa dhaqna iddoobira qabu turee? (IF THE ANSWER IS YES PROBE FOR THE SITE AND DURATION) _____

S12. Qufaa qabu turee? (*no=0; yes=1; DK=9*) ..... |_| COU

(IF THE ANSWER IS NO OR DK PROCEED TO S13)

a. Guyya meeqaa quffaasisaa? (DK=999)..... |_|_|_| DCO

b. Qufichi tufaatii qaba turee? (*no=0; yes=1; DK=9*) ..... |_| PCO

c. Dhiga qufaasisaa turee? (*no=0; yes=1; DK=9*) ..... |_| BCO

S13. Afura kuta turee? (*no=0; yes=1; DK=9*) ..... |_| DIB

(IF THE ANSWER IS NO OR DK PROCEED TO S14)

a. Afura kuta sun walit-fufee irra turee ra moo darbe darbetu?. |_| TDB

(*walit-fufee=1; darbe darbe=2; DK=9*)

b. Guyya meeqaa afura kuta turee? (*DK=999*) ..... |_|_|_| DDB

c. Yeroo afuri baha sagaalee (qoksisaa) qaba?(no=0; yes=1; DK=9) |_| WHE

S14. Waransa qomaa (laphee) qabu turee? (*no=0; yes=1; DK=9*)..... |_| CHP

(IF THE ANSWER IS NO OR DK PROCEED TO S15)

a. Waransichii eessatti dhaga'aamee turee? ..... |_| SCP

(*giddu harmoolee=1; onnee (laphee) oli=2; bakaa bira=3; DK=9*)

b. Waransichii walitifufa turee moo darbe darbetu? ..... |_| TCP

(*walit-fufee=1; darbe darbe=2; DK=9*)

c. Inna waransichii itti jabatuu ammam irra tura turee? ..... |_| DCP

(*<30 daqiqaa=1; >30 daqiqaa - <24 sa'ati; >24 sa'ati*)

S15. Garaa kaasa (boolii) qabu turee? (*no=0; yes=1; DK=9*) ..... |_| DI

(IF THE ANSWER IS NO OR DK PROCEED TO S16)

a. Guyya meeqaa garaa kaasee turee? (*DK=999*) ..... |_|_|_| DDI

b. Garaa kaasan sun walit-fufee irra turee ra moo darbe darbetu? |_| TDI

(*walit-fufee=1; darbe darbe=2*)

c. Inna itti jabatu guyyaa tokkoo keessa almeeqa kaasa turee? |_|_| FDI

(*DK=99*)

d. Kaasichi (boolii) isaani mal fakkaataa turee? ..... |_| TST

(*qalla akka bishani=1; xinno qalla=2; akka dhiga=3; DK=9*)

S16. Kaasichi dhiga qaba turee? (*no=0; yes=1; DK=9*) ..... |_| BST

S17. Oldeebisa (hooqisaa) turee? (*no=0; yes=1; DK=9*) ..... |_| VOM

(IF THE ANSWER IS NO OR DK PROCEED TO S18)

a. Guyya meeqaa oldeebisa turee? (*DK=999*) ..... |_|_|_| DVO

b. Oldeebisun walit-fufee irra turee ra moo darbe darbetu? .... |_| TVO

(*walit-fufee=1; darbe darbe=2; DK=9*)

c. Inna itti jabatu guyyaa tokkoo keessa almeeqa oldeebisa turee? (*DK=99*) .....|_|_| FVO

d. Inni oldeebi'ee sun mal fakkaataa turee? ..... |_| CVO

(*waan nyaatameetu bahe/ qalla akka bishani=1; dararaa kelloo (aldeedoo)=2; buna danffa (buni fakkata)=3; akka dhiga=4; akka boolii boobba=5; kan bira (**specify**) _____=6; DK=9*)

S18. Dhukkuba gara qabu turee? *(no=0; yes=1; DK=9)* ..... |_| ABP

(IF THE ANSWER IS NO OR DK PROCEED TO S19)

a. Dhukkubichi akkam isaan godha turee? ..... |_| CAP
(cininna=1; waraani=2; gubina=3; kan bira=4; DK=9)

b. Dhukkubichi guyya meeqaa irra turee? *(DK=999)*..... |_|_|_| DAP

c. Dhukkubichi iddoo kam dhukkuba turee? ..... |_| SAP
(hannurasa jala (gara gadi)=1; hannurasa oli (gara oli)=2; gara bakka hundaasa=3; hannurasa irra=4; DK=9)

d. Garaa cininnaan (warani) sun cimaa turee? ..... |_| TAP
(bayy'ee cima=1; giddu geleessa=2; laafa=3; DK=9)

e. Osoo hindu'iin dura boolii bahu dhowwee turee?..... |_| CON
(no=0; yes=1; DK=9)

S19. Garaan isaani bookokee turee? (no=0; yes=1; DK=9)..... |_| ABD

(IF THE ANSWER IS NO OR DK PROCEED TO S20)

a. Garaan isaani guyyaa meeqaaf bookokee turee? *(DK=999)*... |_|_|_| DAD

b. Garaa bookokin kun al tokkon guddatee moo yeroo dheera keessati suuta jedhee guddatee? (al *tokkon=1; sutaan=2; DK=9)*.|_| TAD

S20. Waa liqimsun isaani rakkiisa turee? *(no=0; yes=1; DK=9)*..... |_| DSW

(IF THE ANSWER IS NO OR DK PROCEED TO S21)

a. Waa Liqimsun guyyaa meeqaaf isaani rakkiisa turee?(DK=999) |_|_|_| DDS

S21. Garan isaani keessa dhittoo (dhittaa) qabu turee? ..... |_| ABM
(no=0; yes=1; DK=9)

(IF THE ANSWER IS NO OR DK PROCEED TO S22)

a. Dhittoon sun iddoo kam turee? ..... |_| SAM
(gara mirga=1; gara bita=2; gara gadi (hanura jala)=3; kan bira (ibsi)=4 _____DK=9)

b. Dhittichi guyya meeqaa isaan irra turee? *(DK=999)* ..... |_|_|_| DAM

S22. Mata bowwuun isaan qabe turee? *(miti=0; eeyye=1; DK=9)*..... |_| HEA

S23. Mormi isaani googee turee? *(miti=0; eeyye=1; DK=9)*..... |_| STN

(IF THE ANSWER IS NO OR DK PROCEED TO S24)

a. Guyyaa meeqaaf mormi isaani googee turee? (DK=999)..... |_|_|_| DSN

S24. Qalbii isaani geeddaramee turee? *(miti=0; eeyye=1; DK=9)*... |_| LUC

(IF THE ANSWER IS NO OR DK PROCEED TO S25)

a. Qalbiin isaani geeddharamunsa akkam ture? ..... |_| TUC
(jonja'uu=1; of wallaaluu (qalbi dhabu)=2; kanbira (describe) _____=3; *DK=9)*

b. Guuyya meeqqaf qalbiin isaani geeddaramee turee? (DK=99).. |_|_| DUC

c. Akkamiti jalqabee? (*al tokkon=1; suuta jedhee guyyaa tokko keessati=2; suuta jedhee guyyaa ba'yee keessati=3; DK=9*) .... |_| OUC

S25. Gagabdu (romfisisa) qabu turee? (*miti=0; eeyye=1; DK=9*)..... |_| FIT

(IF THE ANSWER IS NO OR DK PROCEED TO S26)

a. Guyyaa meeqaaf gagabdu isaani irra turee? (*DK=999*) ..... |_|_|_| DFI

b. Ibsi akkataa gagabduchii akkam akka turee? ..... |_| TFI

(*jismi (dhaqna) hundatu hoollataa=1; kan bira* (describe)_____
_____=2;DK=9)

c. Inna gagabdichi bayy'iise itti dhufu, guyyaa keessa meeqaa turee? (*DK=99*) ..... |_|_| FFI

d. Giddu gagaabina keessati sirritii of beeka turee? ..... |_| BFA

(*miti=0; eeyye=1; DK=9*)

S26. Afaan isaani banachuuf rakko qabu turee? (*miti=0;eeyye=1;DK=9*) |_| LOC

S27. Jismi (dhaqna) isaani googee turee? (*miti=0; eeyye=1; DK=9*).. |_| OPI

(IF THE ANSWER IS NO OR DK PROCEED TO S28)

a. Guyyaa meeqaaf googee turee? (*DK=99*)..... |_|_| DOP

S28. Jismi (dhaqna) isaani gar tokkeen sochoo'u dadhabee (lawwasha'ee) turee? (*miti=0; eeyye=1; DK=9*)..... |_| HEM

(IF THE ANSWER IS NO OR DK PROCEED TO Q29)

a. Guyya meeqaaf lawwasha'ee turee? (*DK=999*) ..... |_|_|_| DHE

S29. Jismi isaani mudhi dha gadi itti lawwasha'ee turee? ..... |_| PAR

(*miti=0; eeyye=1; DK=9*)

(IF THE ANSWER IS NO OR DK PROCEED TO S30)

a. Guyya meeqaaf lawwasha'ee turee? (*DK=999*) ..... |_|_|_| DPA

S30. Fincaan (bifa) isaani geeddaramee turee?(*miti=0; eeyye=1;DK=9*) |_| CCU

(IF THE ANSWER IS NO OR DK PROCEED TO S31)

a. Fincaan isaani mal fakkata turee? ..... |_| TCC

(*Keelloo=1; buna danfa=2; dhiga walmakamee ture=3; DK=9*)

b. Fincaan isaani guyyaa meeqaaf bifni geeddaramee turee? |_|_|_| DCC

S31. Ba'yeeni fincaan isaani guyyaa guyyaadhan geeddarama turee?. |_| CQU

(*miti=0; eeyye=1; DK=9*)

(IF THE ANSWER IS NO OR DK PROCEED TO S32)

a. Fincaan isaani guyyaa guyyadhan ammaam ta'aa turee? ..... |_| AQU

(*Caalan baayyee (danu) turee=1; caalan xinno turee=2; ooma fincaan hin jiru turee=3; DK=9*)

b. Ba'yeeni Fincaan isaani geeddaramusa guyya meeqaaf turee?.|_|_|_| DQU

S32. Fincaan finca'uu hindhowwaa turee? (*miti=0; eeyye=1; DK=9*).. |_| DPU

(IF THE ANSWER IS NO OR DK PROCEED TO S33)

a. Finca'uu dhowwuun akkaamitti turee? ..... |_| TDP

(*finca'uu hin dandaan turan=1; osoo walirra hinciitin xiqqo xiqqo dhaan bu'a=2; yeroo fincaan isaan guba turee=3: DK=9*)

S33. Dhiyootti otoo hindu'iin dura oprasioni godhatani turani? ... |_| HOP

(*miti=0; eeyye=1; DK=9*)

(IF THE ANSWER IS NO OR DK PROCEED TO S34)

a. Otuu hin du'in guyyaa meeqaa dura oprasioni ta'aani turan? |_|_|_| OP

b. Dhaqna isaani iddoo kam oprasioni ta'aani turan?..... |_| OPS

(*garan=1; kan bira (ibsi)=2* _____ *DK=9*)

IF THE DECEASED IS A FEMALE AND >50 YRS OLD PROCEED TO S37

IF THE DECEASED IS A MALE PROCEED TO S39

S34. Yeeroo du'an ulfa turan? (*miti=0; eeyye=1; DK=9*) ..... |_| PRE

(IF THE ANSWER IS NO OR DK PROCEED TO S35)

a. Ji'a meeqaaf ulfa turan? (*DK=99*)..... |_|_| MPR

S35. Otuu hin du'iin dura guyyoota 45 keessa da'aani turan? ..... |_| DEL

(*miti=0; eeyye=1; DK=9*)

(IF THE ANSWER IS NO OR DK PROCEED TO S36)

a. Du'a isaani guyyaa meeqaa dura da'aani turan? (DK=99)..... |_|_| EDD

b. Eessatti da'aani turan? ..... |_| PDE

(*mana=1; kilinikii=2; hospitali=3; kan bira=4; DK=9*)

c. Cininsu ammamitti isaani irra turee? ..... |_| DDE

(*guyyaa tokko=1; guyyaa tokko oli=2; DK=9*)

d. Yeeroo da'aanu dhigni baayyee dhangala'ee turee? ..... |_| BDE

(*miti=0; eeyye=1; DK=9*)

e. Da'umsa booda dhigni baayyee keessa baha (dhiga) turee? .... |_| HDE

(*miti=0; eeyye=1; DK=9*)

f. Akkaata da'uumsa isaani akkam turee?..... |_| MDE

(*utuu hin rakkatin=1; meeshaa mana yaalaa tin gargaaramudhaan=2; oprasioni gararra=3; DK=9*)

g. Mucichi lubun jira? **(IF NO, PROBE FOR THE TIME OF DEATH)**.... |_| PNC

(*lubun jira=1; du'ee bahe=2; dhalamee guyyaa torban keessa du'ee=3; dhalamee guyyaa torba booda du'ee=4; DK=9*)

h. Dahun isani kanan dura rakkina da'uu qabu turee? ..... |_| PCP

(*miti=0; eeyye=1; DK=9*)

S36. Otuu hin du'iin dura guyyaa 45 keessa garatti baasan turan (dhigniisan rukkutee turee)? *(miti=0; eeyye=1; DK=9)*..... |_| ABO

S37. Jismi (kara dhaqna) dubartuma isaani keessa dhigu garmalee qabu turan? *(miti=0; eeyye=1; DK=9)*..... |_| ABV

S38. Harma isaani keessa dhitawuu ykn madaa qabu turan? ..... |_| BT
(miti=0; eeyye=1; DK=9)

S39. Balaa (adagaa) isanitti ga'ee du'an? ..... |_| INJ
(miti=0; eeyye=1; DK=9)
(IF THE ANSWER IS NO OR DK PROCEED TO Q41)

a. **(IF THE ANSWER IS YES, PROBE FOR THE TYPE OF INJURY)**..... |_| TIN
(balaa rukutta=1; balaa konkolaata=2; balaa warana=3; cininii bineesa=4; balaa ibidda=5; balaa summii=6; kan bira (ibsi)=7
_____ DK=9)

S40. Ofin of ajjeesan jattani yaaddu? *(miti=0; eeyye=1; DK=9)* .... |_| SUI
(IF THE ANSWER IS NO OR DK PROCEED TO NEXT SECTION)

a. Akkamitti of ajjeesan turan? ..... |_| TSU
(of faniisudhan=1; summidhan (maarzidhaan)=2; abbidaan gubidhan=3; kan biradhan (ibsi) =4 _____ *DK=9)*

VI. Interviewer's comments and observations

42. Interviewer IDNO ..... |_|_| IID
43. Date of interview .....(dd\mm\yy) |_|_|_|_|_|_| DOI

Interviewer's assessment of cause of death

cause of death 1 _____

cause of death 2 _____

cause of death 3 _____

APPENDIX-8

VERBAL AUTOPSY QUESTIONNAIRE FOR ADULT DEATHS

I:Identification & Demographic Data of Deceased

Q1. Kpiim la yuure _____ **Q2.IDNO** |_|_|_|_| IDN

Q3. Address _____

Q4. Kpiim la yuma ..... |_|_| AOD

Q5. Kpiim la ane dao be poa (dao=*1; poa=2*)..... |_| SXD

Q6. Kpiim la more poa/sida ..... |_| MSD

(o po mor poa/sida=1; mor poa/sid=2; ba da bas taaba=3; poakor/dakor=4)

Q7. Kpiim la sukur zamisug a yuma ala ..... |_|_| YED

Q8. Kpiim la tuuma a bo _____ |_| OCC

II:Circumstance of Death

Q9. O be dabsa alla ka nyaa n'kpi? (*m'zi=999*)..... |_|_|_| DID

Q10. O kum dabsir (*dd/mm/yy*) ..... |_|_|/|_|_|/|_|_| DOD

Q11. O kum ziiga (*yin=1; sibiti=2; zii sia=3*) ..... |_| POD

(IF THE ANSWER IS HOME OR OTHERS PROCEED TO Q12)

a. Sibiti kan ka o kpi la yuure _____

b. Sibiti ni tumtum so yelif dine kuu o ? ..... |_| RIF

(ayeei (ayi)=0; ee=1; m'zi (MZ)=9)

Q12. Fo bang ba'a kane kuuo? (ayi=*0; ee=1; MZ=9*)..... |_| RKC

a. IF THE ANSWER IS YES PROBE TO SPECIFY THE CAUSE(S)

cause (1)_____ |_|_|_| RD1

cause (2)_____ |_|_|_| RD2

Q13. (ASK WHETHER S/HE HAD ANY OF THE FOLLOWING ILLNESS)

Ziim ba'a (ziim galis)..... (*ayi=0; ee=1; MZ=9*)..... |_| HYP

Sikir ba'a ..... (*ayi=0; ee=1; MZ=9*)..... |_| DIA

Kpisinkpiir.....(*ayi=0; ee=1; MZ=9*)..... |_| EPI

Kosunkudug (Koskuruk) .....(*ayi=0; ee=1; MZ=9*)..... |_| TB

AIDS (anii).....(*ayi=0; ee=1; MZ=9*)..... |_| HIV

IDNO: |_|_|_|_|

III: Respondents Account of Final Illness

Summary of symptoms & signs reported by Respondent

Symptoms	duration	Severity
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

IDNO: |_|_|_|_| **IDN**

V: Specific questions to elicit symptoms & signs of the final illness

S1. O daa mor ningwalisugo (ningtulim)? (ayi=0; ee=1; m'zi(**MZ**)=9) |_| FEV

(IF THE ANSWER IS NO OR MZ PROCEED TO S2)

a. Daba ala ka o ningwalisug daa be? (*MZ=999*)..... |_|_|_| DFE

b. Ningwalisug la daa muguse? *(biela=0; mugus=1; MZ=9)*..... |_| SFE

c. Ningwalisug la daa be ne ala bee le daa kyen ne ka lebida?. |_| TFE

(*be ne alla=1; kyen ne ka bas=2; MZ=9*)

S2. O daa mor sangkpana? (*ayi=0; ee=1; MZ=9*)..... |_| RAS

(IF THE ANSWER IS NO OR MZ PROCEED TO S3)

a. Daba ala ka sangkpana la daa moru? (*MZ=999*) ..... |_|_|_| DRA

b. Sangkpana la daa wene bo? (*dankong=1; sangkpana mor kuom=2;*

sangkpana mor met=3; sieba=4; MZ=*9*)..... |_| TRA

c. O nini daa muoe? (ayi=*0; ee=1; MZ=9*)..... |_| SEY

d. O daa ebisida? (ayi=*0; ee=1; MZ=9*)..... |_| ITC

S3. O daa wangim ka nyaa n'kpi?(*ayi=0; ee=1;MZ=9*)..... |_| LOW

(IF THE ANSWER IS NO OR MZ PROCEED TO S4)

a. O daa wangin bedigo? *(bedigo=1; biela=2; MZ=9)*..... |_| SLW

S4. O nop pumpama daa fuusim? (*ayi=0; ee=1; MZ=9*)..... |_| SAA

(IF THE ANSWER IS NO OR MZ PROCEED TO S5)

a. Daba ala ka o nop-paung la daa fuusim? *(MZ=999)*..... |_|_|_| DSA

S5. O nindaa daa fuusim? *(ayi=0; ee=1; MZ=9)*..... |_| PUF

S6. O daa pelige (ziim kai)? (*ayi=0; ee=1; MZ=9*) ..... |_| PAL

S7. O nini daa wenne dobuulim (wet duunum)?..... |_| JAU

(*ayi=0; ee=1; MZ=9*)

S8. O ningoor daa fulise? (*ayi=0; ee=1; MZ=9*)..... |_| SWN

S9. O bauk daa fuusim? (*ayi=0; ee=1; MZ=9*)..... |_| SWA

S10. O kpalpuweogin daa fuusim? (*ayi=0; ee=1; MZ=9*)..... |_| SWG

S11. O zii-sia daa lem mod be, mor feede? (**IF THE ANSWER IS YES PROBE FOR THE SITE AND DURATION**) _____

_____ |_| SOU

S12. O daa kosida? *(ayi=0; ee=1; MZ=9)*..... |_| COU

(IF THE ANSWER IS NO OR MZ PROCEED TO S13)

a. Daba ala ku daa kosida? *(MZ=999)* ..... |_|_|_| DCO

b. O kosung la daa lakida? *(ayi=0; ee=1; MZ=9)*..... |_| PCO

c. O daa mii kos ziim? *(ayi=0; ee=1; MZ=9)*..... |_| BCO

S13. O daa vosid kali pu paagidaa? *(ayi=0; ee=1; MZ=9)*..... |_| DIB

(IF THE ANSWER IS NO OR MZ PROCEED TO S14)

a. Vosid kali pu paagid la daa kpem be daar wusa *(=1)* bee,
di bene ka basida *(=2)* ? *(MZ=9)* ..... |_| TDB

b. Daba ala ka o da puton vosida? *(MZ=999)*..... |_|_|_| DDB

c. Lida mugusu (osib) o gama? *(ayi=0; ee=1; MZ=9)*..... |_| WHE

S14. O nyoog daa zabida? *(ayi=0; ee=1; MZ=9)*..... |_| CHP

(IF THE ANSWER IS NO OR MZ PROCEED TO S15)

a. Zabir la daa be zii-kane? ..... |_| SCP

(nyoog zug=1; susuf zug=2; zii-sieba=3; MZ=9)

b. Zabire la da bene daar wusa*(=1)* be li da zabide
ne ka basida*(=2)*? *(MZ=9)*..... |_| TCP

c. Zabir la ne daa mukko la le daa yuuge?..... |_| DCP

(<30min=1; >30min but <24hrs=2; >24 hrs=3; MZ=9)

S15. O daa saadaa? *(ayi=0; ee=1; MZ=9)*..... |_| DI

(IF THE ANSWER IS NO OR NS PROCEED TO S16)

a. Daba ala ku daa saa? *(MZ=999)* ..... |_|_|_| DDI

b. Saa la daa kpem bene daar wusa*(=1)* bee, di bene
ka basida*(=2)*? *(MZ=9)*..... |_| TDI

c. Saa la daa muukk la nora ala ku daa saad daari yini? *(MZ=99)*|_|_| FDI

d. O bin la, daa a wela? *(kuom-kuom=1; ga-alug=2; ziim=3; MZ=9)*..|_| TST

S16. Ziim daa gyerdig bin la ni? *(ayi=0; ee=1; MZ=9)*..... |_| BST

S17. O daa tiida? *(ayi=0; ee=1; MZ=9)*..... |_| VOM

(IF THE ANSWER IS NO OR NS PROCEED TO S18)

a. Daba ala ku, o tii? *(MZ=999)*.....|_|_|_| DVO

b. Tiid la daa kpem bene daar wusa *(=1)* bee, di bene
ka basida *(=2)*? *(MZ=9)*..... |_| TVO

c. Tiid la daa muukk la nora ala ku tiid daari yini *(MZ=99)*... |_|_| FVO

d. Tiid la daa a wela? ..... |_| CVO

(kuom maa=1; dobuulim=2; sablek=3; ziim=4; bin tiid=5;
sieba=6 _____; *MZ=9)*

S18. O puug daa zabidaa? (*ayi=0; ee=1; MZ=9*) ..... |_| ABP

(IF THE ANSWER IS NO OR MZ PROCEED TO S19)

a. Puug la daa zabid wela? ..... |_| CAP

(*welligid=1; non=2; kabit=3; zab sieba=4; MZ=9*)

b. Daba ala ka o puula zabe? (*MZ=999*) ..... |_|_|_| DAP

c. Zabir la daa be yaane tutuaa ne? ..... |_| SAP

(*sangin=1; nyoog baba=2; poog la wosa=3; zii sieba=4; MZ=9*)

d. Zabir la daa toe welawela? ..... |_| TAP

(*zabid pam=1; zabid biel biel=2; MZ=9*)

e. O daa pu yang nye bine ka naan kpi?..... |_| CON

(*o daa nye=0; o daa pu yang nyeda=1; MZ=9*)

S19. O puura daa uk-kee? (*ayi=0; ee=1; MZ=9*)..... |_| ABD

(IF THE ANSWER IS NO OR MZ PROCEED TO S20)

a. O puura daa uk daba ala? (*MZ=999*)..... |_|_|_| DAD

b. O puura daa uk ne toto bee, bielabiela?

(*toto=1; bielabiela=2; MZ=9*) ..... |_| TAD

S20. O ya daa von le da toi yaa? (*ayi=0; ee=1; MZ=9*)..... |_| DSW

(IF THE ANSWER IS NO OR MZ PROCEED TO S21)

a. Le daa nok daba ala ka o puyang von-na?(*MZ=999*) ..... |_|_|_| DDS

S21. Siel daa bee o poogin kpiongo? (*ayi=0; ee=1; MZ=9*) ..... |_| ABM

(IF THE ANSWER IS NO OR MZ PROCEED TO S22)

a. Ya baba ka kpiongo la daa be?..... |_| SAM

(*datiu-lugur=1; dagobug lugur=2; sa-ang=3;*

ne zisiaba (specify_____= 4; MZ=9)

b. Kpiongo la daa be pae daba ala? (*MZ=999*)..... |_|_|_| DAM

S22. O zug daa zabida? (*ayi=0; ee=1; MZ=9*) ..... |_| HEA

S23. O ningor daa kpar kangkang ne? (*ayi=0; ee=1; MZ=9*)..... |_| STN

(IF THE ANSWER IS NO OR MZ PROCEED TO S24)

a. Le daa nok daba ala (*MZ=999*) ..... |_|_|_| DSN

S24. O yam daa tieke (o da mi o meng ziga)? (*ayi=0; ee=1; MZ=9*).. |_| LUC

(IF THE ANSWER IS NO OR MZ PROCEED TO S25)

a. O yam daa tiek wela-wela? ..... |_| TUC

(*yam tulima=1; daa likni=2; ne sieba_____=3; MZ=9*)

b. O yam-la ne daa a yam tulima la, le daba ala ? (*MZ=999*). |_|_|_| DUC

c. Le si'ing welawela?..... |_| OUC

(*tooto yim=1; tooto daar yinni poogin=2; biel biel dabsa poogin=3; MZ=9*)

S25. O daa damida (niis)? (*ayi=0; ee=1; MZ=9*)..... |_| FIT

(IF THE ANSWER IS NO OR MZ PROCEED TO S26)

a. Daba ala ka ba'as la gba o? (*MZ=999*) ..... |_|_|_| DFI

b. (**ASK THE RESPONDENT TO DESCRIBE THE FITS**)..... |_| TFI

(*o ningwusa daa dammed ne=1; sieba*_____

_____*=2; MZ=9*)

c. Nora ala ka o lut ka damid daa yini? (*MZ=99*)..... |_|_| FFI

d. O ya eti li ka due, o ye mor ya'am (*=1*) be o pu mor yaam (*=2*)? (*MZ=9*)..... |_| BFA

S26. O daa yang ya'ad o nore?..... |_| LOC

(*o daa toe yaad=0; o daa pu toe yaada=1; MZ=9*)

S27. O ning daa pirr kangkang be? (*ayi=0; ee=1;MZ=9*).....|_| OPI

(IF THE ANSWER IS NO OR MZ PROCEED TO S28)

a. Le daa nok daba ala? (*MZ=999*)..... |_|_|_| DOP

S28. O lua yinni daa kpii? (*ayi=0; ee=1; MZ=9*) ..... |_| HEM

(IF THE ANSWER IS NO OR MZ PROCEED TO S29)

a. Le daa nok daba ala? (*MZ=999*)..... |_|_|_| DHE

S29. O noba daa kpii? (*ayi=0; ee=1; MZ=9*)..... |_| PAR

(IF THE ANSWER IS NO OR MZ PROCEED TO S30)

a. Daba ala ka o nobala da kpii? (*MZ=999*)..... |_|_|_| DPA

S30. O dunum la wenim daa tiek wala? (*ayi=0; ee=1; MZ=9*) ..... |_| CCU

(IF THE ANSWER IS NO OR MZ PROCEED TO S31)

a. O dunum la wenim a wala? ..... |_| TCC

(*dobulum=1; zie=2; ziim=3; MZ=9*)

b. Daba ala ku o dunum la tieke? *(MZ=999)*..... |_|_|_| DCC

S31. Tiakre dabe o dunum la zuor pugun ne? (*ayi=0; ee=1; MZ=9*).... |_| CQU

(IF THE ANSWER IS NO OR MZ PROCEED TO S32)

a. O dunit ka li zemi wala ? ..... |_| AQU

(*bedigo galis=1; fii galis=2; kpankpan=3; MZ=9*)

b. Daba ala ka o dunum la daa tieke? (MZ=*999*) ..... |_|_|_| DQU

S32. Duunug daa toe tis o?(ayi=0; ee=1; MZ=9).....|_| DPU

(IF THE ANSWER IS NO OR MZ PROCEED TO S33)

a. Duunug toog la daa a welawela? ..... |_| TDP

(po ton duunuda=1; duunug tuasid ne yinne yinne=2;
duunug zabid bedigo=3; zii sieba=4; MZ=9)

S33. Ba daa ladigu, sibitini ku naan kpii? *(ayi=0; ee=1; MZ=9)*.... |_| HOP

(IF THE ANSWER IS NO OR MZ PROCEED TO S34)

a. Ba daa ladigu daba ala ka o nyaa n'kpi?*(MZ=999)*.....|_|_|_| OPD

b. (**ASK FOR THE SITE OF OPERATION**) ..... |_| OPS

(poorin=1; zii sieba=2 _____ MZ=9)

IF THE DECEASED IS A FEMALE AND >50 YRS OLD PROCEED TO S37

IF THE DECEASED IS A MALE PROCEED TO S39

S34. O ne daa kpiid-la, o daa mor puuga? *(ee=1; ayi=0; MZ=9)*..... |_| PRE

(IF THE ANSWER IS NO OR MZ PROCEED TO S35)

a. Puug la daa a nwadis ala? *(MZ=99)* ..... |_|_| MPR

S35. O daa dua dabisa piis naasi ne anu pugon ka nan kpii bee?

(ayi=0; ee=1;MZ=9).....|_| DEL

(**IF THE ANSWER IS NO OR MZ PROCEED TO S36**)

a. O daa dua daba ala ka nyaa n'kpi? *(MZ=99)*.....|_|_| EDD

b. O daa dua ne yin ne?*(yin=1; sibiti billin=2; sibitini=3; MZ=9)*|_| PDE

c. One sa-a la, la yugiyabee la puyuge ku naan dua?

(<24 hrs=1;>24hrs=2;MZ=9)..... |_| DDE

d. Ziim daa yi bedigu one daa dua la?..... |_| BDE

(ayi=0; ee=1; MZ=9)

e. (**IF YES, PROBE TO FIND OUT WHETHER THE BLEEDING STARTED BEFORE OR AFTER THE DELIVERY OF FOETUS**) ..... |_| HDE

f. O daa dua wela-wela? ..... |_| MDE

(poa tuon=1; nok siel veeg biig la yis na=2;
poor ladigir duam=3; MZ=9)

g. Bila voyaa? (**IF NO PROBE FOR THE TIME OF DEATH**)..... |_| PNC

(bila voi=1; bila daa kpiini=2; bila daa kpiini dabisa
ayopoi dar=3; daba ayopoi daa gaad ne bila naan kpii=4)

h. O duam daa enti kpemma? *(ayi=0; ee=1; MZ=9)* ..... |_| PCD

S36. O daa kpai poog dabsa pisnaase ne anu poogin ka nyaa n'kpi bee?
(ayi=0; ee=1; MZ=9)..... |_| ABO

S37. Ziim daa yit o tuan kali ka o kpanne? ..... |_| ABV
(ayi=0; ee=1; MZ=9)

S38. Obisa nda mode mode?..... |_| BT
(ayi=0; ee=1; MZ=9)

S39. O daa paam sapuad ka nyaa n'kpi be?..... |_| INJ
(ayi=0; ee=1; MZ=9)
(**IF THE ANSWER IS NO OR MZ PROCEED TO S40**)

a. (**IF THE ANSWER IS YES, PROBE FOR THE TYPE OF INJURY**) ..... |_| TIN
(boot=1; lor=2; tapp=3; bunkobug daa dum o=4; bugum=5;
tiim daa ku-u=6; sieba=7 (specify) _____)

b. Daba ala ka o paam sapuad la nyaa n'kpi ? *(MZ=999)* |_|_|_| DIN

S40. Fo tees ka o daa ku ne o meng bee? (ayi=0; ee=1; MZ=9)..... |_| SUI
(**IF THE ANSWER IS NO OR MZ PROCEED TO NEXT SECTION**)

a. O daa ku o meng welawela? ..... |_| TSU
(o yul o meng=1; o nu ne tiim=2; bugum dieu=3; sieba=4
_____)

VI. Interviewer's comments and observations

Interviewer's assessment of cause of death

Cause of death 1 _____

Cause of death 2 _____

Interviewer's IDNO ..... |_|_| IID

Date of Interview (dd/mm/yy) ..... |_|_|/|_|_|/|_|_| DOI