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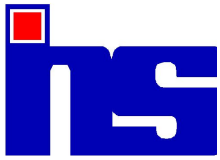
Working Paper - WP 37/2000 (1-29)



THE INSTITUTE OF HEALTH SYSTEMS

The verbal autopsy based cause of death reporting systems in rural areas of India: A review.

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Valid and reliable statistics on cause of death is an essential input for setting of priorities in the health sector (Mahapatra, 1999). In the rural areas medical certification of cause of death is usually not feasible since many deaths occur without any prior medical attendance. Thus the country depends on a system of lay reporting of cause of death using what is called a verbal autopsy methodology. Until December 1999, cause of death data for the rural areas used to be collected under the Survey of Cause of Death (SCD) Rural scheme. SCD-Rural data used to be collected from a sample of primary health center (PHC) headquarters villages by a lay diagnosis and reporting system in accordance with guidelines issued by the Registrar General of India (1991, 1993). The SCD-Rural scheme was discontinued from beginning of 1999 (Registrar General, 1999). Instead, a cause of death component has been added to the sample registration scheme (SRS). The SRS is designed to register deaths and births in another set of sample areas in rural and urban areas. The cause of death (SRS-COD) component is also based on verbal autopsy. The verbal autopsy guidelines were developed in the 1960s when the model registration - survey of cause of death (MRS) scheme first came into existence. The MRS later came to be known as the SCD-Rural scheme. The verbal autopsy introduced by India in 1965, was the first verbal autopsy based cause of death reporting system in the world.

The concept of verbal autopsy as a source of cause of death information has been used in many developing areas have poorly developed facilities for medical certification of cause of death. It will be useful to review the content validity of the verbal autopsy-based cause of death reporting system in the light of research findings and field experiences gained over the

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last four decades. In this paper I first review the design characteristics of the SCD-Rural system and then turn to the SRS-COD component.

SCD-Rural System in India:

Administrative guidelines and technical methodology of this survey of cause of death (SCD) rural has been published on more than one occasion (Registrar General, 1991, 1993). A short summary of the methodology is presented below. A sample of primary health centres are selected and a system of continuous survey of deaths is done in the headquarters village. Each sampling unit covers between 3000 to 5000 rural residents. For example, the State of Andhra Pradesh had 200 sampling units as of 1998 covering a population of 0.735 million which is about 1% of the State's population. A paramedical person from the PHC is designated as the field agent who does the primary survey. (S)he identifies key informants and maintains liaison with them. A household register is drawn up and updated half yearly. For each death occurring in the village the field agent identifies one or more persons having knowledge of the circumstances of death, interviews them and records the symptoms and circumstances of death in form 7. A structured questionnaire is used to investigate cause of death using the symptoms and circumstances of death. The structure questionnaire is supplemented by a check list. The field agent arrives at a probable cause of death by applying the structured questionnaire to symptoms and circumstances recorded in Form 7. The check list entry against the probable cause of death arrived is then tallied with the symptoms and circumstances of death. The cause of death thus arrived is reported in Form 3 (referred to as certificate of death here). The PHC statistician is designated as the recorder of events reported by the field agent. Half yearly verification of the household list is done by the recorder. Medical officer of the PHC is expected to check and certify the correctness of cause of death assignment by the field agent. Assignment of cause of death is done by the field

agent based on a structured interview with a member of concerned household. The structured questionnaire currently in use was adopted after taking into account five years of field experience with a provisional questionnaire. The non medical list (NML) of cause of death was last revised in 1983 to correspond to ICD 9th revision (RGI, 1991). SCD (Rural) uses verbal autopsy (VA) to arrive at cause of deaths using paramedical personnel.

General design features of a verbal autopsy system:

The verbal autopsy method has since been studied and applied in many parts of the world. The demographic surveillance system (DSS) in Matlab, Bangladesh (Nahar et al 1985; Zimicki, 1989); assessment of child mortality in Latin America (Puffer and Serrano, 1973); monitoring endemic diseases in west Africa (Bradley and Gilles, 1984; Greenwood et al, 1987) in Kenya (Omondi-Odhiambo et al, 1984); in Phillipines (Kalter et al, 1990) and in India (Bang et al 1992) could be cited as of these instances. Much of the VA related work, however, remains unpublished. For example the WHO-UNICEF (1994) memorandum on measurement of cause specific mortality in children cites many unpublished sources.

The current knowledge base on feasibility and validity of VA is largely restricted to childhood mortality. The WHO-UNICEF memorandum, cited above, summarizes results of validation studies and has tabulated sensitivity and specificity of VA for detecting major causes of childhood death. In addition, the memorandum contains expert opinion about use of VA for investigation of causes of childhood death. This memorandum was the result of an internal consultation in December 1992 in which experts engaged in research and implementation of VA participated. Bang et al (1992), for instance, have used consensus development techniques to synthesize expert opinion on diagnostic criteria for identification of causes of childhood deaths. They have developed questionnaire incorporating local

terminologies in their study area (Gadchiroli, Maharastra) to generate the required information by verbal autopsy to satisfy the coding algorithm.

Studies about validity of VA to identify causes of adult death are being undertaken recently (Garenne and Fontaine, 1989; LSHTM, 1993). These authors in their work (1989) have reported their experience in Senegal. Similarly, The London school of hygiene and tropical medicine (LSHTM) workshop (1993) on verbal autopsy tools for adult deaths was conducted on the eve of a study currently under way in sub Saharan Africa. Proceedings of this workshop, cited above, documents a consensus of expert opinion about VA for adult deaths. Another summary and source of expert opinion is the World Bank working paper by Hayes et al. (1989). Chandramohan et al (1994) have published discussions at the LSHTM verbal autopsy workshop and have summarized all VA based studies published upto mid 1993.

I have mainly drawn upon these sources to critically examine the extent to which SCD-Rural meets the criteria of a good VA based system. Certain general design features are key to wide applicability, efficiency and validity of data generated by a VA based cause of death reporting system. Over the years some degree of consensus on major design issues have emerged. The structured questionnaires prescribed by the Registrar General of India for the SCD-Rural system was systematically examined for each of the conditions included in the non medical list. The SCD-Rural questions were examined in the light of available research results on verbal autopsy. A comparative statement of the SCD-Rural algorithm, expert opinion and findings from field studies about diagnostic algorithms and validity of verbal autopsy (VA) to assign specific cause of death, and the extent to which the SCD-Rural question satisfy expert opinion is contained in annex-1. A summary is presented in Table - 1. SCD (Rural) seems to satisfy most of these criteria except reporting of multiple causes of death. This is one area for improvement of existing SCD guidelines. On the other hand

assigning multiple causes of death creates problems for aggregation and reporting of deaths by cause. Manton and Stallard (1984) analyzed multiple cause of death patterns in the USA. Although their preferred suggestion is to use patterns of failure as the basis of analysis, it may not be a feasible alternative considering small sample sizes inherent in verbal autopsy based statistics. To the extent certain deaths are assigned to combination of causes there will be reduction in number of deaths reported under the respective component causes (LSHTM, 1993). A compromise may be to restrict the number of multiple causes of death to a manageable number and develop algorithms to distribute these to their component causes. Manton and Stallard's (1984) study suggests that recording upto three multiple causes would include more than two third of deaths. Choosing the top three most probable causes contributing to death may help improve the accuracy of estimates and keep it manageable.

The trade off between open ended interview and structured questionnaire needs further elaboration at this stage. Although open ended interview format allows pursuit of unusual diagnostic clues not covered by structured questionnaire, it requires more skilled interviewers. For example comparatively lower assignment to unknown category has been achieved with physicians acting as interviewer (Greenwood et al 1987). Open ended interviews and coding of cause based on judgment of the interviewer reduces the inter regional and inter temporal comparability of cause of death statistics.

Table-1 General design features of a good VA system and the SCD (Rural) scheme in India.

Criteria / Expert opinion	SCD (Rural)
Identification of respondents	
In the LSHTM workshop it was suggested that the field agent ask which member from the household were present at time of death, were close to the deceased and are available for the interview. A household roster would help identify these persons. The field agent then indicates who the actual respondents were, and a supervisor could later check appropriateness of the choice. Garene and Fontaine (1989) have noted that the best respondent for investigation of a childhood death is the child' s mother if she is alive and present. In her absence or unavailability, father, foster parents who used to take care of the child would be appropriate. For maternal deaths, a person from among the women including traditional birth attendants or trained midwife, who took care of the deceased would be appropriate. For other adult deaths the spouse may be a good source.	Yes. The recorder does an independent survey of households once every six months and tallies with report of field agent. Specific review of field agents choice of respondent is not made. SCD guidelines do not contain recommendations on choice of respondent as is done by Garene and Fontaine (1990).
Recall period	
Participants in the LSHTM workshop believed that recall of circumstances of death by close relatives and attendants would be adequate up till 12 months after the event. It would be preferable to wait for a month after the death to avoid distress to the respondent. Garene and Fontaine (1989) found , in rural Senegal, that the best period to ask questions about cause of death was between 3-9 months after the death. Questions asked too early are either not answered or inadequately answered. Deaths of children investigated more than 9 months after are poorly reported. Zimicki (1990) also noted from her study in Matlab, Bangladesh that intervals of upto ten months between death and interview do not affect the amount or quality of information. Stanfield and Glazacka (1984) report that omissions were minimal during 1-7 months period after neonatal deaths in a study in Ivory coast.	Yes. The field agent maintains regular contact with suitable informants from the village on a weekly or fortnightly basis. The recorder does an independent survey half yearly. The VA interview would take place between 2 weeks to 7 months after the date of death.
Structured questionnaire and diagnostic algorithm.	
Standardized pre-coded questionnaire and predefined algorithm is to be preferred (WHO-UNICEF, 1994). Participants at LSHTM workshop (1993) preferred a check list as opposed to an open format of interview and a predefined algorithm for coding.	Yes
Filter questions	
At the LSHTM workshop (1993) most participants preferred the check list with filters to one without. Symptom based filtered modules (e.g. cough module) were preferred to disease specific filters. Zimicki (1990) reports that the respondents in Matlab, Bangladesh were asked a list of 16 questions. If the answer was yes, auxiliary questions specific to each symptom was asked. This was found superior to a large checklist of symptoms.	Yes
Recording multiple causes	
Multiple causes of death should be permitted (WHO-UNICEF, 1994, LSHTM 1993).	No

Since SCD (Rural) satisfies most of the general design criteria for VA does it mean that the statistics generated by it would be valid? Not necessarily. Although the design features shown in Table - 2 are necessary for efficiency and validity they are not sufficient. Validity of

classification of deaths to particular causes will depend on characteristics of the cause of death per se, content of the questionnaire and algorithm used for specific disease entities. Contents of questionnaire and coding algorithms are discussed below.

Validity of SCD-Rural disease specific algorithms:

As the WHO-UNICEF (1994) consultation noted, VA is suitable only for causes that have clear and unambiguous set of symptoms at the time of death. The symptoms and signs chosen to code deaths to a particular disease should result in most of the deaths truly due to the cause concerned to be coded as such (sensitivity) and exclude other causes that may have related symptoms. In addition, the choice of symptoms and signs must be parsimonious to reduce interviewer and interviewee fatigue. At the least, questions and coding algorithms should have face and content validity. In other words they should be based on expert judgment about their usefulness to identify and exclude specific causes. In addition validity with respect to a criterion will be desirable. Criterion validity of an instrument is assessed by comparing its result with some reference standard. Thus choice of a reference standard is the key to empirical validation of VA algorithms.

The gold standard reference for assignment of cause of death has been the autopsy. As the LSHTM (1993) workshop has noted, this is not a practicable solution to validate VA since the later alternative to medical certification of cause of death is considered only in areas with scarce medical facilities. Two other references have been proposed (LSHTM, 1993) and used, namely (a) hospital diagnosis and (b) clinical diagnosis. To validate VA with respect to hospital diagnoses, deaths in a community are coded using the VA instrument under testing. If the deceased happened to have been hospitalized, the medical records from hospital are retrieved. The reference cause of death is assigned on the basis of the person's medical record in hospital. Alternatively, patients discharged from a hospital may be followed up after a lapse of time and deaths if any may be coded by VA. The hospital based reference diagnosis

and the VA based code are then compared. Major shortcoming of the hospital based reference is selection bias. The LSHTM workshop discussed possible ways of reducing selection bias. An example of hospital diagnosis based reference is the study in Kenya by Snow et al (1992). In this study, hospital diagnosis was used as a reference to check validity of cause of death coded by physicians from verbal autopsy data. On the other hand, clinical diagnosis in the community has less of a selection bias. This would require a lot of medical manpower, which may not be available in an area for which VA is considered. It may, however, be possible to temporarily mobilize physicians for purposes of a validation study, since methodological lessons learnt from it would be useful for wider application. Kalter et al (1990) used physician diagnosis as the reference to estimate validity of different verbal autopsy based algorithms. Zimicki (1990) compared interviews by lay reporters with in-depth interview by physicians.

Sometimes empirical validity of VA tools are assessed indirectly by checking consistency of VA based statistics with known epidemiological patterns. One approach has used known efficacy of vaccination to reduce mortality due to the disease concerned Validity of a VA tool measuring mortality due to that disease may be indirectly inferred from the time trend of estimates generated by it and vaccination coverage. For instance, Stephens (1990) studied measles related morbidity and mortality data collected by nonmedical field interviewers in a rural area in Senegal. Data on measles incidence and cause specific mortality was aggregated by hamlets. Stephens examined the movement of measles epidemic from hamlet to hamlet implied by the verbal autopsy data, consistent with known epidemiologic pattern of measles and vaccination coverage in respective hamlets.

SCD (Rural) algorithm organizes all causes, at the highest level, into ten modules based on obvious age-sex-major symptom complex (Table-2). An answer to the first round of questions about applicability of these modules leads the interviewer into the detailed

questions under that module. It will be fairly obvious to determine if the death was due to say accidents and injuries (SCD module-1), maternity (module-2) or was of an infant less than one year old. There is a problem about the last module on senility. There are no further expansion of causes under senility. Criteria for inclusion under senility is that the person was extremely old and apparently not sick. The person should be above 60 years and none of the specific causes in SCD list be traced. The age criteria of more than 60 years would tend to put more deaths under this category.

Table-2 SCD (Rural) cause groups, availability of expert opinion or validity information on each cause and concordance of SCD questions with expert opinion.

Category[1]	Not Available	Availability and Concordance[2]
Fevers (3)	Influenza, Typhoid	Malaria
Digestive disorders (6)	Food poisoning, Peptic ulcer, Acute abdomen	Gastroenteritis (diarrhoea), Cholera, Dysentery
Coughs (5)		Tuberculosis of lungs, Bronchitis, Asthma, Pneumonia, Whooping cough
CNS disorders (3)		Stroke, Meningitis, Convulsions
Diseases of the Circulatory System (3)	Anaemia	Congestive heart failure, Ischaemic heart disease
Other clear symptoms (13)	Cirrhosis and chronic liver diseases, Chicken pox, Leprosy, Poliomyelitis, Mental disease, Diabetes, Hyperplasia of prostate, Uraemia, Obstructed hernia	Jaundice, Measles, Tetanus, Cancer
Infant deaths (6)		Prematurity, Congenital malformation, Birth injury, Respiratory infection of the new born, Cord infection (Neonatal tetanus), Diarrhoea of the new born

[1] Figures in parentheses are the number of conditions within the group. For 12 causes under Accident and Injuries expert opinion is not available by specific cause. However, there is general agreement that these causes are obvious to lay reporters and hence verbal autopsy is considered to accurately assign deaths due to these causes. For similar reasons, the six causes under maternal deaths is not shown. Senility and other residual codes are not shown.

[2] Expert opinion and SCD questions for the underlined causes of death listed under this column do not agree.

The SCD structured questions, and check list were compared with currently available expert opinion or validity information for respective causes of death in the SCD non medical list. Table-2 gives a summary of SCD non medical list causes of death for which at least some expert opinion or validation information is available and if the SCD questions are in accordance with them. Altogether there are 57 specific causes in the SCD non medical list, excluding the residual categories. Accidents and injuries account for 12 of these. Consensus about validity of VA to code deaths due to accidents and injuries is quite strong, since most of these are easily recognized by lay persons. Cause specific discussions of VA on accidents and injuries are not available in the literature. So is the case with deaths due to maternal causes under which SCD non medical list contains 7 causes. Excluding these 19 causes under accidents, injuries and maternal deaths there are 38 specific codes in the rest of the SCD non medical list. At least some expert opinion or validity information is available for 24 out of these 38 causes. As can be seen in Table-2 most of the causes for which some expert opinion is available are infant deaths, respiratory and diarrhoeal diseases. For 21 out of these 24 causes the SCD questions appear to be in accordance with expert opinion and validity information available in the literature.

The three causes for which there is major discrepancy are (a) cord infection, (b) pre maturity, and (c) cancer. Most experts agree and validation studies show that verbal autopsy is good at detecting neonatal tetanus. In SCD neonatal tetanus is included under cord infection and thereby misses an opportunity for accurate estimation of deaths due to a cause which is very important from public health point of view. Experts opine that it is usually difficult to distinguish between pre maturity and low birth weight (Garene and Fontaine, 1989; Gray, 1989). Hence they ought to be lumped together for accuracy of VA based statistics. The SCD list does not include low birth weight in its list. It can be added to pre maturity without any disturbance to the structure of the rest of the questionnaire. The SCD list

lumps all cancers into one cause. Some expert opinion is usually available by site of cancer. More over, some cancers would have symptoms which may be confused with the filter questions for other modules. For example stomach cancer cases may be investigated as deaths due to digestive diseases. In that case the field agent may get to consider cancer of stomach at all since there is no mention of it in the digestive causes module. So is the case for lung cancer.

Non availability of expert opinion or validity information in the literature for other causes in the SCD non medical list does not imply that they are prima-facie not valid. The SCD design was based on expert opinion obtained at the time of drawing up the scheme and revision of manuals. The SCD design process included a phase of field testing of provisional questionnaires and finalisation by expert consultation. Considering the large extent to which questions for specific causes are in accord with expert opinion and information from VA validity studies, the SCD questionnaire appears to be prima facie valid.

Prima-facie, validity of SCD questionnaire is reassuring in the sense that the scheme design is largely in accord with current knowledge about verbal autopsy. But it does not assure us that the cause of death statistics are accurate for all causes. In case of causes for which VA is known to be highly sensitive and specific (say more than 75% for each) the SCD statistics can be mapped to medical causes directly. For other causes more detailed algorithms for mapping of SCD statistics onto the desired set of medical causes will have to take into account available knowledge about sensitivity and specificity of VA in general and specific peculiarities of SCD implementation as well.

SRS-COD Component:

From January 1999, survey of cause of death was integrated with the SRS (RGI, 1999). It is understood that the SCD-Rural guidelines have been extended to the SRS-COD

component. Although formal communication regarding this is yet to be available, I was able to obtain a copy of the RGI instructions on "Collection of data on causes of death" (Director of Census Operations, Andhra Pradesh, 1999). Two more columns have been added to SRS Form 5 (Columns 16-17) and Form-10 (columns 12-13). The SRS part time enumerator (PTE) records cause of death in column 16 and the code in column 17 of the revised Form-5. The SRS supervisor records similar information in columns 12 and 13 of the revised Form-10. A major departure from the SCD-Rural design is doing away with the symptom record (SCD-Rural Form-7). The SCD-Rural symptom record was similar in its information content to the WHO cause of death report format, which requires information about underlying causes of death. The SRS-COD component asks field agents to record the code to which cause of death is assigned. No further information about symptoms and circumstances of death need be reported. This later information is required for systematic screening and coding of cause of death reports. Another departure from the SCD-Rural is doing away with the structured questionnaire. Instead the instructions contain a list of causes, related symptoms for some, and the corresponding ICD10 code. For some causes, no description of expected symptoms is given. However, it is too early to make a judgment on the new system. It will be helpful if specific research studies are taken up to evaluate the performance of the new cause of death reporting system in rural areas.

The SRS-COD component will generate verbal autopsy based cause of death information for urban and rural areas, since SRS is operates both in rural and urban areas. Thus there will be two sources of cause of death data from urban areas, namely the (a) SRS-COD component, and (b) the Medical Certification of Cause of Death (MCCD) reports. It is claimed that this will allow for comprehensive statistics on cause of death for all areas of India. While availability of verbal autopsy based cause of death data for urban areas will allow for some plausibility checks and comparisons with the MCCD based data, the later

source is definitely more preferable, since it is based on medical certification. The problem for urban areas is poor compliance by hospitals and medical attendants. This is mainly due to the fact that there is no effort, at all, by municipal authorities to ask for compliance with provisions of the Registration of BD Act. about reporting of cause of death.

Summary and conclusion:

Valid and reliable statistics on cause of death is an essential input for setting up of priorities in the health sector. Developing countries like India are making efforts to operate cause of death reporting systems that are feasible within the given constraints of partially developed registration of vital events, and poor availability of medical facilities. In the rural areas medical certification of cause of death is usually not feasible since a lot of deaths happen without any prior medical attendance. So India depends on a system of lay reporting of cause of death using what is called a verbal autopsy methodology. Until December 1999 cause of death data for the rural areas used to be collected under the Survey of Cause of Death (SCD) Rural scheme, from a sample of primary health center (PHC) headquarters villages by a lay diagnosis and reporting system. From January 1999 the a cause of death component has been added to the SRS (SRS-COD component). Certain general design features are key to wide applicability, efficiency and validity of data generated by a VA based cause of death reporting system. Over the years some degree of consensus on major design issues have emerged. The structured questionnaires prescribed by the Registrar General of India for the SCD-Rural system was systematically examined for each of the conditions included in the non medical list. The SCD-Rural questions were examined in the light of available research results on verbal autopsy. SCD-Rural system appeared to satisfy most of the general design criteria for a good Verbal Autopsy system. The SCD structured questions, and check list were compared with currently available expert opinion or validity information for respective causes

of death in the SCD non medical list. Altogether there are 57 specific causes in the SCD non medical list, excluding the residual categories. Accidents and injuries account for 12 of these. Consensus about validity of VA to code deaths due to accidents and injuries is quite strong, since most of these are easily recognized by lay persons. Cause specific discussions of VA on accidents and injuries are not available in the literature. So is the case with deaths due to maternal causes under which SCD non medical list contains 7 causes. Excluding these 19 causes under accidents, injuries and maternal deaths there are 38 specific codes in the rest of the SCD non medical list. At least some expert opinion or validity information is available for 24 out of these 38 causes. For 21 out of these 24 causes the SCD questions appear to be in accordance with expert opinion and validity information available in the literature. The three causes for which there is major discrepancy are (a) cord infection, (b) pre maturity, and (c) cancer. Most experts agree and validation studies show that verbal autopsy is good at detecting neonatal tetanus. In SCD neonatal tetanus is included under cord infection and thereby misses an opportunity for accurate estimation of deaths due to a cause which is very important from public health point of view. Experts opine that it is usually difficult to distinguish between pre maturity and low birth weight (Garene and Fontaine, 1989; Gray, 1989). Hence they ought to be lumped together for accuracy of VA based statistics. The SCD list does not include low birth weight in its list. It can be added to pre maturity without any disturbance to the structure of the rest of the questionnaire. The SCD list lumps all cancers into one cause. Some expert opinion is usually available by site of cancer. More over, some cancers would have symptoms which may be confused with the filter questions for other modules. For example stomach cancer cases may be investigated as deaths due to digestive diseases. In that case the field agent may not get to consider cancer of stomach at all since there is no mention of it in the digestive causes module. So is the case for lung cancer. In terms of its design and verbal autopsy guidelines, the SCD-Rural system was reasonably

valid. It appears to have been discontinued mainly on account of poor coverage and poor compliance at different levels of the cause of the reporting system.

The SRS-COD component relies on verbal autopsy to determine cause of death. However, major departures from the SCD-Rural design are (a) doing away with the structured questionnaire approach, and (b) lack of a symptom record. The SCD-Rural symptom record (SCD-Rural Form-7) was similar in its information content to the WHO cause of death report format, which requires information about underlying causes of death. The SRS-COD component asks the field agents to record the code to which cause of death is assigned. No further information about symptoms and circumstances of death need be reported. This later information is required for systematic screening and coding of cause of death reports. However, it is too early to make a judgment on the new system. It will be helpful if specific research studies are taken up to evaluate the performance of the new cause of death reporting system in rural areas.

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Annex-1: SCD (Rural) algorithms and current knowledge base on verbal autopsy.

SCD Code and Cause SCD algorithm i.e. structured questions and check list (CL)	Expert opinion and findings from field studies about diagnostic algorithms and validity of verbal autopsy (VA) to assign specific cause of death.	Does SCD questions satisfy expert opinion?
100 Accidents and injuries		
Did the death occur due to an accident or injury or violence? Was the death due to accident? Was the death due to drowning?	Zimicki (1990) found coding of drowning by VA in the Matlab, Bangladesh DSS to be most sensitive and specific.	
200 Maternal not classifiable		
Did the woman die of complication of childbirth, pregnancy or puerperium? What was the death due to, if not from any of the following causes?	Hayes (1989): Can be diagnosed if during labour or delivery with hemorrhage, prolonged labour, convulsions. If fever in six weeks after delivery. If fever after abortion. Abortion deaths may be concealed. Can be excluded in late pregnancy, labour or immediate postpartum. Can not be excluded in early pregnancy.	
300 Fevers: not classifiable		
Did the deceased have high fever? What was the death due to, if not from any of the following causes?	Zimicki (1990) found that there was a tendency for deaths coded to fever and respiratory disease among 1-4 year children vary inversely with each other.	
311 Malaria		
Did the deceased have high fever? Were there repeated attacks of fever? Was the fever coming on alternate days or every 4th day and was there delirium, sweating and chills? CL: There is fever daily, on alternate days or every 4th day, rise high with chills and headache and returns to normal with sweating. The high fever may be accompanied by delirium loss of appetite, vomiting and pain in limbs. In chronic cases, it is associated with anaemia and debility.	Gray (1989) cites studies showing that it is difficult to diagnose malaria on the basis of verbal autopsy without laboratory investigations to demonstrate parasites in peripheral smear. The WHO algorithm of intermittent high fever with chills and prostration can be used as a crude diagnostic algorithm. It has not been validated. Hospital studies of clinical diagnosis correlated with blood smears show considerable error (Essex, 1978). However, in endemic areas the falciparum malaria is easily recognised. AP is an endemic area. Since most deaths due to malaria occur due to P.Falciparum, its recognition as cause of death should cover most malaria deaths. Garene and Fontaine (1989): malaria is most difficult to evaluate from verbal autopsy. Their criteria were: (a) high fever with sweat or chills, (b) death within three days of beginning fever, and © no evidence of adequate prevention of treatment, such as chloroquin or quinine, at least 12 hours prior to death. Hayes (1989): Can be diagnosed in adults if cerebral malaria with headache , shivering attacks, delirium especially in some one recently arrived from non malarial area. If black water fever. Can be excluded if only slight or no fever.	Yes. Does not include additional questions suggested by G&F such as death within 3 days of start of fever and no evidence of antimalarial treatment. A large number of deaths due to malariaoccur in early childhood. Specific opinion on this aspect lacking.
411 Gastro- enteritis		
Did the person die of any digestive disease in the form of diarrhoea, pain in abdomen, vomiting, loss of weight, debility? Did the person have vomiting and diarrhoea? Did the person have a large number of vomiting associated with diarhoea and dehydration?	Zimicki (1990) found coding of diarrhoea by VA in the Matlab DSS to be most sensitive and specific. Gray (1989) lumps diarrhoea and dysentery together and suggests following algorithm adapted from Black et al (1982): (a) history of three, four or more liquid stool per day (diarrhoea), (b) passage of blood and mucus (dysentery), dry mouth, dry wrinkled skin, sunken eyes, lack of urine, and in young infants depressed fontanelle and (d) the above conditions should have occurred immediately before time of death. In a study in	Yes. No questions about frequency of stools in the structured part. But the check list refers

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SCD Code and Cause SCD algorithm i.e. structured questions and check list (CL)	Expert opinion and findings from field studies about diagnostic algorithms and validity of verbal autopsy (VA) to assign specific cause of death.	Does SCD questions satisfy expert opinion?
CL: There is vomiting and diarrhoea of sudden onset. There is dehydration with shallow eyes. The vomiting an diarhoea are numerous in number. Diarrhoea means abnormal frequent discharge of fluid faeces from the bowel.	Bangladesh (Black et al 1982) the above definition was validated by obtaining a history form mother and examining a single stool specimen. Aggrement was obtained in 80% cases. Mothers subjective report about occurrence of diarrhoea tallied with findings from above algorithm 97% of times. Garene and Fontaine (1989) used following criteria for their study in Senegal: (a) declaration of diarrhoea, (b) evidence of abundant stools until death, © no evidence of other disease mentioned in check list, (d) signs of dehydration such as thirst, sunken eyes, or sunken fontanelle. However open ended questions on the presence of "diarhoea" may be unreliable (Gray 1991 citing Black 1984, Kendal et al 1984). Kalter et al (1990): The best algorithm for diagnosis of death due to diarrhoea was the presence of frequent loose or liquid stools irrespective of whether death was due to diarrhoea alone or in combination with other illness (sensitivity=78% and specificity=79%). The additional specification of diarrhoea stool frequency of 6 or more per day, and signs of dehydration like thirst or sunken eyes improved specificity (92%) but reduced sensitivity (57%).. WHO-UNICEF 1992: Sensitivity and specificity for diarrhoea presented a mixed picture. Sensitivity ranged from0.36 to 0.90 while specificity ranged from 0.61 to 0.97. Several of the verbal autopsies used in these validation studies contained a number of questions about frequency and consistency of stools during the illness preceding death. Sensitivity and specificity varied depending on which criterion was used. overall, the levels of sensitivity and specificity for deaths associated with diarrhoea were moderate and not high enough to recommend that verbal autopsies be undertaken on a regular basis in every country to monitor mortality from diarrhoea.	to "countless number of motions". Specificity of 80% would balance out the sensitivity of 80% to some extent. Hence the resultant estimate should at best be marginally off. Hence can be relied.
412 Cholera		
Did the person die of any digestive disease in the form of diarhoea, pain in abdomen, vomiting, loss of weight, debility? Did the person have vomiting and diarhoea? Was it an acute onset of profuse watery motions resembling rice water followed by vomiting and stoppage of urine, with cramps? Was there acute dehydration without bellyache? CL: Profuse watery motions resembling rice water, followed by vomitting. There is stoppage of urine. Excessive thirst. Collapse and death due to dehydration. The pain in the abdomen is not very distressing.	Garene and Fontaine (1989) include cholera among the adult causes of death identifiable with some degree of confidence in their study in Senegal. Their criteria for cholera was: (a) severe abundant watery diarrhoea (like rice water) or vomiting, without fever. (b) signs of dehydration, © death within three days of onset of diarrhoea, and (d) good evidence of contamination or an epidemic.	Yes. Meets first two of G&F's criteria. Criteria (d) about evidence of contamination appears valid on the face of it and could be added to SCD questions. Criteria © about death within 3 days needs to considered.
414 Dysentery		
Did the person die of any digestive disease in the form of diarhoea, pain in abdomen, vomiting, loss of	Zimicki (1990) found coding of dysentery by VA in the Matlab, Bangladesh DSS to be fairly specific but less sensitive. It included some cases of mal absorption. Some dysentery deaths are reported as due to measles or	Yes. Considering low sensitivity

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weight, debility? Did the person have vomiting and diarhoea? Did the person have diarhoeal faeces containing blood or mucus with belly ache? CL: Frequent motions with lower bellyache not of rice water variety containing mucus or blood. There is constant desire to defecate without actual defecating.	dropsy. Gray (1989) lumps diarrhoea and dysentery together and suggests following algorithm adapted from Black et al (1982): (a) history of three, four or more liquid stool per day (diarrhoea), (b) passage of blood and mucus (dysentery), © dry mouth, dry wrinkled skin, sunken eyes, lack of urine, and in young infants depressed fontanelle and (d) the above conditions should have occurred immediately before time of death.	dystentery deaths may be underestimated. The questions regarding diarhoea and dysentery branch off from each other regarding presence or absence of blood and mucus. Under reporting in one may be picked up by the other. Lumping both as diarhoeal diseases may avoid this problem. However, some correction for Zimicki's (1990) finding that some dysentery deaths are coded as measles or dropsy would be needed.
511 Tuberculosis of lungs (Pulmonary TB)		
Did the deceased die due to cough? Whether the cough was of long duration more than a few months? Was the person rapidly getting weak and losing weight? Was there a history of night sweats? Was there spitting of blood, pain in the chest and loss of appetite? CL: The deceased had a history of chronic cough. The person would have lost weight rapidly. There may be	Gray (1989) notes that it is difficult to recognise tuberculosis in childhood. WHO algorithm for TB in children: (a) chronic cough for three months or more unresponsive to antibiotic treatment, (b) weight loss, © slight fever, (d) blood in sputum, (e) abdominal swelling, (f) painless swellings (lymph nodes) in neck, under the arms, or in the groin, (g) swelling of the joints of slow onset The algorithm is yet to be validated. Hayes (1989): Can be diagnosed if cough, blood in sputum, weight loss, fever, night sweats, anorexia were present. Possibility of confusion with lung cancer is there. Can be excluded if no related symptoms. Can not be excluded from lung cancer.	Yes. WHO algorithm includes lymph nodes, abdominal swelling etc. characteristic of primary complex in children. Note that

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history of blood in coughed material, or pure blood itself might have been coughed out. There would be continued emaciation with loss of weight, fever and sweats.		SCD code here is for pulmonary TB.
512 Bronchitis		
Did the deceased die due to cough? Whether the cough was of long duration more than a few months? Was the elderly person having continuous cough with frothy mucous expectoration? CL: Cough of long duration, elderly person. Shortness of breath. Bouts of cough resulting in frothy mucous expectoration. Some times with fever. Patient usually has no sleep and slow deterioration of his conditions.	Hayes (1989): Emphysema is lumped with bronchitis. Can be diagnosed if there was cough and wheeze +/- fever, history of recurrent episodes, say 3 per year. Differential diagnosis with asthma. Can be excluded if no relevant symptoms at time of death.	Yes.
513 Asthma and allergic disorders of respiratory system		
Did the deceased die due to cough? Whether the cough was of long duration more than a few months? Was the person having cough during certain seasons? Was he spending sleepless nights due to cough? Was there wheezing sound with breathing? Was he always siting in bed for relief of cough? CL: Symptoms similar to bronchitis but the suffering is usually seasonal. There is difficulty in breathing with "catcall" (wheezing) like sounds. The cough is paroxysmal in nature and with breathlessness. In case of asthma the disease if of chronic nature. The household gives a history of several years.	Hayes (1989): Can be diangosed especially in young person, typical wheeze, cyanosis, unable to drink more than sips, history of past recurrent episodes. Can be excluded if not breathless at time of death although wheeze would be less apparent at the terminal stage.	Yes.
521 Pneumonia		
Did the deceased die due to cough? Was the cough of short duration? Was there high fever with cough of sudden onset? CL: There is cough of short duration, with high fever. This is of sudden onset. There is pain in chest. There may be rapid breathing. If child there may be	Gray(1989): cute lower respiratory tract infections (ALTRI) such as pneumonia and bronchiolitis of bacterial and viral origin may be important in Indian subcontinent. The following algorithm from Rile et al (1981) and Essex (1978) is recommended by Gray: (a) cough and fever, (b) difficulty in breathing or rapid respiration due to shortness of breath or chest pain, © duration less than two weeks. Although not adequately validated vaccine trial data suggest its usefulness. Garene and Fontaine (1989): (a) evidence of fever until death and (b) symptoms like rapid breathing, breathing like a little dog, difficult breathing, palpitating nostrils, insuction, acute cough. Symptoms should have lasted at least 24 hours before death to avoid cofution	Yes. Going by Kalter et al's finding, the SCD algorithm of cough and fever should have 82% sensitivity and

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convulsions and vomiting. There is respiratory failure causing death.	with signs of agony. Kalter et al (1990): For acute lower respiratory infection (ALRI) in children presence of cough and dyspnoea had sensitivity of 84% and a specificity of 76% in excluding non respiratory causes and a specificity of only 44% in excluding deaths due to upper respiratory tract infection (URTI). Including presence of fever in the algorithm reduced sensitivity slightly to 82% and increased specificity to 58% for theURTI comparison. Adding signs of respiratory distress improved specificity to 83% for URTI comparison and 84% for exclusion of non respiratory causes. However sensitivity reduced to 68%. Hayes (1989): Can be diagnosed in adults if dyspnoeic at rest, high fever, +/- cough or chest pain. Can be excluded if none of these symptoms present.	specificity of 58% for exclusion of URTI and 76% for exclusion of non respiratory causes.
530 Whooping cough		
Did the deceased die due to cough? Was there paroxysmal attacks of coughing over a period of time and severe bouts of cough with whoop at the end? CL: Cough with whoop at the end of the spell of severe bout of cough. Vomiting of food leading to emaciation during short illness. Fever not essential. Generally in the case of children.	The WHO EPI algorithm for identification deaths due to whooping cough: (a) history of severe cough persisting for two or more weeks, (b) recurrent bouts of coughing with characteristic whoop, © cough followed by vomiting. Gray (1989) reports that in a Kenyan study (Voorhoeve et al, 1978) using criteria similar to WHO algorithm whooping cough could be confirmed by more objective clinical investigation in 40% of cases. When mothers of children with confirmed whooping cough were reinterviewed after an interval of 6-12 months 96% gave a concordant history of whooping cough, suggesting reliability of recall for positive cases. Gray also cites vaccine trials which show decline in whooping cough deaths estimated by algorithms similar to the WHO's shown above (Cook, 1978, Muller et al 1984). Garene and Fontaine (1989): Whooping cough is easily recognised by people. In addition to declaration by the family following criteria was used: (a) death during the period of cough (100 days after the start), (b) evidence of an epidemic in the village or contamination from outside, © long lasting cough together with symptoms such as whoop, vomiitng, red eyes.	Yes. G&F's point (b) about epidemics could be added. The criteria of death within 100 days need to be considered.
610 Stroke		
Was the deceased in coma for long time before death? Was there paralysis of sudden onset of one half of body or a limb, along with fever or without fever? CL: An elderly person moving about freely suddenly gets sick and loss of consciousness and becomes comatose. Paralysis of half of body or all limbs or face is noticed later. The person may regain sense and remain paralytic or may die without coming to consciousness level.	Hayes (1989): Can be diagnosed if sudden paralysis or loss of speech leading to unconsciousness. Can not usually be excluded Can be excluded only if no other suggestive history.	Yes.
620 Meningitis		
Was the deceased in comma for long time before death? Was there fever with convulsions, stiffness of	Garene and Fontaine (1989): Meningitis appeared to be more difficult to assess than other causes. Criteria; (a) fever until l death, (b) symptoms of menigitis like head bent backwards, arms and legs bent, swollen	Yes. G&F's criteria

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SCD Code and Cause SCD algorithm i.e. structured questions and check list (CL)	Expert opinion and findings from field studies about diagnostic algorithms and validity of verbal autopsy (VA) to assign specific cause of death.	Does SCD questions satisfy expert opinion?
the neck with headache, and pain in eyes, the fever remaining high and continuous, patient getting irritated by sound or light? CL: There is fever of short duration. There is rigidity of neck, convulsions and headache. The patient is irritated and does not like light, sound etc. The patient becomes unconscious and dies.	fontanelle, and © convulsions, headaches, photophobia might have been present. Evidence of an epidemic of meningitis.	about epidemic could be added.
630 Convulsions		
Was the deceased in comma for long time before death? If a child, did it die of convulsions, with no other symptoms? CL: The child had convulsions over and over due to any of several underlying causes. It may have convulsions with high fever, diarrhoea and infections of brain, etc. Convulsions mean violent involuntary muscular contraction. They are followed by unconsciousness, leading to death.	Garene and Fontaine (1989): Epilepsy is well identified by people. Their criteria: (a) declaration by the family, (b) report of an epileptic crisis, © evidence of treatment for epilepsy since most people usually receive treatment prior to death.	Yes.
700 Congestive and other heart failure		
Was it heart failure not due to heart attack? Was there breathlessness or palpitation? CL: Chronic breathlessness and cough with swelling feet and abdomen and palpitation of heart. Breathlessness increases in walking, relief by sitting. Death is due to acute and severe breathlessness in case of congestive heart disease. Other heart disorders (not due to heart attack); if diagnosed during last illness may also be included here.	Hayes (1989): Can be diagnosed. Exertional dyspnoea, edema, orthopnea. Can be excluded if no edema or dyspnoea.	Yes.
730 Ischaemic heart disease (heart attack)		
Was the death sudden? Was there acute pain in the chest or the arm followed with breathlessness? CL: Patient might have complained of severe and acute pain in chest or arm followed by sweating and severe breathlessness. Becomes cold and clammy and	Hayes (1989): Diagnosis by verbal autopsy doubtful. Can be diagnosed only if there was history of typical pain, although it can be difficult even with living patient. Can not be excluded. Any unexplained sudden death could be provoked by ischaemic heart disease. Can be excluded if there is history of chronic disease leading to death without pain.	Yes.

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dies suddenly due to breathlessness or unconsciousness. It is a sudden death.		
812 Jaundice		
Was other clear symptoms present? Was there any external evidence of disease like yellow eyes and skin? Was the colour of the eyes and skin yellow? Did he have vomiting and hatred for food? Did he finally die of swelling all over the body? CL: The eyes are yellow in colour, and the skin is yellow. There is fever, malaise, headache, nausea, vomiting and loss of appetite. Urine is of high yellow colour.	Hayes (1989): Hepatitis can be diagnosed if anorexia and nausea +/- vomiting, fever, followed by jaundice. It can be excluded if no related symptoms. Could be confused with gall stone infection , but pain will be severe in that case.	Yes. Need to change the label from jaundice to hepatitis.
821 Chicken pox		
822 Measles		
Were other clear symptoms present? Was there any skin eruptions and skin changes? Was it a child? Did the deceased have fever for 4 days and later the body became red, and developed cough and cold? (Usually a child.) CL: Did the deceased have fever for 4 days and later the body became red and developed cough and cold.	The WHO EPI algorithm is as follows: (a) history of a blotchy rash lasting three or more days, followed by peeling of the skin, (b) history of fever, © history of cough, runny nose and red eyes, and (d) the above conditions should have occurred within three months of death. Gray (1989) informs that lay diagnosis using above algorithm has been used successfully in numerous vaccine efficacy studies. In addition the disease is commonly recognised by the community. It has been shown that the rash, subsequent peeling of skin, cough, and conjuctival inflammation provided maximum discrimination between cases with confirmed measles and control children with other illness. The sensitivity and specificity of the above algorithm exceed 90% (Leeuwenberg et al, 1984). Garene and Fontaine (1989): Measles death were easy to determine since people recognize the disease accurately. Their criteria were; (a) declaration of measles by parents, (b) death within six weeks of the beginning of fever and rash, © evidence of an epidemic in the village, (d) symptoms in the following sequence i.e. fever running nose, red eyes, rash starting on face, rash in mouth, rash all over body, peeling skin, and (e) no evidence of excluding symptoms such as water in the pimples. Zimicki (1990) found that the measles category contains some deaths occurring after other diseases in which rashes occur, while some measles related deaths were classified as dysentery, respiratory disease, fever or dropsy. Kalter et al (1990) found that the algorithm consisting of (a) death after 120 days of age, and (b) both rash and fever last for three or more days yielded 94% sensitivity and 89% specificity. Information about fading of rash increased specificity to 94% without affecting sensitivity. These authors noted that most children dying of measles do not survive till peeling of skin (desqaumation). WHO-UNICEF 1992: Verbal autopsy would seem to be a good method for identifying measles as a cause of death, although the epidemic nature of	Yes. Scope for improvement. For example points like age at death more than 120 days (4 months), revising existing question of fever for 4 days to fever and rash at least for 3 days, evidence of epidemic in the village, red eyes.

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	measles must be kept in mind. During any short time period, whether or not there are deaths from measles depends largely on whether there has been an outbreak of measles during the period under study.	
831 Tetanus		
Were there other clear symptoms present? Was there any external evidence of disease like convulsions or spasms? (deaths of new born excluded here) Was there a history of injury? Was there locking of the jaw? Was there severe spasms of the limb? CL:Does not include neonatal tetanus	Hayes (1989): Can be diagnosed by verbal autopsy.	Yes.
861 Cancer		
Were there other clear symptoms present? Was there any external evidence of disease like tumour? Was there a small swelling in the mouth, breast, lips and skin, uterus or other sites, rapidly breaking and bleeding with pain, growing bigger and bigger at a great speed? CL: There may be a swelling of small size in breast, tongue, mouth, face, penis, skin. It takes a rapid growth and soon begin to bleed. In case of breast and penis the growth goes on like mushroom. In the case of malignancy of the cervix or uterus, there will be little bleeding not related to menses, or in a woman who is in menopause there is extreme emaciation and loss of weight. In case of lung cancer, there is unexplainable cough. In case of cancer of the throat, there is change or loss of voice and difficulty in swallowing. In the case of cancer of the anus or rectum, the motion is to being passed due to pain, there is bleeding at the passing of motion etc.	Hayes (1989): Breast cancer can be identified only if there is no cultural inhibition about intimate area. It could also be confused with chronic infection. Thus it would be difficult to discriminate breast cancer in AP. It could excluded there was no treatment for it and there was no weight loss. For cervical cancer history may not be forthcoming to male interviewer. Post-menopausal age may be used as suggestive. Lung cancer can be confused with tuberculosis, although the later would have longer history and low grade fever compared to lung cancer. It could be excluded if no cough, no weight loss and no haemoptysis. Liver cancer may not be distinguished from terminal cirrhosis. It may be excluded if no vomiting, no jaundice, swollen abdomen or diarrhea. Stomach cancer may be confused with chronic peptic ulcer or pyloric stenosis. It can be excluded if there was no weight loss, no vomiting and history of loss of appetite. Colon cancer can be confused with other causes of intestinal obstruction or anemia which of course would be more acute.	Can't say. Likely to underestimate cancer deaths, since these questions would bring out the most obvious cancer deaths only. It may be desirable to ask about cancer stomach in the digestive disorder module than here. Similarly questions about lung cancer would appropriately belong in the cough module. The omnibus label of cancer is too vague. Site specific labels would be more desirable.
900 Infant deaths: not classifiable		
Did the new born child die soon after birth or within	Gray(1989): In summary, if a death is reported during the first month of life it should be possible to	

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one year. What was death due to if not from any of the following causes?	discriminate between neonatal tetanus, birth trauma/asphyxia and low birth weight, or external congenital abnormalities. Garene and Fontaine (1989) designed their questionnaire for neonatal deaths to assess five main causes: neonatal tetanus, pneumonia of the new born, birth trauma, congenital defects and a composite group consisting of prematurity and low birth weight. Community studies from India (Kielman et al 1983, Shah et al 1984) suggest that roughly 1/3rd of perinatal deaths can be attributed to pre maturity, another one third to birth injury and about 6% to congenital defects, 5% due to infections and rest unknown causes.	
910 Pre maturity		
Did the child die soon after birth or within one year? Was the baby premature, underweight and small in size or was it one of plural births? CL: This always refers to the new born baby. The baby is very small in size and markedly under weight. The child has feeding and sucking difficulty. The skin is very soft, and nails are not fully developed. The cry of the baby is feeble and week.	Difficult to distinguish pre maturity in the absence of birth weight or definite record of gestational age. Garene and Fontaine (1989) lump prematurity and low birth weight together and assess it from mothers report either of low number of weeks of pregnancy or that the child was markedly small, or of cases of twins or triplets. Death usually occurred within three days of birth. Gray (1989) opines that the WHO algorithm for low birth weight, birth trauma or asphyxia is potentially valid. This algorithm is as follows: (a) Stillborn infant or infant dying within first week of life, (b) failure to suckle or cry normally after birth and any time prior to death, © very small infant, (d) history of prolonged or complicated labour, (e) signs of trauma, particularly bruising or indentation of the skull.	No. Difficult to distinguish prematurity from low birth weight (LBW). So lumping with low birth weight is called for. Since LBW label doesnot exist, it can be added here without disturbing structure of SCD list.
922 Congenital malformation		
Did the child die soon after birth or within one year? Was the death of baby due to injury at birth? Was the injury at birth due to congenital malformations? CL: The cild has an abnormal head, too big or too small, Some times, the intestines are outside. Some times the urinary system has some malformation, some times the anus is not perforated to pass motion. In major abnormalities life is not compatible. Some times minor malformations like hare lip may occur which through surgical care can be rectified, but are neglected and the child may die of starvation and malnutrition at a later stage though not immediately.	Gray (1989) citing Christianson et al (1981) notes that congenital anomalies are frequently under diagnosed at birth in industrialised countries. However major external deformities such as anencephaly, spina bifida or limb reduction defects are easily recognized. May be difficult to distinguish from birth injury and congenital malformation. Garene and Fontaine (1989) assessed congenital defects from mothers report of the history of delivery and child's aspect after birth.	Yes.
923 Birth injury		

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Did the child die soon after birth or within one year? Was the death of baby due to injury at birth? Was the injury at birth due to use of instruments, difficult labour etc. CL: Generally there is a history of prolonged labour with or without use of instruments. The child after birth is usually blue in colour, cries in low voice, had convulsions or facial paralysis or injuries on the face, upper extremities, collar bone etc.	Gray (1989) opines that the WHO algorithm (shown above) for low birth weight, birth trauma or asphyxia is potentially valid. Garene and Fontaine (1989) assessed congenital defects from mothers report of the history of delivery and child's aspect after birth.	Yes.
931 Respiratory infections of the new born		
Did the new born child die soon after birth or within one year? Was the death due to infection after birth? Did the baby have fever after birth with difficulty in breathing? CL: The infections of the respiratory tract, are most common. A few days after birth there is fever. The infant may have rapid breathing, convulsions, vomitings and feeding difficulties and may die without any external sign of infection.	Garene and Fontaine (1989) label this as pneumonia of the new born. In their study it was diagnosed from: (a) fever until death, (b) symptoms of pneumonia such as rapid breathing, difficult breathing, palpitating nostrils at least one day prior to death. WHO-UNICEF 1992: It would be almost impossible to distinguish between sepsis and pneumonia in the new born based on verbal autopsy.	Yes.
932 Cord infection		
Did the child die soon after birth or within one year? Was the death due to infection after birth? Was there sepsis of the umbilical cord? CL: With same description as for respiratory infection of the new born, the child may have an abscess of the umbillical cord, or sepsis of the cord, or even of the umbillicus itself at a later stage. Deaths due to tetanic convulsions of new born to be included here.	WHO EPI (1983) algorithm for neonatal tetanus: (a) babies born alive who die between 3rd-30th day of life, (b) history of normal suckling and crying at birth and for at least two days after birth, (b) onset of illness between 3-28 days of age, (d) history of an inability to suckle followed by stiffness and /or unremitting muscle spasm. Gray (1989) has cited references and given arguments that the WHO algorithm is highly specific. Fever and umbilical sepsis is reported in 20-50% of neonatal tetanus cases (Galazka and Stroh, 1986 cited in Gray, 1991). Thus the label cord infection may not capture all neonatal tetanus deaths. Kalter et al (1990) found that for neonatal tetanus the algorithm consisting of (a) death at ï 30 days associated with (b) convulsions or spasms during two weeks prior to death had cent percent sensitivity. The addition of information that child suckled normally after birth until onset of illness did not reduce sensitivity. Questions that child stopped suckling after onset of illness or had generalised stiffness dropped sensitivity to 94%. WHO-UNICEF 1992: Verbal autopsy would seem to be a useful instrument for identifying neonatal tetanus. However deaths from neonatal tetanus are known to be underreported owing to underreporting of neonatal deaths in general.	No. This diagnosis of cord infection needs to be replaced by neonatal tetanus and the questions modified suitably.
933 Diarrhea of new born		
Did the child die soon after birth or within one year? Was the death due to infection after birth? Did the	Zimicki (1990) found coding of diarrhoea by VA in the Matlab DSS to be most sensitive and specific. Gray (1989) lumps diarrhoea and dysentery together and suggests following algorithm adapted from Black et al	Yes. No questions about frequency of

Annex-1: SCD (Rural) algorithms and current knowledge base on verbal autopsy.

SCD Code and Cause SCD algorithm i.e. structured questions and check list (CL)	Expert opinion and findings from field studies about diagnostic algorithms and validity of verbal autopsy (VA) to assign specific cause of death.	Does SCD questions satisfy expert opinion?
child die of diarrhea? CL: Other wise healthy, infant suddenly passes countless number of motions and vomitings, the skin becomes dry, the tongue is dry and parched. The fontanelle are depressed. The eyes are sunken. The urine is yellow and scanty. There is high temperature, and the child soon goes into comma and passed motion in the unconscious state and dies.	(1982): (a) history of three, four or more liquid stool per day (diarrhoea), (b) passage of blood and mucus (dysentery), © dry mouth, dry wrinkled skin, sunken eyes, lack of urine, and in young infants depressed fontanelle and (d) the above conditions should have occurred immediately before time of death. In a study in Bangladesh (Black et al 1982) the above definition was validated by obtaining a history form mother and examining a single stool specimen. Aggrement was obtained in 80% cases. Mothers subjective report about occurrence of diarrhoea tallied with findings from above algorithm 97% of times. Garene and Fontaine (1989) used following criteria for their study in Senegal: (a) declaration of diarrhoea, (b) evidence of abundant stools until death, © no evidence of other disease mentioned in check list, (d) signs of dehydration such as thirst, sunken eyes, or sunken fontanelle. However open ended questions on the presence of "diarhoea" may be unreliable (Gray 1991 citing Black 1984, Kendal et al 1984). Kalter et al (1990): The best algorithm for diagnosis of death due to diarrhoea was the presence of frequent loose or liquid stools irrespective of whether death was due to diarrhoea alone or in combination with other illness (sensitivity=78% and specificity=79%). The additional specification of diarrhoea stool frequency of 6 or more per day, and signs of dehydration like thirst or sunken eyes improved specificity (92%) but reduced sensitivity (57%).. WHO-UNICEF 1992: Sensitivity and specificity for diarrhoea presented a mixed picture. Sensitivity ranged from0.36 to 0.90 while specificity ranged from 0.61 to 0.97. Several of the verbal autopsies used in these validation studies contained a number of questions about frequency and consistency of stools during the illness preceding death. Sensitivity and specificity varied depending on which criterion was used. overall, the levels of sensitivity and specificity for deaths associated with diarrhoea were moderate and not high enough to recommend that verbal autopsies be undertaken on a regular basis in every country to monitor mortality from diarrhoea.	stools in the structured part. But the check list refers to "countless number of motions". Specificity of 80% would balance out the sensitivity of 80% to some extent. Hence the resultant estimate should at best be marginally off. Hence can be relied.
1000 Senility Was the person extremely old and apparently not sick? Patient should be above 60 years and none of the specific causes noted above can be traced in him.		

Detailed reference of Sources cited in the above table:

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2. Leeuwenberg J., Gemert W., Muller A.S.,Voorhoeve A.M. and Kok P.W.; 1984; The epidemiology of measles in Maternal and child health in rural Kenya: an epidemiological study, Croom Helm, London, 127-42.

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3. Kalter (1990): Kalter Henry D., Gray Ronald H., Black Robert E. and Gultian Socorro A.; 1990; Validation of post mortem interviews to ascertain selected causes of death in children; International journal of epidemiology 19(2): 380-386.
4. WHO-UNICEF (1992): WHO and UNICEF, 1994; Measurement of overall and cause-specific mortality in infants and children: Memorandum from a WHO / UNICEF meeting; Bulletin of the World Health Organization 72(5):707-713
5. Zimicki 1989: Zimicki Susan; 1990; Approaches to assessment of the cause structure of mortality: a cse-study from Bangladesh in Vallin et al eds. Measurement and analysis of mortality. New approaches. Clarendon Press, Oxford.
6. Garene & Fontaine 1989: Garene Michele and Fontaaine Oliver; Assessing probable cause of death using a standardized questionnaire: a study in rural Senegal in Vallin et al eds. Measurement and analysis of mortality. New approaches. Clarendon Press, Oxford.
7. Adult VA tools workshop: London School of Hygiene & Tropical Medicine (LSHTM); 1993; Verbal autopsy tools for adult deaths. Workshop report, 11-15 January 1993; Mimeo.
8. Hayes et al 1989: Hayes Richard, Mertens Theirry, Lockett Geraldine and Rodrigues Laura; Causes of adult deaths in developing countries. A review of data and methods. World Bank working paper WPS 246, July 1989.

Acronyms used in the above table:

SCD: Survey of cause of death rural in India.
CL: SCD checklist in SCD (Rural) manual of instructions part II-Non medical list.
VA: Verbal autopsy.
DSS: Demographis surveilance system.
G&F: Garene & Fontaine, 1989

Gray (1989) cites study by Puffer and Serano (1973) who conducted a study on child mortality in Latin America. They could identify clinical malnutrition from retrospective data eventhough death certificates gave other underlying causes. Their algorithm for identification deaths due to malnutrition is as follows: (a) history of weight loss (moderate or severe), (b) did the child's arm, legs, body or face become thinner?, (c) did the child's legs, body or face become swollen (oedema)?, (d) could the ribs be seen more prominently through the skin?, (e) did the child's hair fall out, pull out easily, or change colour?, (f) did the child have difficulty moving around the house or in locating food or toys after dark, compared to other children of the same age?