Cause of Death Reporting in India. A Performance Analysis.

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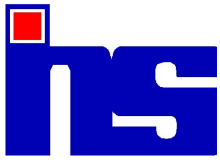

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Valid and reliable statistics on the cause of death is an essential input for setting of priorities in the health sector (Mahapatra, 1999). As is generally known, most developed cause of death reporting systems rely on medical certification of cause of death using a well defined system of classification. The International classification of causes of death (ICD) released by WHO from time to time is usually followed as such or with suitable adaptations to specific country settings. The 10th revision of the ICD (ICD10) is the latest instance of this kind (WHO, 1993). Most developed cause of death reporting systems have invariably achieved near total coverage. In other words a cause of death report is invariable filed by the medical attendant for all deaths in such countries. Developing countries like India have to depend on lay reporting of the cause of death for rural areas, where adequate medical facilities are not available. However, usability of the cause of death statistics is questioned in view of poor coverage, and poor compliance with cause of death reporting, coding and classification. The importance of a good cause of death reporting system to inform public health policy has been described elsewhere (Mahapatra, 1999). Details of the verbal autopsy-based cause of death reporting systems in rural areas of India has been reviewed (Mahapatra, 2000).

In this paper, we examine the cause of death reporting system in terms of the usability of cause of death statistics generated by it. We start with a brief description of the cause of death reporting system in India. Thereafter we define the characteristics of an usable cause of

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death reporting system. We identify nine criteria, based on a review of literature and our own assessment of the problem. We then examine, with facts and figures, the performance of the cause of death reporting system for rural and urban areas of India, against each of the nine criteria. For each criteria, we offer a subjective rating of the extent to which, we think the Indian cause of death reporting system satisfies the respective usability criteria. A three category rating scale consisting of (a) satisfactory, (b) tolerable, and (c) poor is used by us. Having studied performance of the system in detail, and reflecting on our experiences from a study on the causes of death in Andhra Pradesh, we offer some suggestions to improve the cause of death reporting system in India. The section titled "Can we improve the cause of death reporting system in India?" contains our recommendations. Finally, we present a summary of our findings on usability of the cause of death statistics in India, our recommendations in brief to improve the system.

A brief overview of the cause of death reporting systems in India:

At the National level, the Registrar General of India (RGI) is responsible for collection, collation and publication of cause of death statistics[3]. At the state level, the Vital Statistics Division of the Directorate of Health deals with cause of death statistics. Cause of death reports originate from lay reporters in rural areas and medical attendant in urban areas. The reports flow to the state vital statistics office through the primary health centre, in case of rural areas and the municipal health office for urban areas. Tabulation is usually done at the state level but the statistics are published by the RGI. Until December 1998, the cause of death data for the rural areas used to be collected under the Survey of Cause of Death Rural (SCD-Rural) scheme, from a sample of villages by a lay diagnosis and reporting system. A

[3] The responsibility for collection of vital statistics was transferred from the Ministry of Health to the RGI from 1949. However, effective transfer of work from the Director General Health Services to the RGI took place in 1960.

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 then 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 infers the 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 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 causes of death was last revised in 1983 to correspond to ICD ninth revision (RGI, 1991). SCD-Rural uses verbal autopsy (VA) to arrive at the cause of deaths using paramedical personnel.

From January 1999 the a cause of death component has been added to the SRS (RGI, 1999). We call this the SRS-COD component. 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 skipping with the symptom record (SCD-Rural Form-7). 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 ICD-10 code.

In case of the urban areas, a medical certification of cause of death (MCCD) scheme is operational. This scheme has legal sanction under the Registration of Births and Deaths Act. All medically attended deaths are expected to be registered (Form 2) along with cause of death reports in a format (Form 4) which is similar to what is prescribed by the WHO for International Classification of Cause of Death (ICD). Responsibility for reporting cause of death is on the doctor / health care provider who last attended on the deceased. Reports are sent to the municipal health authorities, who forward them to the concerned state vital statistics office. The medical attendant is required to follow guidelines contained in the Physician's manual on medical certification of cause of death (RGI, 1992). This manual prescribed the WHO form for reporting the cause of death according to the current version of ICD. Coding and tabulation is done according to the National List which is an adaptation of the ICD basic tabulation list. Since the MCCD essentially implements the ICD coding and guidelines, the design of the system is considered satisfactory.

Characteristics of an usable cause of death reporting system:

Design characteristics of the reporting system have a bearing on the usability of cause of death statistics. For example, changes in the guidelines of the international classification of causes of death (ICD) have been seen to cause reduction or increase in the assignment of deaths to certain causes, depending on the specific changes brought by the particular version

of the ICD. Analogously, guidelines for verbal autopsy could have some effect on the cause of death structure produced by the concerned cause of death reporting system. The problem is further compounded by the fact that the reporting systems do not achieve the designed coverage giving rise to scope for biases and low statistical power of the cause specific mortality estimates. If the biases due to poor coverage, faulty reporting, poor coding, and tardy processing, etc. can be kept to the minimum, the cause of death data can still be used to generate useful information for policy analysis. Ruzicka and Lopez (1990) for instance listed five criteria used by the World Health Organisation to assess fitness of country level cause of death data for inclusion in its compilations. Firstly, the proportion of all deaths attributed to residual categories such as "Symptoms, signs and ill defined conditions“ is within limits, say less than 10%. Secondly, the proportionate distribution of deaths by cause is consistent with the estimated mortality level for that country. Thirdly, no cause of death with a clear age-sex dependency has been incorrectly assigned. Fourthly, the age-sex distribution for major causes is consistent with what one may expect for each cause. Finally, data generated by the system are consistent with previous years. Note that these are basically plausibility checks. A data set failing these criteria is more likely to be biased. A data set satisfying these criteria may still not be usable, on account of poor statistical power of the generated estimates, and biases that are not readily noticeable. Building upon the criteria suggested by Ruzicka and Lopez (1990), we have identified the following nine criteria to assess the usability of any cause of death statistics:

1. Content validity of lay reporting systems[4], if any.
2. Adequate coverage and compliance.
3. Validity of statistics at sub-national levels of disagaregation.
4. Minimal usage of residual categories, such as unclassifiable, or ill defined conditions.

[4] We have assumed that medical certification of cause of death follows the ICD. Although ICD is not necessarily the most valid system of classification, it represents the consensus of professional opinion at the International level. We have omitted discussions about the content validity of the ICD.

5. Consistency of cause specific mortality proportion with general mortality level.
6. Absence of incorrect assignment of causes with clear age sex dependency.
7. Incidence of improbable age sex distribution by cause is nil.
8. Consistency of cause specific mortality proportion over time.
9. Timely compilation and publication of the statistics.

We examine, below, usability of the cause of death statistics from the rural and urban areas respectively. We take up each usability criteria, discuss its implications briefly and then examine, how India's cause of death statistics fares, using national statistics and state level statistics from Andhra Pradesh. Where required, we supplement the published statistics with information about Andhra Pradesh, available to us from our study on cause of death in AP. We call this the AP Rural Cause of Death (APRCD) study, 1998.

Content validity of the verbal autopsy algorithm for lay reporting of cause of death in India:

Certain general design features are key to wide applicability, efficiency and validity of data generated by a verbal autopsy (VA) based cause of death reporting system. Over the years, some degree of consensus on major design issues have emerged. Content validity of the VA based cause of death reporting systems in India has been examined in detail by one of us (Mahapatra, 2000). Here we present a summary of the findings from the paper just cited. For our purpose, the SCD-Rural structured questionnaire was systematically examined for each of the conditions included in the non medical list. The questions were reviewed 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 VA system. Altogether there are 57 specific causes in the SCD non medical list, excluding the residual categories. Accidents and injuries account for 12 of these. There is a strong consensus over the validity of VA to code deaths due to

accidents and injuries, 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 about 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-Rural 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 (Garenne 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 ailments. 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 the 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 the underlying causes of death. The SRS-COD component asks the field agents to record the cause and 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 the 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. We rate the content validity aspect of the lay reporting system as satisfactory for the SCD-Rural system and tolerable for the SRS-COD component.

Coverage by cause of death reporting systems:

Table- 1 shows coverage of deaths by the SCD-Rural scheme from the sample areas over a period of five years from 1991 to 1995. Coverage is computed with respect to the estimated total deaths for the SCD-Rural sample areas, using the SRS death rates. Some states show more than cent percent coverage in some years, by SCD-Rural system. This could be due to undercounting by the SRS giving rise to a small denominator in the coverage estimate or undercounting of population by the SCD-Rural system. At the all India level, coverage by SCD-Rural ranges from 70 to 90% of deaths. But states differ a good deal in terms of coverage of deaths by the SCD-Rural system. The state of Maharastra has maintained more than 80% coverage consistently for all the five years. Other states with fairly

high level of coverage maintained from year to year are: Haryana, Karnataka, Tamilnadu, Rajasthan, AP, Orissa, Himachal Pradesh, Punjab, and Uttar Pradesh. States like Assam, Bihar, and Madhya Pradesh, show generally poor coverage by the SCD-Rural system. In West Bengal, the SCD-Rural system seems to be defunct altogether. The APRCD study catalogued all SCD Rural reports for Andhra Pradesh state for the year 1998. It is found that about 20% of sample PHC head quarter villages are not sending any report at all. Thus poor coverage appears to be on two accounts, namely (a) undercounting, and (b) complete lack of reporting from a subset of sample villages.

Table-1: Percentage of estimated deaths covered by SCD-Rural, during 1991 to 1995

State	1991	1992	1993	1994	1995
India	NA	68.3	78.7	88.1	90.3
Andhra Pradesh	60.1	70.2	88.5	85.2	94.9
Assam	NA	38.1	43.0	71.5	65.5
Bihar	40.3	45.4	52.6	74.9	66.9
Gujarat	59.0	60.9	108.9	101.3	88.0
Haryana	NA	77.8	106.3	94.1	101.4
Himachal Pradesh	NA	92.7	76.0	94.7	147.2
Karnataka	76.1	79.5	101.6	97.9	103.1
Kerala	NA	66.1	56.9	125.1	101.4
Madhya Pradesh	36.2	47.1	63.3	81.4	102.4
Maharashtra	91.6	95.0	108.2	86.7	82.1
Orissa	66.7	80.9	77.7	107.6	89.5
Punjab	57.7	68.7	61.4	71.7	82.2
Rajasthan	65.4	76.8	91.2	95.5	92.9
Tamil Nadu	76.1	81.9	90.0	80.6	72.0
Uttar Pradesh	67.6	82.4	102.5	97.1	103.4
West Bengal	NA	NA	NA	NA	NA

Table-2 shows coverage by the MCCD scheme of deaths in urban areas. Coverage is computed with respect to SRS estimate of deaths rates applied to the urban population. At the all India level, coverage is about 25% of urban deaths. Note that coverage, in this case, is computed with respect to the total population of urban areas notified by respective state government for medical certification of the cause of death. In case of the SCD-Rural scheme, the reference population is much smaller, consisting of the sample of villages included in the

scheme. Even though coverage by MCCD is much lower, the number of cause of death reports arising out of the MCCD scheme appears to be much larger. Variation between States in terms of coverage by the MCCD scheme is much more pronounced. Many States are simply not reporting a single death under the MCCD scheme. These are: Assam, Bihar, Gujarat, Himachal Pradesh, Punjab and West Bengal. Maharasthra is the only state with fairly high degree of coverage, between 60 to 75% in different years. We must recall that the same State has consistently achieved high levels of coverage in the SCD-Rural scheme also. On the other hand States like Orissa, Haryana, Karnataka, Tamil Nadu have consistently collected cause of death reports for about 40% of deaths in urban areas.

Table-2: Percentage of medically certified deaths to expected urban deaths in major States during 1991 -1994 and AP for 1995,1996 and 1998

Country / State	1991	1992	1993	1994
All India	25.1	24.2	27.7	24.2
Andhra Pradesh[1]	17.2	24.5	21.9	15.7
Assam	0.0	0.0	0.0	0.0
Bihar	0.0	0.0	0.0	0.0
Gujarat	0.0	0.0	0.0	0.0
Haryana	44.8	40.1	44.0	26.6
Himachal Pradesh	0.0	0.0	0.0	0.0
Karnataka	34.9	41.1	35.4	42.5
Kerala	40.3	17.0	17.1	11.4
Madhya Pradesh	10.8	13.0	9.3	17.5
Maharashtra	76.2	77.4	58.4	74.7
Orissa	68.0	53.3	36.5	56.9
Punjab	0.0	0.0	0.0	0.0
Rajasthan	22.5	27.8	17.2	27.0
Tamil Nadu	35.5	40.5	35.2	43.5
Uttar Pradesh	0.8	0.7	0.4	0.7
West Bengal	0.0	0.0	0.0	0.0

[1] For AP we have data for some more years. The coverage of MCCD in urban areas of AP was as follows: 1995= 7.9%, 1996=13.9% and 1998=20.4%.

To get a better understanding of factor leading to poor coverage, we looked at the performance of MCCD in Andhra Pradesh for the year 1998 (Table-3). The state government has notified 116 municipalities under the MCCD scheme (Govt. of AP, ?). This means the

medical attendant, or health care institutions (HCIs) are required, under the Registration of Births and Deaths Act, to send a cause of death report for all deaths taking place in their charge. In 1998 only 15% of these municipalities sent some cause of death reports to the State Vital Statistics Division. We call these the "reporting" municipalities. Only 11% of health care institutions, accounting for 33% beds, within these reporting municipalities are sending some cause of death reports. We call these the "reporting HCIs". We studied the performance of some large reporting HCIs in the state capital, i.e. Hyderabad, to gain some more insights about completeness of cause of death reporting by them. We added up the number of deaths in these hospitals and registered with the municipality, as well as the number of cause of death reports received from them. Cause of death reports were filed only for about 65% of the registered deaths.

Table 3: MCCD in AP, 1998: Compliance by municipalities and Health Care Institutions (HCIs) within municipalities.

Number of municipalities in AP		100%
Number of municipalities notified by state for MCCD	116	
Number of municipalities sending some COD Reports to state	17	14.7%
Compliance by Institutions within the 17 reporting municipalities:		
Number of Institutions sending some COD reports	249	10.6%
Cumulative bed strength of these reporting Institutions	11,229	33%
Some Reporting Institutions in Hyderabad		
Number of registered deaths from these HCI		100%
Number of deaths for which COD Report received		

[1] Source: Compiled by the authors based on data collected from the Vital Statistics Division, AP
[2] Percentage of health care institutions and beds is arrived at with respect to total institutions and beds as in the AP Health Institutions Database (APHIDB) maintained at the Institute of Health System, Hyderabad, AP.

To understand the situation in case of the non reporting municipalities, we looked at the list of the 99 of this kind and discovered that five of them had teaching hospitals attached to medical colleges. We expected that at least some clinical teams in teaching hospitals would

follow protocols and write cause of death reports. We investigated with two of these teaching hospitals and found that they had indeed submitted the cause of death reports for 1998 to the concerned Municipal Health Office. The latter did not forward these to the State Vital Statistics Office, apparently out of ignorance. As a result, the cause of death reports from all reporting health care institutions within these registration areas stagnated at the municipality level. This finding is strengthened by the fact that the arrival of cause of death reports in the state vital statistics division of AP increased after our study started. For example, in 1999 the number of reporting municipalities increased to xxx from the figure of 17 in 1998.

We summarise our findings on the causes of poor coverage by MCCD as follows. Firstly, many health care institutions, clinical teams and medical attendants are either not aware of their responsibility to write and send cause of death reports or simply do not care. In case of health care institutions reporting some cause of death reports, there is still a problem of compliance by all clinical teams. Thirdly, many municipal health officers and their staff, meant to play a crucial role in collection of cause of death reports and enforcement of the provisions of the RBD Act, either are not aware of their role or simply do not care. As a result, some of the cause of death reports pile up in individual municipal offices, without ever getting tabulated. Finally, there is the case of municipal health offices totally unaware of and unconcerned about their responsibility in reporting of the cause of deaths. These are the ones who never receive a single cause of death report. Overall, we rate the coverage aspect as poor.

Validity of statistics at sub national levels of disaggregation:

Valid cause of death statistics at the state level allows for interstate comparisons. Small area comparisons of mortality experience is useful to identify inequalities in health care services. In the Indian context, interstate and small area comparison of causes of death have

the greatest potential to influence health policy. Ideally, we should use the same nine criteria to assess validity of cause of death statistics in each of the States. But adequate data is not available for the purpose. Hence we rely on differences in coverage by cause of death reporting systems in different states. Maharashtra is the only State with high coverage by cause of death reporting systems in both rural and urban areas. Four more States, namely; (a) Haryana, (b) Karnataka, (c) Tamilnadu, and (d) Orissa have reasonable coverage in both rural and urban areas. Rajasthan, Andhra Pradesh, Himachal Pradesh, Uttar Pradesh, and Punjab show reasonable coverage in rural areas but poor coverage in the urban sector. Thus only five out of 15 major states have reasonable coverage to give some confidence of interstate comparison of their cause of death structures. Considering the size of the country and potential of small area comparisons of mortality statistics to inform health policy, we feel that the usability of cause of death statistics in India for interstate and small area comparisons is rather poor.

Deaths coded as unclassifiable:

High incidence of unclassifiable deaths affects the accuracy of cause of death statistics. If unclassifiable deaths are equitably drawn from all causes, the amount of unclassifiable deaths may not affect the estimated cause of death profile. However, deaths attributable to certain causes have a greater tendency to end up in the unclassifiable category. Deaths due to causes with ill defined symptoms, or giving rise to multiple presentations would be difficult to classify. Such deaths would end up in the unclassified category in comparison to deaths due to clearly identifiable causes. For example, as Preston (1976) pointed out, many deaths due to cancer appear under senility or unknown cause, on account of poor diagnosis. Cardiovascular diseases, particularly of ischaemic heart disease causing death by sudden heart attack, may remain unrecognised and assigned to senility or

unclassifiable categories. On the other hand, respiratory tuberculosis is easy to recognise and would not usually contribute much to the deaths coded to miscellaneous categories. To the extent proportion of deaths assigned to miscellaneous codes like unclassifiable, senility, etc. is small, we can rely on the cause specific mortality proportions. Non availability of age or sex of the deceased imposes a further burden and may contribute to biased estimation of cause specific mortality proportions.

Table-7: Percentage of deaths coded as unclassifiable by the SCD-Rural and MCCD Scheme.

	SCD Rural		MCCD (Urban areas)			
Year	India:	AP:	India		AP	
	Unclassifiable	Unclassifiable	Missing age	Unclassifiable	Missing age	Unclassifiable
1991	26.70%	22.10%	1.90%	14.50%	0.00%	12.40%
1992	26.40%	22.20%	2.20%	14.40%	0.00%	10.40%
1993	26.20%	23.90%	1.90%	15.40%	0.00%	8.30%
1994	24.30%		2.50%	13.40%	0.00%	8.00%
1995	18.60%				8.20%	8.80%
1996					4.80%	6.50%
1998		27.93%			7.60%	

[1] SCD data for the years after 1995 is yet to be published. For 1995 - 1996 (MCCD) and 1998 (SCD) data from AP has been compiled by us for this study.

Table-4 shows the incidence of unclassifiable deaths for the SCD (Rural) and MCCD data. More than 20% of deaths from the rural areas for which cause of death was reported by the SCD (Rural) scheme, was coded to unclassifiable category. In AP during 1988-93, 38% of these deaths were coded as “not classifiable”. Another 25% deaths were coded to “senility”. These figures are based on compilations of data obtained from the State vital statistics division. For urban areas, the incidence of unclassifiable deaths is comparatively lower at around 15%. But this is still higher than the 10% norm proposed by Lopez (1990). Information about deaths where the age was not specified is not available for the SCD (Rural) data. In case of the MCCD data from urban areas of the country, age data was missing in about 2% of cases. In Andhra Pradesh, there were no cases of missing age data for the period 1991 to 1994. Most probably the figures were either not tabulated or has not been reported.

We collected the state's data for some recent years and found that incidence of age missing cause of death reports was 4.8% in 1995 and 7.6% in 1998. We feel that the incidence of cause of death reports without age of the deceased is rather high both for urban and rural areas. Such high levels of missing age cause of death reports could not have been due to lack of primary data. Most probably it is a result of poor attention and lack of interest and awareness by the institutions and field agents filling up the cause of death reports.

Consistency reported cause of death structure with general mortality level:

Preston (1976) demonstrated, with help of cause of death data for 165 populations, that cause specific mortality tend to be a function of the all cause mortality. Simply put, high mortality populations tend to have higher proportion of deaths attributable to infectious and parasitic diseases. As the general mortality reduces, there is usually a more than proportionate reduction in deaths due to infectious and parasitic diseases. Preston estimated linear models relating the general mortality levels to mortality attributed to 12 cause groups. Recently Murray and Lopez (1996) have estimated logarithmic models using more recent data. These models estimate the cause of death structure with equations for specific age sex groups in the three categories of causes described for burden of disease estimation. Murray and Lopez (1996) have published model predicted cause specific death rates for group 1, 2 and 3 causes[5] along with values at one, two and three standard deviations from the mean predictions. The models are used by Murray and Lopez to predict cause specific mortality for populations with poor cause of death statistics. We can use the same models to assess the quality of cause of death statistics in India. We believe that the models do not necessarily predict the truth. The actual cause of death structure can be revealed only by a good cause of death reporting system. However, we can use the models to examine plausibility of cause structure suggested

[5] The three groups are: group-1 = communicable, maternal, perinatal and nutritional conditions, group-2 = non communicable diseases, and group-3 = injuries.

by currently available cause of death statistics. For this purpose, we have estimated mortality in respective cause groups for urban areas of India, using the general mortality estimates from SRS as inputs. We compare these figures with the corresponding cause group mortality data from the cause of death statistics for the corresponding year. If a data point is within one standard deviation of the mean predicted cause group mortality, we consider the data point to satisfy the cause of death model under One SD rule. If a data point differs from the mean predicted value by more than one standard deviation, then we consider it not to satisfy the model under One SD Rule. We examine all data points using One, Two and Three SD Rules. A data point satisfying the One SD rule will satisfy the Two and Three SD rule. A data point not satisfying the One SD Rule may, however, satisfy the Two SD Rule. In other words, the One SD Rule is most restrictive and three SD rule is most liberal. If the cause of death structure revealed by the cause of death statistics is largely consistent with the cause structure predicted by the model, then most data points would satisfy the One SD Rule. In other words, the percentage of data points not satisfying the Two or Three SD Rule gives us an idea about the unreliability of the cause of death statistics.

Table-5: Age, sex cause specific mortality proportions data points not satisfying model based expectations based on general mortality

	One SD Rule		Two SD Rule		Three SD Rule	
Year	#	%	#	%	#	%
1991	21	50	18	43	16	38
1992	25	60	18	43	15	36
1993	34	81	23	55	14	33
1994	27	64	22	52	12	29
1995	29	69%	21	50%	14	33%
1996	23	55%	18	43%	16	38%

Table-5 shows the result of comparisons of model predicted cause group specific mortality for different age sex groups with corresponding data points from MCCD for the years 1991 to 1996. About 30 to 40% of data points do not satisfy the Three SD rule.

Incorrect assignment of causes with clear age sex dependency:

Certain causes of death have very clear cut age sex dependency. Deaths due to reproductive organ pathology are limited to the sex concerned . For example, death due to carcinoma of cervix is impossible for a male. Certain other factors are improbable cause of death for some age sex groups. Such as, death due to ischaemic heart disease in children below five years. Such impossibilities and improbabilities are usually rectified through systematic screening of cause of death reports by medical care supervisors at the health care provider level and vital statistics authorities at regional and national levels. Reporting of deaths with clear age sex dependency under other age sex groups are evidence of poor scrutiny at various levels. Table-6 shows instances of such deaths between 1991 - 1994. Number of deaths with impossible or improbable cause and age, sex combination is small compared to the total reported deaths (mentioned in the footnote to the table). However, their very existence suggest lack of systematic screening, which may contribute to poor quality of cause of death data.

Table-6: Instances of deaths with clear age sex dependency reported under other age sex groups.

Selected Cause with clear age sex dependency.	SCD-Rural				MCCD (Urban)			
	1991	1992	1993	1994	1991	1992	1993	1994
Maternal deaths in females not in reproductive age group (... to .. years)	0	0	0	0	1	10	23	4
Suicides in children aged less than five years.	1	2	3	3	8	4	5	3
Deaths at ages > 5 years attributed to low birth weight	0	0	0	0	33	2	118	0
Death at ages > 5 years attributed to birth trauma / birth asphyxia	0	0	0	0	0	2	86	1
Heart attach (SCD-Rural) / Ischaemic heart disease (MCCD) in children less than five years.	1	14	7	7	130	126	173	140
Pulmonary tuberculosis in infants	1	8	12	4	202	141	226	191

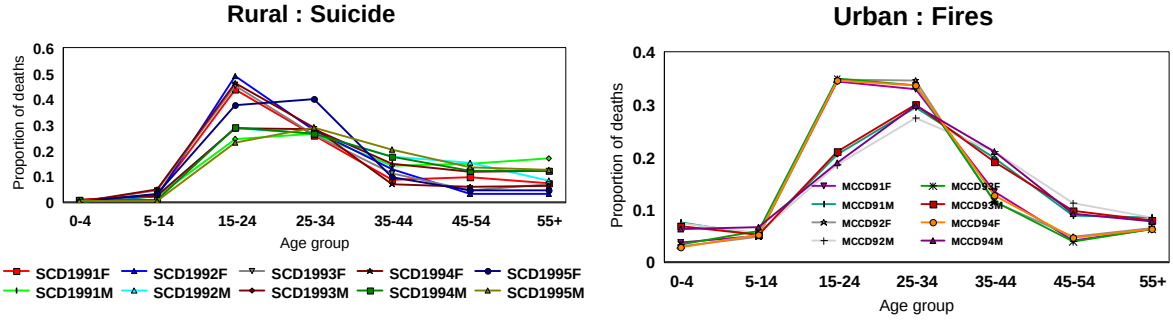
[1] Total deaths reported under SCD-Rural: 1991=22629, 1992=26118, 1993=29597, and 1994=36799.
[2] Total deaths under MCCD: 1991=384325, 1992=374839, 1993=362581, and 1994=374141.

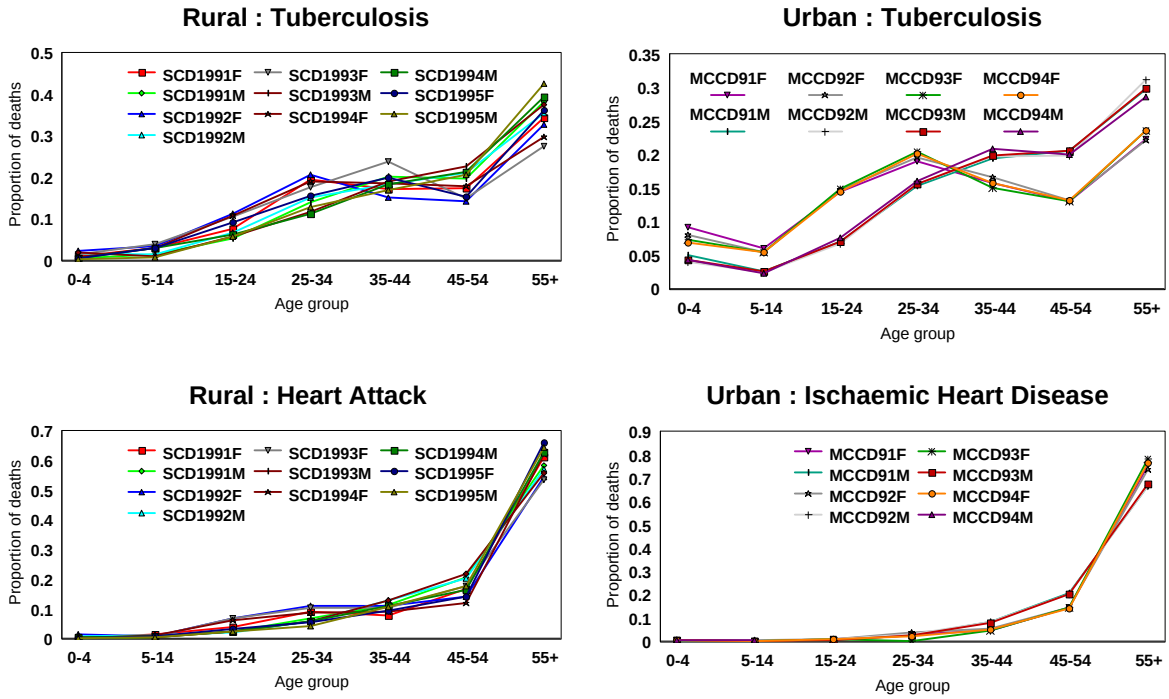
Incidence of improbable age sex distribution by cause:

Based on our knowledge of pathophysiology and disease epidemiology a certain age pattern of deaths due to a cause can be expected. For example, we know that deaths due to cancer generally increases with age. We use this fact to assess the quality of cause of death statistics. If age pattern of deaths attributed to a cause by the cause of death reporting system, is found to clearly deviate from the expected age pattern, we suspect the validity of the cause of death statistic. We are looking for major deviations in age pattern. The best way to do that is to look at graphs showing age pattern of deaths attributed to a cause. We plotted such graphs for the top ten causes, using data for five consecutive years (1991 to 1995). For the SCD-Rural these causes are: suicide, excessive heat, gastroenteritis, tuberculosis, bronchitis, pneumonia, paralysis, congestive heart disease, heart attach, and jaundice. In case of the MCCD these causes are: ischaemic heart disease, tuberculosis, lower respiratory tract infection, low birth weight, cerebrovascular disease, diarrhoeal disease, road traffic accidents,

chronic obstructive pulmonary disease, fires, and birth asphyxia / birth trauma. Twenty such graphs were plotted (10 for SCD-Rural and 10 for MCCD). Each graph had 10 plots at the rate of two plots (female and male) for each year. The plots were visually examined, looking for unusual age patterns if any. We did not find any instance of unusual age pattern. Figure 2 shows a sample of six such graphs. Assignment of deaths to neoplasm are known to be affected by deficiency in cause of death reporting systems. Hence we examined the age pattern of such deaths as reported by SCD-Rural in 1995 and MCCD in 1995, 1996. We expect that mortality due to cancers increases as age advances. The plot of data from SCD-Rural 1995 also showed the expected trend. But the plots of data from MCCD showed a decline in cause specific death rate after 55 years. This is most probably due to under diagnosis of cancers at older ages. On the whole, we find that by and large age sex pattern of deaths attributed to major causes, by the Indian cause of death reporting systems are on expected lines. However, existence of deviations in age pattern for a few causes not be ruled out. Overall we rate performance of the system as satisfactory.

Figure-2: Age distribution of deaths attributed to selected causes by SCD-Rural and MCCD.





Consistency of cause specific mortality in consecutive years:

Table-7 shows percentage of deaths in all age groups attributed to major cause groups by the SCD Rural and MCCD systems in rural and urban areas respectively in different years. We have examined data for the period 1990-95, for rural areas and 1990-1994 for urban areas. Miscellaneous cause groups like senility are not taken into account since it has been examined earlier under a separate criteria. The last column shows variance of the cause specific mortality percentages in different years. Evidently, the cause specific mortality percentages at major cause group level do not vary much over consecutive years. To see if this characteristic is retained at the detailed cause level, we examined data for top ten[6] detailed causes of death for the same period. Variance of the cause specific mortality

[6] Top ten causes examined for SCD-Rural: Heart attack, Paralysis, Tuberculosis, Bronchitis, Suicide, Pneumonia, Gastroenteritis, Congestive heart disease, Excessive heat, and Jaundice. For MCCD: Ischemic heart disease, Tuberculosis, Lower respiratory tract infection, Low birth weight, Cerebrovascular diseases, Diarrhoeal diseases, Road traffic accidents, Chronic obstructive pulmonary disease, Fires, and Birth asphyxia / Birth trauma.

percentages was low and in the similar range as at the cause group level. Consistency of cause group specific mortality proportions for consecutive years gives some confidence about usability of the statistics.

Table-7: Percentage deaths in all ages attributed to major cause groups by SCD - Rural and MCCD schemes in different years.

	1990	1991	1992	1993	1994	1995	Variance
SCD-Rural							
Accidents	8.87	8.54	8.63	8.36	8.79	10.29	0.406
Maternal	1.04	1.11	1.03	1.30	1.05	0.93	0.012
Fevers	7.57	7.29	7.62	6.66	7.25	7.34	0.098
Digestive	6.48	6.39	6.16	6.79	6.23	6.23	0.046
Coughs	19.43	18.88	19.50	19.21	19.30	20.75	0.344
CNS	4.43	4.40	4.52	4.21	5.04	4.75	0.072
CVS	11.52	11.05	10.75	10.64	11.18	12.49	0.380
Infant dths	10.14	10.26	10.62	11.08	9.66	9.84	0.226
MCCD - Urban Areas							
Infectious diseases	16.300	17.000	16.700	17.300	16.700		0.112
Cancers	3.400	3.700	3.600	3.600	3.600		0.010
Central Nervous System	3.300	3.500	3.700	3.700	3.400		0.026
Cardio Vascular System	20.400	21.100	21.300	21.600	21.900		0.258
Respiratory diseases	7.700	8.100	7.800	7.700	7.400		0.050
GIT	4.000	4.300	4.600	4.600	4.500		0.052
Perinatal	8.900	8.700	9.100	9.200	8.500		0.066
Endocrine	2.600	2.700	2.800	3.300	3.300		0.090
Injurys	14.100	11.200	11.000	11.200	11.700		1.330
Blood disorders	2.000	2.000	2.100	2.000	2.200		0.006

Timely availability of data to a great extent determines its usefulness. Timeliness has two dimensions, namely (a) time taken for publication of results, and (b) regularity in publication. Table - 8 shows the time taken for collation and publication of cause of death reports in India. The SCD-Rural reports usually took about one to two years for publication. The MCCD reports are taking about four to seven years. In the pre computerisation era a gap of about a year can be justified. But the delay has gone upto seven years in some cases. Even in case, of SCD-Rural, for which the tabulations workload is lower, there has been delay upto two years. Note also that four MCCD reports were published in single year. This means that publication of the reports are episodic. Irregularity in publication of reports means that some

potential users may decide not to use cause of death statistics, if regularity of their output is to be maintained. For example certain health care program evaluations could benefit from regularly available cause of death statistics. Instead, most programs use input measures and assume the program would have had the intended effect of mortality or morbidity reduction. Some programmes may generate their own statistics and use them for their evaluation purposes, giving rise to scope for bias in favour of programme effectiveness. Thus both MCCD and SCD-Rural statistics suffer from long delays and episodic publication of results.

Table-8: Time taken for collation and publication of cause of death reports in India.

Data year	SCD-Rural		MCCD	
	Publication Date	Delay in years	Publication Date	Delay in years
1989	1990 Dec	1		
1990	1992 Jan	1	1998 Mar	7
1991	1992 Dec	1	1998 Mar	5.25
1992	1,994	2	1998 Jul	5.6
1993	1,995	2	1998 Nov	4.9
1994	1996 May	1.5	1999 Feb	4.1
1995	1,997	2		

Can we improve the cause of death reporting system in India?

We have examined the cause of death reporting system in India, using the nine criteria to assess usability of the cause of death statistics generated by it. In table 12 we summarize the findings and give our own rating of the contemporary Indian cause of death reporting system. We follow a three category ratings namely satisfactory, tolerable and poor.

Table-9: Overall assessment of performance of cause of death reporting system in India

Criteria	Brief Review of Performance	Rating
Design of Reporting System	SCD-Rural based on verbal autopsy. Recently replaced by summary verbal autopsy questions added to the SRS. MCCD based on WHO-ICD basic tabulation lists.	Satisfactory
Coverage / Compliance	In rural areas, coverage is about 60-75% of designed sample. In urban areas, cause of death reports are filed only for 20-25% deaths. Under counting is uniform across age groups, except for children in 0-4 years.	Poor
Incidence of unclassifiable deaths	SCD-Rural: 20% or more. MCCD: 15%	Poor
Consistency of cause specific mortality proportion with general mortality level	In about 30 to 40% of age, sex, and cause group, mortality reported by Indian cause of death systems deviated by more than 3 standard deviations from the general mortality based model predictions for the corresponding groups.	Tolerable
Incorrect assignment of causes with clear age sex dependency	A few such cases are reported both by SCD-Rural and MCCD. Suggests no systematic screening of cause of death reports at any level.	Tolerable
Incidence of improbable age sex distribution by cause	No such evidence for top ten causes of death. However, deviations for other causes can not be ruled out.	Satisfactory
Consistency of cause specific mortality proportion over time	Examined for major cause groups and top ten detailed causes as well. Cause specific mortality proportions are consistent over consecutive years.	Satisfactory
Timeliness of reports.	One to seven year gap between the year to which data relates and the year of publication.	Poor

We find that major factors affecting usability of the cause of death statistics in India are (a) poor coverage, (b) high incidence of unclassifiable deaths, (c) long delay and irregular publication of statistics, and (d) lack of systematic screening. We give below our subjective assessment of factors contributing to various aspects of poor performance, and then discuss possible measures that we think will improve the usability of cause of death statistics in India.

Poor coverage is has two aspects to it, namely (a) total non reporting from certain areas, and (b) under reporting from other areas. These areas are sample villages in case of

SCD-Rural and non reporting municipalities in case of the MCCD. Total non compliance is most probably due to lack of awareness. We attended some SCD-Rural training programmes in Andhra Pradesh during the year 1998 and found that some PHC medical officers were totally unaware of the cause of death reporting system supposed to operate in their PHCs. In case of MCCD, we generated a list of non reporting municipalities in Andhra Pradesh and then wrote to the municipal authorities concerned. We found that in some of these municipalities, some cause of death reports had been received. But the personnel concerned were not aware as to, where to send these reports. We observed a spurt in receipt of cause of death reports by the State vital statistics division, after our communication to municipal authorities concerned.

Other contributors to poor coverage are non reporting health care providers. The Institute of Health Systems at Hyderabad maintains a computerised database of health care institutions in Andhra Pradesh (APHIDB). We compared the list of health care institutions from which cause of death reports had been received with the list of all health care institutions in the APHIDB. We found many hospitals with sufficiently large bed capacity not sending a single cause of death report in a year. Finally, hospitals with a tradition of sending cause of death reports may not do so for all deaths. Some hospitals care to send cause of death reports only for cases with some medico legal implication. We have come across cases, where cause of death reports are written by clinical departments, but the reports are not transmitted to the concerned municipal health authorities. In a nutshell there is total apathy at every level, contributing to poor coverage by the cause of death reporting systems. A lot of this apathy and managerial inattention is perhaps due to the fact that the data is being analysed at the national level. There is no mechanism or effort to analyse cause of death data at the State level and use the results for State level health policy analysis. As a result, field agents and medical practitioners do not have any means of direct feedback about the nature of

utilisation of data collected by them. This contributes to the gradual deterioration in accuracy of cause of death statistics. It will be desirable for each State to build capacity for local analysis of causes of death and to put a system of feed back between cause of death pattern analysts and field functionaries in charge of primary data collection. It is high time that State directorates of public health and ministries of health and municipal administration, review the state of cause of death reporting system and revamp the same to facilitate more informed health policy formulation. Sponsored research to analyse cause of death statistics and the implications for health policy, will, we hope, generate some enthusiasm for usable statistics. In addition, state departments of health and municipal administration need to pay some managerial attention and periodically review the performance of cause of death reporting systems. We feel that if a drive is launched by the health and municipal administration departments, consecutively for a period of say five years, coverage of the MCCD scheme would go up substantially. We conjecture that once coverage goes up substantially to about 80% of estimated deaths, it will most likely sustain itself without the need for much managerial and supervisory resources. The need of the aware is to launch a drive to make every one aware of the need to write and file cause of death reports. The RBD Act provides for a fine of upto Rs50 for non filling or wrong filling of cause of death reports. On the other hand, our experience in Andhra Pradesh is that this provision has not been used at all. The amount of fine prescribed by the RBD Act is not much. Its more of a token fine than a real financial burden on health care providers. We feel that this fact can be conveniently exploited to improve awareness about cause of death report writing among health care providers. The fine can act as a token but effective reminder to defaulting health care providers, to comply with the legal requirement of filling in and sending of a cause of death report.

High incidence of unclassifiable deaths is due to poor cause of death report writing skills. Chiefs of clinical units do not appropriately emphasise the importance of writing up the

cause of death report. Short term training programmes[7] to build cause of death report writing skills will help improve physician skills. In addition to poor physician skills in cause of death report writing, non maintenance of medical records or poor maintenance of medical records contributes to inaccurate assignment of cause of death. Faced with a situation of inadequate information from medical records, the physician writing the cause of death report would tend to assign the death to unclassifiable category or to some miscellaneous codes. Hence the RBD Act needs further amendments requiring health care providers to maintain appropriate medical records to facilitate accurate classification of cause of death.

Delay in compilation and publication of cause of death statistics can be reduced by computerising the operations. At present a lot of the tabulation work is taking place manually. Some amount of computerisation has been done in the office of the RGI. It is understood, that the RGI has started the practice of subcontracting data entry to private computer service providers. We believe feeling is that computerisation needs to be done at the state level, so that state level statistics could be published locally enabling its usage to inform state health policies. The tabulation and publication of State level statistics should be decentralised to state vital statistics offices. If the operations are computerised and complementary services are locally purchased, this decentralisation can be achieved without any significant addition to current staff. Computerisation of cause of death report filling and collation is essential. The IHS has developed a software called the PRISM (Processing and Research Information System for Mortality data). The software is designed to work in municipal offices as well as state vital statistics offices. This software allows for transmission of cause of death reports

[7] The IHS has developed a training package consisting of one day workshop on cause of death writing. The workshops gives an overview of cause of death reporting and classification systems and then requires participants to write cause of death reports from sample medical records obtained from hospitals. Participants then work with a sample of poorly written cause of death reports to identify the deficiencies.

and statistics from municipal offices to State headquarters and processing of data to generate cause of death statistics according to the formats being used by the RGI.

The current sate of affairs about reporting of causes of death in rural area is a cause for concern. We have analysed the features and performance of the SCD-Rural scheme above. Unfortunately the scheme has been discontinued. Instead, certain cause of death questions has been added to the SRS data collection formats. It is too early to comment on the performance of the new system. But one thing is clear about the design of the system. Although the new guidelines prescribe use of the verbal autopsy guidelines developed for the SCD-Rural system, the cause of death data columns in the SRS forms do not allow for recording of symptoms and signs leading to death. These information in the cause of death reports allow for meaningful systematic screening, review and coding of cause of death.

Summary and conclusion:

Valid and reliable statistics on cause of death is an essential input for setting of priorities in the health sector. Major initiatives to systematically identify health sector priorities have used cause of death information. An ideal cause of death reporting system consists of: (a) a fully developed vital registration system with, (b) cent percent medical attendance at the time of death, and (c) full compliance by the health care providers in writing up and transmission of cause of death reports. Developing countries like India are making efforts to operate the 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. We examine the cause of death reporting systems in India and usability of the statistics. For rural areas, cause of death statistics used to be collected through the SCD-Rural scheme which operated till December 1998. There after, rural cause of death statistics is

sought be generated by adding a few columns to capture of cause of death information for deaths reported under the Sample Registration Scheme (SRS). For urban areas, there is the medical certification of cause of death scheme extended by state governments, mostly, to municipalities and urban areas. To assess usability of cause of death statistics we examine the SCD-Rural and MCCD data for a period of about five years in the first half of 1990s using nine usability criteria. These usability criteria are: (a) content validity of lay reporting systems, (b) adequate coverage and compliance, (c) validity of statistics at sub-national levels of disaggregation, (d) minimal usage of residual categories, such as unclassifiable, or ill defined conditions, (e) consistency of cause specific mortality proportion with general mortality level, (f) absence of incorrect assignment of causes with clear age sex dependency, (g) no case of improbable age sex distribution by cause, (h) consistency of cause specific mortality proportion over time, and (i) timely compilation and publication of the statistics. We find that major factors affecting usability of the cause of death statistics in India are (a) poor coverage, (b) high incidence of unclassifiable deaths, (c) long delay and irregular publication of statistics, and (d) lack of systematic screening. We recommend, based on our subjective understanding of the problems, certain steps required to improve usability of cause of death statistics in India. We propose that a drive be launched by the Ministry of Health, Government of India, and all State Governments through the Ministries of Health and Municipal Administration, to improve coverage by cause of death reporting systems. Based on our experience in Andhra Pradesh, we conjecture that simply introducing periodical reviews jointly by the Departments of Health and Municipal Administration, identification of non reporting municipalities and sample units, and further identification of non reporting health care institutions sustained over a period of say five years will raise coverage substantially. Other measures recommended by us include: (a) training programs to build up cause of death reporting writing skills among physicians, (b) compilation and publication of

cause of death statistics at the State level, (c) sponsored research on cause of death structure and their policy implications, (d) computerisation of filing, tabulation and flow of cause of death statistics, at the municipality and at the State . To reduce the unusually high level of unclassifiable deaths, we recommend that an amendment be brought in the Registration of Births and Deaths Act (RBD Act.) requiring hospitals and health care institutions to maintain medical records. We are unable to make any definite recommendations specifically for the rural areas, since a change in the system has taken place recently. We have some reservations about the design of the new system. We point out that the cause of death columns added to the SRS data collection forms do not provide for recording of symptoms. 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. We recommend that research be taken up in order to evaluate the performance of the new cause of death reporting system in rural areas.

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