

Mortality Statistics from National Censuses: A Low Cost Viable Method

Kandel N,¹ Singh N,¹ Fric A¹

¹Evidence and Health Information Unit - Department of Health Systems Development, WHO- Regional Office for South-East Asia, New Delhi, India.

ABSTRACT

Information related to mortality is pivotal for evidence based policy and planning, resource mobilization and impact of intervention. This information is essential to monitor trends in health situation of the population, detect new epidemics, encourage research into avoidable causes of death, evaluate the success of control programs, and improve accountability for expenditures on disease control. Sixty percent of the countries of the world don't provide enough information on vital events and complete and representative information.

Apart from vital registration system, other methods for getting mortality data are in current practices, such as facility based information system, censuses, household survey, research demographic surveillance sites, epidemiological studies and sample vital registration system, which complement the national health information system. All methods have their limitations. Piggy backing of national censuses for mortality statistics would follow the principle of Sample Registration System (SRS) using verbal autopsy tools to generate the mortality data just after the censuses. This method can be the suitable/useful mortality measuring system representing the population by age, sex, location and causes of death with less effort and at a lower cost. This method can be used to verify mortality data collected from other sources and/or for adjustment of existing mortality data.

Key words: epidemics, epidemiological studies, sample registration system, surveillance, survey

INTRODUCTION

Three of the Millennium Development Goals and one indicator of the Human Development Index are related to mortality. Information on the determinants and distribution of causes of death in population are very essential for evidence based policy and planning, allocation of resources and impact of interventions. Thus, the registration of vital events like births, deaths by age, sex and cause are fundamental to evidence-based health policy and planning and monitoring and evaluation.¹ However, only 40% of the countries of the world and a quarter of its population routinely collect data on vital events and provide complete and representative information.² Only 64 countries which are predominantly developed countries in the European

region, the Americas and the Western Pacific have the complete death registration system.³

Why mortality data

Reliable, representative, routine, low-cost, and long-term mortality measurements are essential to monitor trends in health situation of the population, detecting new epidemics, encouraging research into avoidable causes of death, evaluating the success of control programs, and improving accountability for expenditures on disease control.⁵⁻⁷ Routinely collected data have helped to encourage further research and public health action and therefore, contributed to enormous increases in life expectancy in the 20th century.⁸

Correspondence: Dr. Nirmal Kandel, Evidence and Health Information Unit - Department of Health Systems Development, WHO- Regional Office for South-East Asia, New Delhi, India. Email: drnirmal@kandel.com.np, Phone: 985111219.

Public health in industrialized countries was transformed when vital statistics on age, sex, and socioeconomic distribution of births and deaths became available in the late 19th and 20th centuries. Vital statistics have demonstrated major trend in fertility, child survival, and mortality. They have brought good news, such as the large decline in under 5 mortality and tuberculosis mortality during the 20th century. They have also raised alarm in the mid- 1940s, a dramatic increase in lung case death after second World War II led to more research on smoking.^{7,9}

Vital statistics is an essential tool for monitor trends of disease. India and other countries have seen consistent decrease in child mortality (under- 5mortality has fallen about 2% per year since 1971 in India).¹⁰ Reliable information on trends in the diseases and deaths of adults and their causes are still limited.

Situation in SEAR Region

SEAR countries (Bangladesh, Bhutan, DPR Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand and Timor-Leste) have different status of mortality registration. If we look at the coverage of mortality registration, then only one country, Sri Lanka has more than 90% coverage, two countries Maldives and Myanmar have 70-90% coverage and India and Thailand have 50-70% coverage and 4 countries like Bangladesh, Bhutan, Indonesia and Nepal has less than 50% coverage and data is not available from DPRK, where as the Timor-Leste has no system of vital registration in place.⁹

However, the “Gold Standard” for the generation of mortality data and vital events is Civil registration system. There is the system of civil registration in all SEAR countries except Timor-Leste. Despite the Civil registrations systems are in place, the generation of mortality data coverage is limited. For example, only one third of deaths in India are registered.⁶

For the evidence base planning, the generation of cause specific disaggregated data on mortality is required. SEAR countries are using different methods in order to fill the gaps of civil registration. For example, India and Bangladesh are generating the mortality data through Sample Registration System, and other countries are generating through annual households and other types of surveys and others through some kind of micro census and sample surveys like Maldives and Myanmar.⁹

This paper attempts to elaborate the possible cost effective and sustainable solution of generating disaggregated information of mortality by age, sex and causes of deaths. The paper also highlights the various practices or methods applied to generate the mortality data.

METHODS

Various sources have been used to collect information on methods of mortality registration and procedures currently practiced, including online resources. We also used the situation analysis of mortality statistics reports prepared by the member countries of WHO-Regional Office for South-East Asia (SEARO) for the Regional Consultation of Mortality Statistics held during April 24-27th 2007, New Delhi, India. Online searches included WHO headquarters’ library database (WHOLIS), and ELIN (Electronic Library Information Navigator, Lund University, Sweden). Medical Subject Headings (MeSH) searches for different literatures on techniques and methods of mortality statistics and census from 1990 were carried out. Literatures both published and unpublished have been reviewed.

DISCUSSION

Sources of mortality data

The ideal mortality measurement system has several characteristics, which is labeled as “RLM”, namely being representative, routine, regular, reproducible, reliable, long-term and low-cost mortality measurement.¹⁰ The ideal system should represent of the age, gender and geographic disaggregation of the population, and also captures data on the underprivileged population, who tend to be excluded from surveys. The ideal system captures not only the act of death, but also reliable causes of death based on the International Classification System of Diseases (ICD-10).¹⁰ Typically, causes of death are based on physician death certificates. In most of the high income countries, registration of deaths with causes assigned by physicians on death certificate is nearly universal. About 46 million out of the estimated 60 million deaths worldwide occur in developing countries, where as death registration and medical attention at the time of death is low.¹¹

Apart from vital registration, vital events are measured through: facility-based information systems, censuses, household surveys, research demographic surveillance sites (DSS), epidemiological studies and sample vital registration system. All of these are necessary and complementary elements of comprehensive national health information systems.

Routine facility-based information systems are essential for managing the public health system, and generally have wide coverage. However, they have a limited value for population-level estimates of disease burden, primarily because the statistics they generate are biased towards those who actually use public health facilities

who tend to be better-off urban residents. Passive facility-based systems miss deaths that occur at home. In low-income, and even some middle-income countries, these may constitute the caste majority of all deaths in the population, and ascertainment is likely to be much worse in poorer communities.¹²

Censuses, which cover entire populations, are an important source of data for the measurement of mortality. Specific modules can estimate child, adult and age-specific mortality. In a few countries, a question on specific cause of death (maternal mortality) has been incorporated to a national census.¹ Unfortunately, census data have historically been of inadequate quality and collected with insufficient frequency to permit the analysis of child mortality, and the application of modules to measure adult mortality has not been a priority.¹

Household surveys have been the sole sources of data for measuring infant and child mortality in Asia and Latin America, and most of African countries.¹³ Well organized nationally representative surveys produce high-quality data and are increasingly being designed to provide key indicators from the sub national level according to geography, ethnicity and poverty status. Although the contribution of and necessity for surveys is clear, they do have certain limitations with respect to mortality measurement. Because sample size for surveys has not necessarily been chosen specifically to detect mortality, they have generally been too small to allow disaggregation of data on infant and maternal mortality at the national level; therefore monitoring of trends becomes questionable.¹⁴

DSS and epidemiological studies generate both mortality data and methodological innovations for measuring them.^{1,15} Yet certain characteristics make problematic to rely indefinitely upon DSS data from national mortality statistics. DSS sites generally consist of one or two large surveillance areas comprising of several contiguous communities or neighborhoods, and hence are not nationally representative and also frequently established in areas where diseases of public health importance occur.¹⁶

Sample vital registration system (SRS) is a viable solution to generate the mortality data in the absence of completeness of data through civil registration.⁸ SRS is a community based system in which a nationally representative cluster sample is used. SRS generates the information on births, deaths and migrations.² For

mortality statistics SRS uses the verbal autopsy (VA) methods to determine probable causes of death (A VA is a questionnaire administered to the caregivers or family members of deceased persons to elicit signs and symptoms and their durations, and other pertinent information about the decedent in the period before death). Nevertheless, the demand for and use of VA data by variety of sources is rapidly gaining importance in the quest for evidence needed to set global health priorities.⁶⁻⁹ SVR is already the best source of representative mortality statistics in India, and partial coverage has been obtained through a “sentinel” vital registration system in the United Republic of Tanzania.^{1,6} National statistics offices and Ministries of Health in four African and two Asian countries are evaluating the costs and benefits of SRS and have begun to plan for and establish systems.

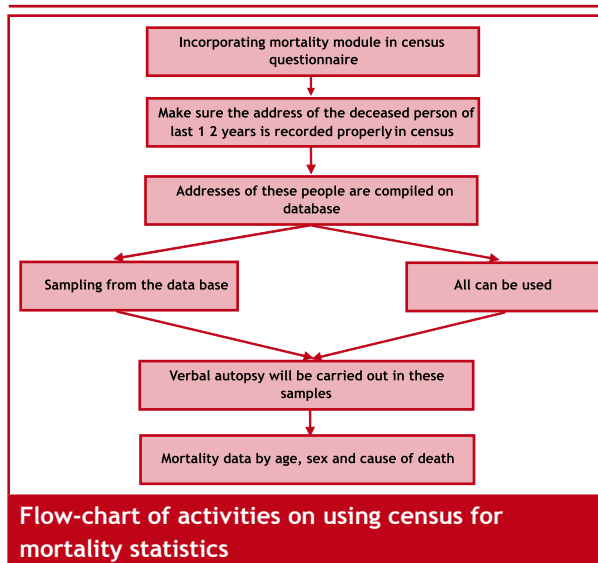
Piggybacking national censuses for mortality statistics

The gold standard of generation of mortality data is vital registration system. Almost all countries of WHO - South East Asia Region have vital registration system in place, but not functioning at the optimal level. However various methods are used to generate data on mortality, needed for the evidence base policy and prioritizing the programs. For example, Bangladesh and India are using SRS, while others use periodic surveys, DHS and others to generate information on mortality statistics. Some countries use the data generated from Demographic Health Survey. All these methods have pros and cons and different levels of cost effectiveness.

Using national censuses for collecting mortality data combines the principles of census and sample registration system with lower cost. It is representative of the population by age, sex, location and captures the underprivileged population. Most of the countries regularly carry out the census in every 10 years.

Post Census verbal autopsy

This method would require additional information in the mortality module of the census (recording the address of the deceased person). Some countries have already included this information in the census questionnaires, e.g. Nepal¹⁷, other countries (Thailand and Indonesia) have also used census for collection of data on child or maternal mortality.^{18,19} After the census verbal autopsy would be carried out in the households of the deceased persons to collect information on age, sex and causes of death of the deceased.



Steps

- Sorting census questionnaires for households having a question of ‘yes’ for death(s) in past 12 months.
- Linking the identification code of these households to household address list, if the questionnaire did not have household address recorded in it.
- Households can be used this to carry out verbal autopsy in two ways by using standard VA tools:
 - o We can use all the households; or
 - o Sampling those households and then verbal autopsy. (Sampling can be simple random or clustered sample)
- Cause of death will determine by trained physician assigned according to ICD-10.

Advantage of this method

1. Just after the census, the recent data on mortality by causes can be generated quickly.
2. No planning and design of separate survey required.
3. Only VA survey is carried out in identified households, thus reducing the financial cost and effort is less.
4. No separate sampling frame is required as the sample is readily available.
5. Same sample can be used to risk factor analysis of the population.

6. Right after the census the policy maker can use this information to prioritize the programmes.
7. Will cover the entire population of the country.
8. Will give the mortality data of acceptable quality.
9. Can be a tool of minimizing biases in mortality data collected by other methods.
10. Can be used for adjustment of existing mortality data.

Limitation

1. Doesn't give the longitudinal mortality trends. This will be the snapshot of the 1 year prior to the census as the recall period for verbal autopsy is about a year and can be up to 21 months,²⁰
2. This will be the purposive sample as sample of households with death data will be used.
3. This method would generate the information in every 10 years only.

Cost Effective Analysis (an Example)

Sample Registration System costs approximately \$1 dollar per respondent and it samples between 0.5- 2% of the total population.¹¹ For example, India has the population of approximately 1 billion and the cost of SRS is approximately US \$ 10,000,000, if the sample size is 1% of the total population and records 76,000 deaths per year. (For the calculation, see the text box below).

If we use the Post Census verbal autopsy, the cost would be about US \$ 7,600,000, covering all the national deaths recorded during census {Approximately 7,600,000 deaths}.²¹ If we sample only 50% of all deaths then it will cost only US \$ 3,800,000 and with the 1/3rd of the sample, the cost will be US \$ 2,533,333. If we take only 1% of the total death then it will cost only US \$ 76,000. The results of the post census verbal autopsy will be too small to generalize at the national level, if we take only 1%-2% of the total death.

Let's calculate the sample size and its cost with 95% confidence level and ± 5% of precision level the required sample will be 2,551,755 and the cost will be approximately US \$ 2,551,755. The cost will be US \$ 3,548,487 for the sample size of 3,548,487 (99% confidence level and ± 5% of precision level) of total death.

- Number of samples = 10,000,000 (1% of total population or 1 billion people)
- Total cost = US \$ 10,000,000 {10,000,000 × US \$1 (1\$ per participant)}
- Number of deaths in one year covered by sample registration = 76000 (10,000,000 × crude death rate)
- To cover 1 million deaths, the SRS has to be carried out for 14 years.

Box 1. Cost of Sample Registration System

Total death in 1 billion populations with the crude death rate 7.6/1000 population

= 7600000

- Total cost of total death = US \$ 7,600,000 (7,600,000 × US \$ 1 per participant)
- Total cost of half of total death = US \$ 3,800,000 (3,800,000 × US \$ 1 per participant)
- Total cost of sample size with 95% confidence level and ± 5% precision level of total death = US \$ 2,551,755 (2,551,755 × US \$ 1 per participant)
- Total cost of sample size with 99% confidence level and ± 5% precision level of total death = US \$ 3,548,487 (3,548,487 × US \$ 1 per participant)

Box 2. Cost of Post Census Verbal Autopsy

CONCLUSION

Despite having a system of vital registration, many countries are not generating enough quality information on mortality by age, sex and causes of death. In order to fill this gap countries use various methods for collection of mortality data, i.e. Demographic Surveillance System, Sample Registration System and household surveys. The costs of these methods seem to be high for the developing countries, where the resources are limited and the countries depend on donors support. The post census verbal autopsy would be a quick and low cost method, which would generate important information for the policy makers to verify mortality data collected from other sources, and to prioritize the policies and programs. It is a representative sample of the entire population.

ACKNOWLEDGEMENTS

Special thanks go to Dr. Sultana Khanum, Department of Health Systems Development, WHO/SEARO for her

valuable support and inputs. The idea of bringing out this paper was conceived after the discussion and deliberation of recently concluded Regional Consultation on Mortality Statistics held in WHO/SEARO in April 2007. Thus we thank all the participants and representatives of member states of South-East Asia Region. We would also like to extend our sincere gratitude to resource persons of consultation; Dr. Alan Lopez, Dr. Prabhat Jha, Dr. PC Gupta, Dr. Rajesh Kumar, Dr. Chalapati Rao, Dr. Soe Myint, Dr. V. Gajalakshmi, Mrs. Carla Abou-Zahr, Mr. RC Sethi, Dr. Suharsono Soemantri and Dr. Soewarta Kosen.

REFERENCES

1. Setel PW, Sankoh O, Rao C, Velkoff VA, Mathers C, Gonghuan Y et al. Sample registration of vital events with verbal autopsy: a renewed commitment to measuring and monitoring vital statistics. *Bull World Health Organ.* 2005 Aug;83(8):611-7.
2. Lopez AD, Ahmad OB, Gulliot M, Ferhudson BD, Slamon IA, Murray CJL, et al. World mortality in 2000: life tables for 191 countries. Geneva: World Health Organization; 2002
3. Overview of mortality statistics in the South-East Asia region and ways to improve. Background papers of Regional Consultation on Mortality Statistics. EHI/HSD SEARO; 2007.
4. Mitra B. India's mortality measurement systems. In: Asma S Jha P, Gupta PC, editors. Counting the dead in India in the 21st century. Atlanta (Georgia): US Centers for Disease Control; 1999. p. B2-8.
5. Jha P. Reliable mortality data: a powerful tool for public health. *Natl Med J India.* 2001 May-Jun;14(3):129-31.
6. Global IDEA Scientific Advisory Committee. Health and economic benefits of an accelerated program of research to combat global infectious diseases. *CMAJ.* 2004 Nov 9;171(10):1203-8.
7. Gottlieb MS, Schroff R, Schanker HM, Weisman JD, Fan PT, et al. Pneumocystitis carinii pneumonia and mucosal candidiasis in previously healthy homosexual men: Evidence of new acquired cellular immunodeficiency. *N Eng J Med* 1981 305: 1425-1431.
8. Jha P. Avoidable mortality in India: past progress and future prospects. *Natl Med J India.* 2002;15 Suppl 1:32-6.
9. Country reports on situation analysis of mortality statistics of SEAR countries, *Working papers and country presentation.* Regional Consultation on Mortality Statistics, April 24-27th, 2007. SEARO; 2007.
10. How can we improve mortality data by cause for populations with low levels of medical attention at the time of death? Working Draft for the Regional Consultation on Mortality Statistics, April 24-27th, 2007. SEARO, WHO; 2007.
11. Jha P, Gajalakshmi V, Gupta PC, Kumar R, Mony P, Dhingra N et al. Prospective study of one million deaths in India: rationale, design, and validation results. *PLoS Med.* 2006 Feb;3(2):e18.

12. Murray CJ, Lopez AD, Wibulpolprasert S. Monitoring global health: time for new solutions. *BMJ*. 2004 Nov 6;329(7474):1096-100.
13. Moser K, Shkolnikov V, Leon DA. World mortality 1950-2000: divergence replaces convergence from the late 1980s. *Bull World Health Organ*. 2005 Mar;83(3):202-9.
14. Korenromp EL, Arnold F, Williams BG, Nahlen BL, Snow RW. Monitoring trends in under-5 mortality rates through national birth history surveys. *Int J Epidemiol*. 2004 Dec;33(6):1293-301.
15. Black RE, Morris SS, Bryce J. Where and why are 10 million children dying every year? *Lancet*. 2003 Jun 28;361(9376):2226-34.
16. INDEPTH Network, editor. *Population and health in developing countries*. Vol 1. Population, health and survival at INDEPTH sites. Ottawa: International Development Research Center; 2002.
17. Central Bureau of Statistics, Government of Nepal .Census questionnaire of Nepal (2001), Central Bureau of Statistics, Government of Nepal. Central Bureau of Statistics, Government of Nepal; 2001.
18. Census questionnaire of Thailand (2000), The 2000 Population and Housing Census, Thailand. Thailand: 2000.
19. Census questionnaire of Indonesia (2000), Central Bureau of Statistics, Indonesia. Indonesia: 2000.
20. Gajalakshmi V, Peto R. Verbal autopsy of 80,000 adult deaths in Tamilnadu, South India. *BMC Public Health*. 2004;4:47.
21. WHO-Regional Office for South-East Asia (2007). 11 questions of 11 SEAR countries. WHO-Regional Office for South-East Asia (2007); 2007.