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Commentary: Reliable measurement of the causes of mortality in developing countries

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Public health in industrialized countries was transformed when vital statistics on age, sex and socioeconomic distribution of deaths by cause became available in the 19th and 20th centuries.[1] These statistics have shown good news, such as the large declines 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 cancer deaths in British and American men after World War II led to a great deal of research on smoking.[2] In the early 1980s, routine mortality data from San Francisco revealed an exceptional increase in immune-related deaths among young men and signalled the start of the American HIV-1 epidemic.[3] Routinely collected data have helped to spur further research and public health action and contributed to the enormous increases in life expectancy in the 20th century.[4]

About 46 million of the estimated 60 million deaths world-wide occur in developing countries, where death registration and medical attention at the time of death is low. A recent review of 115 countries that report mortality to the World Health Organization (WHO) found that only 64 had complete death registration with good quality and coverage of cause of deaths. Seventy-five countries, including 90% of those in the African region, did not provide data on causes of death for any year after 1990.[5]

In this issue, Chalapati Rao and colleagues[6] present important new research that examines the validity of causes of death in urban China from routine registration. They compare about 3000 deaths that occurred in urban health facilities with detailed hospital records. They find that the routine registration system has reasonably high sensitivity versus hospital records for some of the major causes of death in China (such as stroke, specific cancers), and only modest sensitivity for some other leading killers (such as chronic lung disease and heart attack). Importantly, they find that specificity is reasonably high.

What then are the implications of their findings for China, and for other developing countries? We think there are three. Note that the implications differ for capturing the *act* of death and for documenting *causes* of death.

First, routine death data is likely to be useful to monitor future trends in mortality by cause in urban China. The coverage of routine death registration has been stable for most of the last decade, but should expand in the future. Notwithstanding the misclassification of causes from routine

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death registration that can be expected, changes in mortality by cause should help monitor major changes in important risk factors or in treatment. Notably, China can expect a huge increase in male deaths from smoking: Richard Peto and colleagues[7] predict that 100 million current male smokers will die from smoking. The consequences of smoking in urban China can be examined in part by documenting changes in the mortality patterns in the future (adding simple questions on past smoking on death certificates would help substantially). In urban areas, routine death certification is likely to be helpful to the follow-up of the Kadoorie Prospective Study,[8] a blood-based prospective study of 500 000 adults in 10 provinces of China that will document changes in smoking, diabetes and other risk factors for chronic disease for the next few decades.

Second, the study enforces that the need for complementary measures to study causes of death in populations with low or no medical attention. Access to medical care remains far less common in rural than in urban China and is low in most poor countries. The Rao study did not examine home deaths, which are 37% of urban deaths and a much higher percentage of rural deaths in China. In poor countries of Africa and Asia, most deaths occur at home rather than in hospitals. There are only limited incentives for households in most developing countries to register deaths. Most developing countries lack the pension and insurance schemes, enforceable familial inheritance and property rights and other civil needs that might spur households to register deaths. Increasing death registration to near universal coverage with medical certification is clearly a common goal for all countries. However, this will probably take decades to achieve. Even the USA took the better part of a century to increase death certification, and some states did not have complete coverage until the 1970s.[9] Death registration is likely to be slower particularly in large countries with wide geographic dispersion, economic disruption and high levels of internal migration. Strategies to increase death registration, aside from increasing medical attention at death, include training local health care workers to ensure that all deaths are reported and recorded. Requiring burial and cremation grounds to record deaths has been effective in the urban settings, but it is not likely to be effective in rural areas.

India's civil registration system is probably illustrative of most other countries in being only marginally reliable due to marked under-registration of deaths. While some areas have very good vital registration (Mumbai provides death registration as far back as 1848),[10] overall, only 50% of the estimated 10 million annual deaths were registered in India in 2004, up from about 40% a decade earlier.[11] Among registered deaths, cause-of-death data are available for about one in three deaths, but this often merely subdivides deaths as due to accident, violence or disease, without further details. Thus, civil registration is not yet a reliable source for causes of death—at least for causes which do not change rapidly.

Experience from several countries[12] suggests that in the absence of medical attention at death, 'sample registration systems' are probably the most useful method to obtain cause-of-death information. Nearly all sample registration systems involve 'verbal autopsy' which is the household assessment of the cause of death via an investigation of the train of events and circumstances at the onset and during the course of the illness leading to death, through an interview of relatives or associates of the deceased. The methodological issues for verbal autopsy have been extensively discussed elsewhere[13,14] including the more recent evidence that verbal autopsy can capture reliably the causes of adult death in childhood and early and middle adult life.[15,16] In India, a further enhancement involves the RHIME or Routine, reliable, representative and re-sampled Household Investigation of Mortality with Medical Evaluation.[17] The RHIME method is an enhancement of methods developed initially by Chennai researchers[15] and has several components. First is the routine or 'lay' assessment of the causes of death by non-medical staff through a household interview. Second is the random re-sampling (typically 10%) of the fieldwork to ensure that it is done to standard. Third, there is a central medical evaluation of the field reports to arrive at a final cause of death, with 100% double coding by two independent physicians. The RHIME method has been successfully used among 140 000 nationally representative deaths in India.[17]

Third, the Rao study reinforces the need for periodic assessments of death registration systems. This includes assessment of the completeness of such registration (meaning if they are reaching the entire population), and examination if causes are reliably reported. Civil-based death registration generally improves over time in coverage and quality due to increases in medical attendance at death and increases in physician familiarity and training with correct procedures for completing death certificates. In Kerala state, the levels of child mortality are low enough that sample registration may be too small to measure rates and changes in cause-specific mortality. Thus, the Registrar General of India is planning a comparison of the routine registration with sample registration and household visits using RHIME to 'calibrate' the overall levels and causes of childhood deaths. Even developed countries with universal registration need external re-validation and measurement to correct for systematic misclassification which can appear,[12] and complementary sample registration systems are useful as adjuncts for documenting the quality of universal registration.

Investments to improve death registration and cause-of-death statistics are highly feasible, effective and cost-effective.[18] There have been calls to improve global health statistics[19] including the need to monitor progress on health targets such as those in the Millennium Developmental Goals and in large-scale programs funded by the Global Fund for AIDS, Tuberculosis and Malaria. It is clear there is a need to build a core set of scientifically reliable, politically independent, and widely accessible mortality data sources. Innovations in mortality measurement, if paired with renewed political will to count the dead, and technical support[20] could result in developing countries being able to generate the much needed mortality data within a few years, matching in quality and relevance to what has taken more than a century to produce in many developed countries.

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