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**Improving vital statistics and cause of death statistics: the experience of Thailand**

*Corrigendum*

The dates of the session *should read* as above.

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First session  
15-17 December 2008  
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**Improving vital statistics and cause of death statistics: The experience of Thailand<sup>1</sup>**

**Introduction**

1. Although efforts to enumerate the population in Thailand go further back, the first real census that covered all 17 provinces of the Kingdom was undertaken in 1910. This was soon followed by the first civil registration bill passed in 1916, decreeing that all births and deaths must be reported. The original purpose of civil registration in Thailand, like in many other countries, was to recruit military personnel and for taxation. Civil registration data have become the main data source to inform government about population dynamics, to carry out national and local elections, for monitoring health status and for socio-economic planning. Besides, for the individual Thai citizen, civil registration provides identity, legal status and official documentation of important events.

2. Civil registration in Thailand is the responsibility of the Ministry of Interior and is carried out through the Bureau of Registration and Administration (BORA) and the Department of Local Administration. Registration of births and deaths is compulsory and each year more than 890,000 births and around 400,000 deaths are registered. Apart from births and deaths, civil registration in Thailand collects information on marriages, divorces and change of residence. No data are currently collected on foetal deaths. Since 2004 the system has been fully computerized and data are transferred electronically from all local offices to the central office in the Ministry.

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<sup>1</sup> This document was contributed by Dr. Yawarat Porapakkham, Dr. Melanie Bertram SPICE project, Ministry of Public Health, Dr. Pramote Prasartkul, Institute for Population and Social Research, Mahidol University, Dr. Lene Mikkelsen, Health Metrics Network and Dr. Alan D. Lopez, School of Population Health, The University of Queensland. It has been reproduced without formal editing. The views expressed are those of the authors and do not necessarily reflect the views of the United Nations.

### **Main data sets derived from civil registration**

3. The law requires that the Ministry each year produces estimates of the number of Thai citizens by age and sex, by province and for the whole country. These estimates are nowadays derived from BORA's central database, which is continuously updated by the civil registration data and the population counts from decennial censuses. Once made, the estimates are considered as official figures and announced each year in March by the Ministry of Interior and used for all government purposes and serve as a basis for resource allocation and planning.

4. Another set of annual population data derived from civil registration are vital statistics on births and deaths. The information which is collected on the birth and death registration forms is sent both to BORA's central database at the Ministry of Interior for updating and to the birth and mortality databases at the Bureau of Planning and Strategy at the Ministry of Public Health. These vital statistics, after processing and compiling, are used for producing various key statistics such as births, deaths, infant deaths, neonatal deaths, maternal deaths, etc. which are included in the annual report of health statistics. The mortality and cause of death data in particular are used to monitor the health status of the Thai population and as critical input to public health planning and policy making.

5. A third key data set, also dependent on the civil registration data, is the central population register managed by BORA which contains information on all households and citizens residing in Thailand. This register was started in 1956 with the enumeration of all households in Thailand, which recorded households' by house number, road, tumbon (cluster of villages), district and province. An extract of the household register is given to citizens for use when dealing with authorities in all official matters. This register is now totally computerized so that data processing, updating and statistical analysis can be undertaken rapidly and it can be kept updated on an ongoing basis. Individuals can be identified in the register through a 13-digit unique number which is used for all Thai citizens. The data owner's rights to confidentiality are protected by law. The data base is used for many administrative purposes which benefit society as a whole (Sripanaratanakul, 2005).

### **Registration of vital events**

6. Notification of birth has to be done by the family within 15 days, while for death it has to be done within 24 hours after death or after the dead body is found. The death notification form is needed in Thailand for funeral purposes and for formally registering the dead person at the civil registration office in the locality where the death occurred. After the official recording of births and deaths, a copy of the birth/death certificate is issued to the person who notifies, while another copy is retained in the system. Data on births are added onto the household unit of the mother in the population register, while deaths result in the name and citizen's number being removed from the register. A similar method applies to migrants. This is all done electronically and the e register is updated in real time.

7. The death registration process varies slightly depending on whether death occurs in a hospital, is a natural death that takes place at home, or is an unnatural death,<sup>2</sup> but generally, involves the following steps:

- notification of the death to a person authorized to certify the death, i.e. a physician or health officer, a village headman, a local administrative officer or a policeman;
- issuance of a death notification form for funeral and formal registration of the deceased.
- the official “death certificate” which is delivered after the death is registered at the local/district/municipal office is used for insurance, inheritance and other legal purposes.

Once these steps have been undertaken the death registration process is complete and the name of the deceased person is deleted from the central population register.

8. All death certificates must indicate the cause of death. Since 1994, Thailand has implemented the Tenth Revision of the International Classification of Diseases (ICD), and the standard International Form of Medical Certificate of Cause of Death is used in hospitals for reporting cause of death.

9. In Thailand some 40% of deaths take place in hospitals. For these a physician completes the Death Notification Certificate indicating the underlying cause that led to death. The deceased’s relative is then supposed to register the death using this death notification form, however, sometimes relatives may not understand that the Death Notification Certificate is not the same as the official death registration and this may lead to some deaths not being registered with the civil registration office.

10. For home deaths, the relative who reports the death to the registration office is asked what the cause of death was. For approximately one-quarter of the home deaths, an attending physician has been involved and has specified the cause of death. For the remainder, the cause of death is often given as “ill-defined”. In the case of an unnatural death, death notification is the responsibility of the police and a clinical review by the medico-legal authorities, sometimes based on an autopsy, determines the cause of death.

### **Completeness of birth and death registration**

11. Like most countries, Thailand has had problems with the completeness of its vital statistics, which can lead to inflated life expectancies and underestimation of infant mortality rates. The degree of incompleteness of vital registration has periodically been assessed by the Thai National Statistical Office via intercensal surveys.

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<sup>2</sup> Unnatural deaths are defined as homicides, suicides, accidents (i.e. traffic accidents, drowning, poisonings, falls, etc.) animal attacks and natural disasters.

12. The National Statistical Office (NSO) in Thailand is responsible for carrying out a population census every 10 years. The last census was taken in 2000. This snapshot of the population is used for checking the accuracy of BORA's population register. The NSO also undertakes the Survey of Population Changes (SPC), which is an intercensal sample survey conducted at the national level, and used, among other things, to measure under-registration of birth and death events.

13. The first SPC (1965-66) was a joint project of the NSO, the Ministry of Interior (MOI), and the Ministry of Public Health (MOPH) carried out specifically to obtain more reliable estimates of population growth and to measure under-registration of vital events. The methodology used to estimate, births and deaths for the first three SPC was the "dual record procedure" (Chandrasekaran-Deming formula) employing two independent sources of data for matching, the survey and registration systems. For the last two surveys, total events were directly estimated from the sampled households, while completeness of vital registration was estimated by including a question on whether the vital events that had taken place had been registered. However, as only one question regarding vital event registration was asked, and no proof of registration was requested, the reliability of this method is questionable.

14. The SPC reports on the coverage of vital registration shows a notable improvement from decade to decade and with little sex differentials (National Statistics Office 1977, 1987, 1997, 2007). However, because of the difference in methodology noted above, the most recent estimates of the completeness are not comparable to those of earlier years.

**Table 1. Completeness (%) of birth and death registration from SPC surveys by sex**

<i>Years</i>	<i>deaths (total)</i>	<i>male deaths</i>	<i>female deaths</i>	<i>births (total)</i>
SPC 1964-65	59.4	57.9	61.4	69.9
SPC 1975-76	59.2	59.0	59.3	71.1
SPC 1985-86	75.7	75.0	76.5	88.4
SPC 1995-96	94.8	94.8	94.9	95.6
SPC 2005-06	95.2	94.8	95.7	96.7

15. Several academic researchers have also estimated the completeness of civil registration data in Thailand, especially death registration, using both direct and indirect demographic methods (Hill et al. 2006; Mathers et al. 2004; Prasartkul et al. 2006; Tangcharoensathien et al. 2006). The degree of completeness of adult death registration from these studies has been estimated to vary between 70% and 95% according to the time period and the method used. Thus, although significant progress to improve the completeness of death registration has been made, some further improvement is still possible.

16. It is known that death registration completeness varies by age, with the very young and very old tending to be most under-reported. Several nationally representative surveys in Thailand have shown that civil registration only records between 30-35% of infant deaths. The underreporting of infant deaths is endemic also to estimates based on household surveys. The main reason for not registering infants deaths is generally that they die shortly after birth and the relatives see no point in registering either the birth nor the infant death.

#### **Specific measures taken to improve the vital statistics**

17. The latest completeness estimate from the SPC suggests that the coverage of death registration in Thailand is now close to 95% of all adult deaths. Overall, 395,374 deaths were registered in 2005, about 100,000 more than a decade or so earlier (see Table 2). Most of the increase can be attributed to improved registration practices, the strengthening of the legal framework in 1991, the fact that administrative arrangements for reporting events have been expanded to cover even villages and remote areas, and to the full computerization of data collection since 2004.

**Table 2. Total number of registered births and deaths, estimated mid-year population and percentages of hospital deaths and ill-defined causes of death derived from vital registration, 1996 to 2005, Thailand**

<i>Year</i>	<i>population</i>	<i>total births</i>	<i>total deaths</i>	<i>% hospital death</i>	<i>% ill-defined*</i>
1996	60,116,182	944,118	342,643	28.71	35.49
1997	60,816,227	897,604	300,323	27.23	34.52
1998	61,466,178	897,201	310,534	17.99	37.64
1999	61,661,701	754,685	362,607	24.97	41.67
2000	61,878,746	773,009	365,741	24.03	40.89
2001	62,308,887	790,425	369,493	23.95	38.03
2002	62,799,872	782,911	380,364	23.39	37.59
2003	63,079,765	742,183	384,131	30.44	33.18
2004	61,973,621**	813,069	393,592	34.55	37.91
2005	62,418,054	809,485	395,374	35.55	38.22

\* ill-defined cause of death (R00-R99) are those deaths for which a specific diseases or injury was not given

\*\*clearance of the over-recorded of population database to delete the duplication of names and deceased persons

\*\*\*source: Bureau of Policy and Strategy, Thai Ministry of Public Health.

18. Another important factor which should be mentioned is that the two government agencies responsible for the preparation and dissemination of vital statistics, the Ministry of Public Health (MOPH) and the Ministry of Interior (MOI), have collaborated closely together since 2000. This has involved the sharing of databases, and working together to improve the quality of the data to meet international standards. For data on causes of death, both ministries have developed guidelines for improving formats/death certificate forms, with the hope that such information will be accurate and useful for health planning purposes (Sripanaratanakul 2005). The National Statistical Office (NSO) has also been part of this cooperation and has worked with various academic institutes with expertise in population studies to improve and develop standard formats for presenting population statistics which correspond better to users' need.

19. An example of the collaborative efforts between the Interior and Public Health ministries to improve completeness of hospital birth and death registration has been the introduction of a one-stop service of registration in the hospital, instead of the routine multistep procedure obliging families to take the hospital notification to the local registration office. This ensures that all vital events taking place in hospitals are also officially registered. This change is also likely to improve cause of death certification as it would provide easy access to the medical records in case of doubts about the underlying cause of death. This system was piloted in 2001 in 6 hospitals in Bangkok and 8 provincial ones, and more hospitals have joined since. It requires that a staff member from the registration office is assigned to work at the respective hospitals and that there is a direct link to the civil registration's electronic network.

### **Quality of vital statistics on causes of death**

20. A review of the literature of death reporting in Thailand suggests that while the degree of underreporting of deaths has been well documented, much less is known about the reliability of cause of death reporting in Thailand, although it is suspected to be poor given the high proportion of deaths that takes place outside hospitals. Moreover, of the roughly 400,000 deaths captured by the registration system each year, about 35%-40% are coded as an "ill-defined" cause. This proportion has not changed much over the past four decades (see Table 2).

21. In 2005, about 65% of deaths in Thailand took place outside hospitals. In these cases, the cause of death was mostly attributed by a non-medically trained person who would not be familiar with the concept of the underlying cause leading to death, hence the frequent use of ill-defined codes. More worrying, however, is the fact that a significant number of those who appear to have died from a specific cause were assigned that cause by a relative or non-medically trained person. This suggests a strong likelihood of diagnostic misclassification and hence the reported cause of death distribution may not be all that reliable for public health purposes.

### **Misclassification of medically certified COD**

22. Even for hospital deaths where the cause of death was medically certified, physicians do not always accurately identify the underlying cause of death, because they have not been properly trained in certifying death according to the rules and guidelines of the International Statistical Classification of Diseases and Related Health Conditions (ICD). According to this standard, it is the “underlying cause of death”, meaning the disease or injury that initiated the train of morbid events that led to death that should be reported and used for compiling statistics. From a public health standpoint, the most important health objective is to prevent the precipitating cause to occur. ICD death certification therefore is mainly focused on facilitating epidemiological research for prevention purposes, whilst the “dead case conference”<sup>3</sup> aims to identify the organs that failed to function and led to death. In addition, when certifying cause of death from an accident, the organs that were injured are frequently chosen by the clinical specialist instead of what caused the accident.

### **Research to identify the true cause of death**

23. In 2000 the Ministry of Public Health undertook a study to verify the causes of death in 15 provinces using verbal autopsy (VA) procedures.<sup>4</sup> The methods used were a combination of a modified verbal autopsy and hospital records, with the probable cause of death certified by a medical doctor. The overall agreement between cause of death using VA and routine death registration was found to be only 29%, but of even greater concern was that the registered cause of death matched the cause determined by medical records review in only 30% of cases. 1.(Chanpen et al. 2001)

24. Based on these findings another project was jointly conducted between the Ministries of Health and Interior to ensure that all deaths in 18 trial provinces were certified by a physician. For those who died outside hospital, VA techniques were used. This study, however, was stopped after one year because of concerns by the Medical Council that ethical codes were violated because physicians were asked to certify cause of death in patients they had not examined whilst alive. (Chanpen et al. 2005)

25. These results clearly demonstrated that while Thailand has been successful in increasing the overall registration of deaths, there remained very significant problems with the quality of the reported causes of death, with more than one-third of deaths being classified to ill-defined causes, and with considerable uncertainty about the validity of the registered cause of death for those people who died at home, or even in hospitals. These problems severely limit the value of routine mortality data for use in health policy and planning.

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<sup>3</sup> The routine meeting, or “Conference”, of doctors in hospitals to review the details of all patients who died in the hospital.

<sup>4</sup> A structured interview with caregivers or family members of households after a death occurs; used to determine the probable cause(s) of death in populations where most deaths occur outside health facilities, and where direct medical certification is rare.

**The validation of causes of death reporting in Thailand, (SPICE project)<sup>5</sup>, 2004-2008**

26. Given the need for a stronger evidence-base for health policy and programs, and pending long-term improvements to the Thai death certification system through better ICD training, the only means of obtaining a more reliable assessment of disease burden in Thailand is through a re-investigation of death certificates. A comprehensive national study to better understand the true pattern of causes of deaths in Thailand for a recent time period was begun in 2004 by the Ministry of Public Health in collaboration with the University of Queensland in Australia.

27. The primary research objective was to ascertain the diagnostic accuracy of the registered causes of death, both for defined and ill-defined diagnoses, and consequently determine the likely true cause distribution of the approximately 400,000 deaths registered in Thailand in 2005. To verify the accuracy of registered causes of death and measure the validity of the verbal autopsy (VA) procedures used, two additional sources of data are required. For each death, an independent assessment of the cause of death is obtained from a household interview with a close relative/caretaker of the deceased, known as “verbal autopsy”, which results in a “VA-assigned cause of death”. A second independent source of information on the cause of death can be derived from a review of the medical records for the deceased, where these are available and of sufficient quality to derive a “medically certified cause of death”. The latter can be used as a reference or “gold standard” to compute the validity characteristics of the verbal autopsy tool, based on those deaths for which there is sufficient confidence in the medical records.

28. The standard WHO verbal autopsy tools (Setel et al, 2006) was first used in a pilot study in one province to determine their suitability in the Thai context. Based on the pilot test results, the VA questionnaire was slightly modified to increase its predictive value in the Thai setting. Typically, each VA interview took a little over 30 minutes and no culturally sensitive questions were reported. Some important lessons were learnt about likely response rates (85%), the training of interviewers and medical doctors, as well as the quality of hospital records and quality control measures that would be required for the main study.

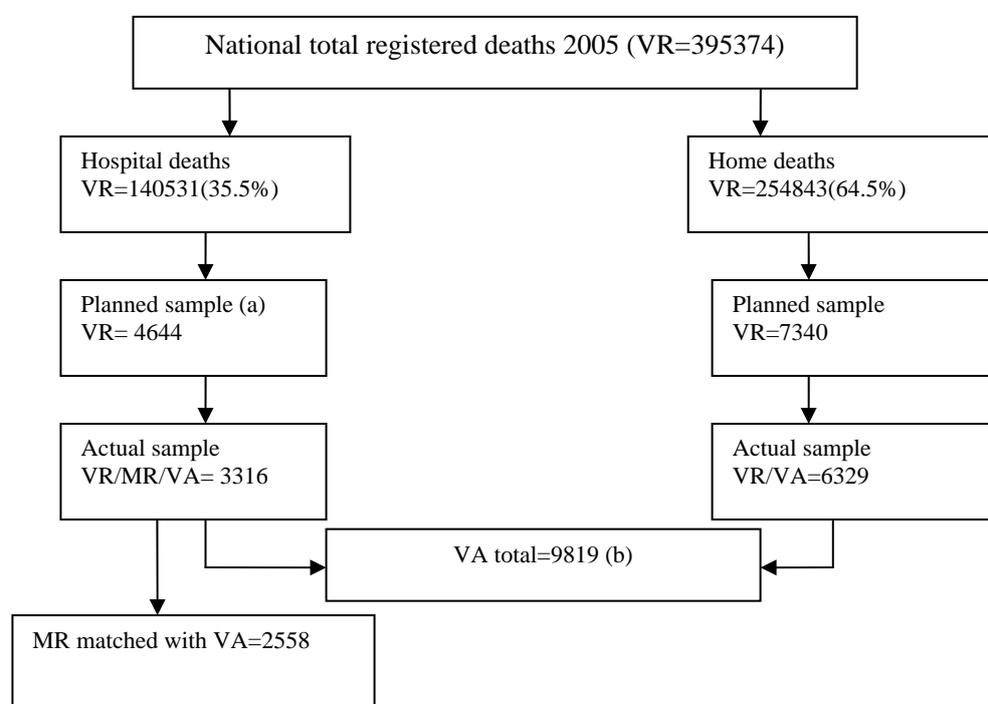
29. The research design is a cross-sectional survey using a national sample of registered deaths representing all 5 regions of the country. The sample includes deaths of the 20 leading causes according to the registered proportion of each cause. A nationally representative sample of approximately 12,000 death records was drawn from the 2005 mortality database of the Ministry of Public Health. An overview of the research design is given in Figure 1.

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<sup>5</sup> Setting Priorities Using Information about Cost Effectiveness (SPICE)

30. For the 4644 cases among the 11984 who had died in hospital, their medical records were retrieved and reviewed by the trained team. Of these, for 3316 (71%) cases (“actual sample”) it was possible to identify medical records with sufficient information to certify a cause of death according to ICD procedures. Further attrition occurred when it was not possible to match a verbal autopsy with the medical records, resulting in 2558 matched cases with two independently assigned causes of death, one from verbal autopsy, and the other (“the gold standard”) from medical records (MR) review.

**Figure 1. Flow chart of research design**



Note: VR=vital registration deaths

VA=verbal autopsy cases

MR=cases for which medical records were available

(a) The proportion of hospital deaths in the sample (38.7%) exceeds the national proportion (35.5%).

(b) Includes 174 cases for which MR review was not possible but VA was.

31. The sample size required for each region was proportional to the total number of registered deaths in that region. Two provinces were randomly selected from each region, and two districts were selected from each sample province. For Bangkok, three districts were randomly selected, representing the inner, middle and outer zones of the city. In total, the study was carried out in 27 districts in 9 provinces distributed in 5 regions of the country.

32. Deaths were selected at random from the sample districts, without replacement, in order to obtain the required sample size of 11,984 deaths, allowing for the 15% non-response rate in the provinces suggested by the pilot, and the higher (approximately 50%) non-response rate expected from Bangkok based on earlier research (Chanpen, et al. 2001; Wattanopas, et al. 1999). Consent forms were obtained from families to conduct the verbal autopsy interviews and to access the medical records of those who had died in hospitals. The data collection was undertaken between August 2006 and September 2007. Thai nationals and permanent residents of the sample provinces were included in the sample. The final composition of the sample populations is shown in Table 3.

**Table 3. Distribution of sample cases across Thailand**

<i>Region</i>	<i>No. of registered deaths in 2005</i>	<i>Percent distribution</i>	<i>Actual sample size required</i>	<i>Number of deaths sampled</i>	<i>Required sample size for selected provinces/districts</i>
Northeast	127,899	32.5	3,252	3,739	Ubolrajthani 2,699; Leoi 1,040
Central	97,006	24.7	2,466	2,836	Supanburi 1,970; Nakorn-nayok 866
North	88,947	22.6	2,261	2,600	Chaingrai 1,849; Payaw 751
South	49,916	12.7	1,269	1,459	Songkhla 1,059; Chumporn 400
Bangkok	29,579	7.5	752	1,350	Rajthewi 386; Kannayao 403; Nongkam 561
<b>Total</b>	<b>393,347*</b>	<b>100.0</b>	<b>10,000</b>	<b>11,984</b>	

\*excluding 2027 incomplete death records from among 395,374 registered deaths in 2005

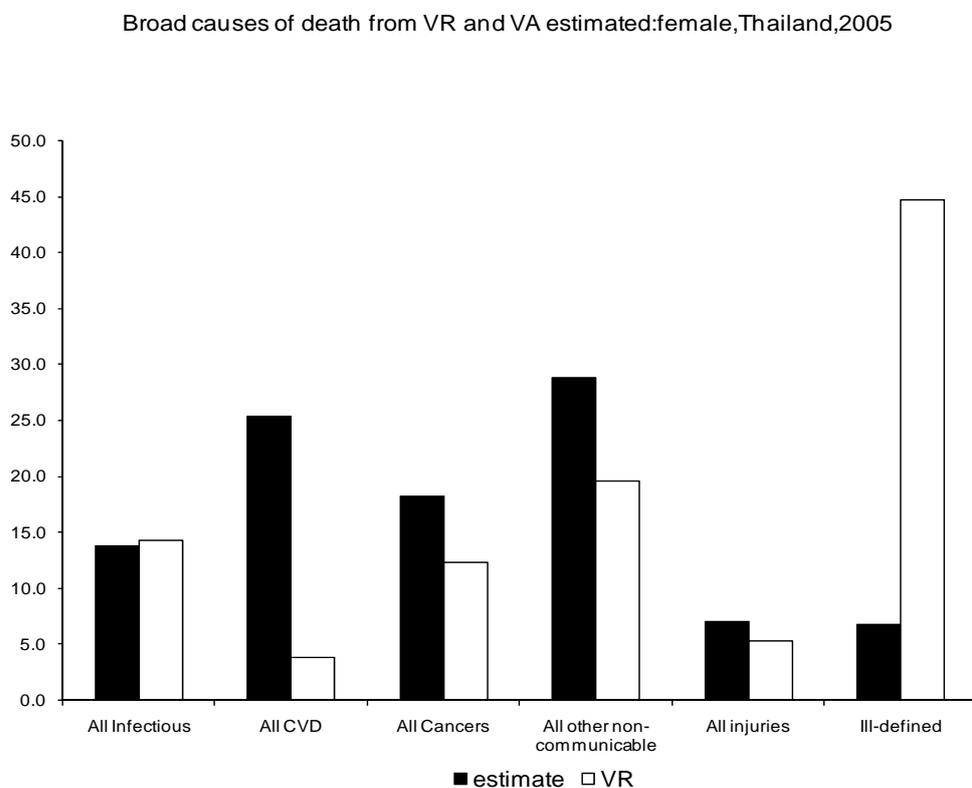
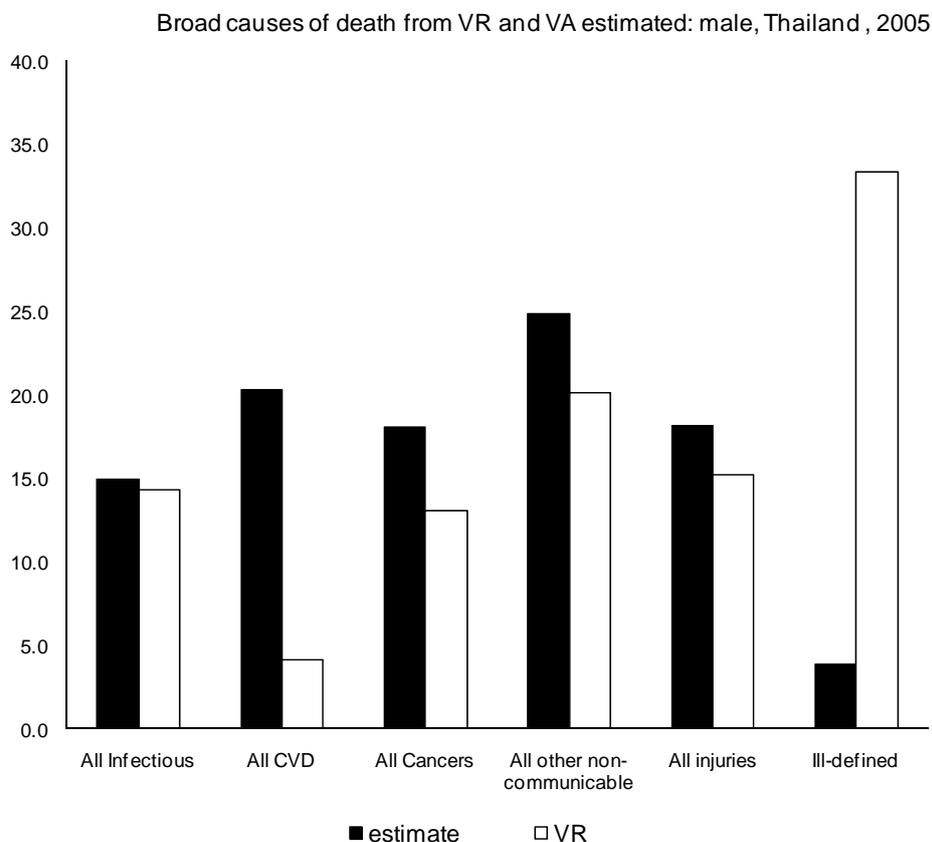
33. A specific objective of the study was to strengthen local capacity for cause of death reporting. Hence interviewers for the verbal autopsies and the teams of physicians chosen to certify the cause of death from the VA interviews, as well as the medical records, were chosen from among provincial health officers. A four-day standard training protocol was carried out for field interviewers just before the data collection began. Physicians were divided into two groups working independently at provincial level, one for certifying deaths from VA and the other to certify causes of death from medical records review. Each team of physicians were trained separately and were responsible at the provincial level for selecting and coding the underlying cause of death.

34. All of the planned sample cases (11984) were contacted for VA interviews, using the contact details given at the registration of death, and 9819 were completed with the response rate of 82%. The most common reason for non-response was that the family had moved to an unknown address, or that the primary caretaker of the deceased was not available to be interviewed. Very few families (approximately 200) refused to take part in the verbal autopsy interview.

## **Results**

35. The reassessment of causes of death via verbal autopsy on all sample deaths, substituted by medical records review where possible, resulted in a substantially different broad cause of death distribution to that suggested by the vital registration system (see Figure 2). In particular, verbal autopsy methods led to a massive reduction in the percent of deaths assigned to ill-defined causes for both males and females, declining from 35-45% of all deaths in vital registration to 4-6%. Most of these ill-defined causes were reassigned to cardiovascular diseases, with substantial reassignment also to cancers and other non-communicable diseases. Interestingly, deaths from injuries appear to be under-diagnosed by about 20-25% for both males and females, whereas proportionate mortality from infectious diseases combined appears to be fairly well reported in the vital statistics.

**Figure 2. Difference in broad causes of death from vital registration (registered) and verbal autopsy (estimated). Males and Females, Thailand 2005**



36. A more detailed assessment of how the cause of death distribution has been modified can be seen from Table 4, which shows the 10 leading causes of death as implied by this research, compared with those recorded in the vital registration. A very substantial amount of ill-defined mortality is clearly due to cerebrovascular diseases (stroke), ischaemic heart disease, road traffic accidents, diabetes, HIV/AIDS, chronic obstructive pulmonary disease and liver cancer. The true extent of these and other conditions as leading causes of death in Thailand is thus being severely underestimated on the basis of vital statistics. After correction, cerebrovascular disease becomes the leading cause of death in Thailand, causing more than one in 10 deaths, closely followed by ischaemic heart disease that causes one in 13 deaths. Diabetes, which was not even among the 10 leading causes in the uncorrected data, now becomes the third most important cause. A similarly strong progression is noticed for road traffic accidents, which go from being number nine to number four in the ranking. HIV/AIDS, another disease that was not ranked among the 10 leading causes in the uncorrected data, becomes the fifth most important cause of death after correction. Many of the ill-defined deaths were clearly reassigned to chronic obstructive pulmonary disease and lung cancer after the investigation. Verbal autopsy methods were able to reassign more than 95% of the ill-defined causes of deaths, suggesting that this procedure might be routinely applied in future to significantly enhance the value of vital registration in Thailand.

**Table 4. The 10 leading causes of death in Thailand before and after correction, 2005**

<i>Top 10 causes of death in VR national (before)</i>	<i>% total</i>	<i>Corrected top 10 causes of death (after)</i>	<i>% total</i>
Ill-defined	38.2	Cerebrovascular disease	11.6
Septicemia	5.8	Ischemic heart disease	7.4
All other external causes	4.8	Diabetes	6.2
Other malignant neoplasm	3.9	Road traffic accident	5.9
Cerebrovascular diseases	3.9	HIV/AIDS	5.9
Other diseases of the genitourinary system	3.2	Liver cancer	5.4
Liver cancer	3.2	COPD	4.4
Pneumonia	3.1	Lung cancer	3.2
Ischemic heart diseases	2.9	Nephritis and nephrosis	3.1
Road traffic accidents	2.8	Lower respiratory infections	2.6
All others	28.2	All others	44.3
Total	100.0	Total	100.0

37. The detailed results of the study described above will be published in a scientific journal in 2009, but even the summary description of the results given here clearly shows that the sampling methods and the use of standard verbal autopsy and medical records review procedures, has been

successful in reducing the massive amount of deaths coded to ill-defined causes in Thailand and yielded diagnoses which are likely to be of much greater relevance for guiding health debates and priorities in Thailand than the uncorrected vital registration data.

#### **Potential lessons for Thailand and other countries' vital statistics**

38. The Royal Thai government has affirmed its strong commitment to reducing the problems of incomplete registration of births, deaths and unreliable attribution of causes of death in order to improve the reliability of statistics on births and deaths and thus permit better allocation of resources to achieve health goals. Over the last forty years Thailand has progressively improved the completeness of its vital registration from about 60% to over 90% in 2005. As a result, population statistics for Thailand are now much more reliable and useful. This progress can be attributed to a long list of different initiatives which were undertaken to improve civil registration and vital statistics, all of which contributed to the same goal of increasing the utility of these data for society and for Thai citizens.

39. An interesting future study would be to try to measure the impact that each of the many initiatives in Thailand has had in terms of improving completeness. For instance, what was the impact of the 1991 revision of the legal framework? Or of the close collaboration between the different stakeholders which began in 2000? Or the computerization of data processing and transfer of registration data? How many more people registered births and deaths after an awareness-raising campaign, or because of the expansion of the network of registration offices? These are key research questions, the answers to which will be of considerable interest to other countries in the region trying to improve the completeness of their vital statistics.

40. The frequent monitoring of birth and death registration completeness in Thailand both by government and academic institutions has been an important driver towards achieving better completeness. This initiative alone shows that government has clearly understood that in order to fully benefit from the significant resource allocation that the country makes to maintain its vital registration system, it must ensure that the data which are collected are sufficiently reliable for planning purposes.

41. As the completeness of birth and death registration in Thailand approaches 100%, the focus is now on improving the quality of the cause of death information to better support health policies and programs, as can be seen from the comprehensive investigation briefly described above. This study has already yielded corrected estimates of the true underlying cause of death pattern in Thailand. There are several obvious lessons that can be drawn from this research. For instance, the study which was conducted over the period 2004-2008, had an important capacity building component which will help with sustainability. As a result, extensive local capacity now exists for conducting verbal autopsy (VA) and for physicians to reliably certify the cause of death from the interview information. This was accomplished by employing and training local government health staff as VA interviewers and supervisors of field data collection. In parallel, capacity has also been built among provincial physicians in the correct procedures for medical certification of cause of death from VA. This has

been further supported through 'on the job' training during the research project for medical certification and ICD coding.

42. Finally, an independent death certification audit has been carried out by national experts based on ICD-10 principles to identify the more common errors and misunderstandings that have a material impact on the death certification process. An interesting finding from this study is that the physicians who frequently misclassified the underlying cause of death were those younger than 30 years of age and older than 50 years of age (in other words, those who had recently graduated and were too busy or inexperienced, or older physicians who had never learned how to certify correctly) (Wansa Poa-in, personal communication, October 2008). One potential approach to improving cause of death certification in these subgroups might be to advocate that the Thai Medical Council include 'certification and ICD-10 coding' in the accreditation curriculum.

43. The research has also led to a feasibility study being conducted to reform the routine death registration system. Different mechanisms to strengthen the routine reporting of non-hospital deaths are being tested. One procedure being tested, for example, is the possibility of health personnel applying a Thai-specific VA instrument to more reliably deduce the cause of all non-medically certified deaths.

44. While the routine cause of death system is being reformed, nationally representative cross-sectional surveys like the one described in this paper could be carried out at 5-yearly intervals to ascertain the causes of registered deaths using the Thai VA instrument. This would ensure that the cause of death correction factors now available from the research project would be periodically adjusted to deliver an updated set of best national estimates of causes of death by age and sex.

45. Vital statistics that are less than 60% complete are only useful to individuals for legal identity purposes and of relatively little value for policy and planning; vital statistics that are more than 90% complete have enormous statistical value for a wide variety of social and health purposes. Similarly, cause of death data where the cause of 30-50% of deaths is unknown are of little use to guide health policy and programs. Research to better estimate true cause of death patterns, and to understand the nature and extent of weaknesses with the cause of death data system, can turn these poor quality data into evidence that is useful to guide health priority setting debates.

46. This paper has tried to describe, albeit very briefly, some of the initiatives and research that Thailand has carried out to improve its vital registration collections and cause of death data. Although there is no detailed estimate of how much each measure has contributed to raising registration completeness and improving the quality of the data, the undeniable progress which has taken place provides compelling evidence of what countries can do to improve their vital statistics systems. It is hoped that the measures and the research described herein may serve as a template for similar initiatives in other countries where the vital registration systems are performing poorly and where there is no reliable information on causes of death.

## References

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